MINNESOTA POLLUTION CONTROL AGENCY
REMEDIATION PROGRAMS

WORKING DRAFT
SURFACE WATER PATHWAY EVALUATION USER'S GUIDE

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EXPLANATION:

This draft user's guide presents only a portion of a Risk-Based Site Evaluation process for CERCLA, MERLA, and VIC sites. It is part of larger group of Petroleum Remediation Program Guidance Documents for Underground Storage Tank (UST) and Aboveground Storage Tank (AST) Release Cleanup also. Sediment cleanup guidance is briefly discussed. Consult with MPCA staff assigned to the site regarding sediment evaluations and cleanups.

Users of this document are responsible for confirming with the MPCA site staff the version of the working draft to be used.

Spreadsheets of the Screening Tables are available for Site-specific application upon request to the MPCA site staff.

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LIST OF ACRONYMS

ACRONYM	FULL NAME
AST	Aboveground Storage Tank Program
BAF	Bioaccumulation Factor
BCF	Bioconcentration Factor
Ch.	Chapter
CERCLA	Comprehensive Environmental Response Compensation Liability Act
CFR	Code of Federal Regulations
cfs	Cubic feet per second
COPC	Contaminant of Potential Concern
CS	Chronic Standard
DDT	1,1'–(2,2,2-trichloroethylidene)–bis/4-chlorobenzene
EAO	Environmental Analysis and Outcomes Division
et seq.	And the following
FAV	Final Acute Value
GLI	Great Lakes Initiative
LUST	Leaking Underground Storage Tank Program
MCLs	Maximum Contaminant Levels
MDD	Minnesota Decision Document
MERLA	Minnesota Environmental Response Liability Act
mg/L	Milligrams per liter
Minn. R.	Minnesota Rule
Minn. Statute	Minnesota Statute
MPCA	Minnesota Pollution Control Agency
MS	Maximum Standard

LIST OF ACRONYMS

ACRONYM	FULL NAME
NCP	National Contingency Plan
NPDES	National Pollution Discharge Elimination System
OIRWs	Outstanding International Resource Waters
ORVWs	Outstanding Resource Value Waters
PCBs	Polychlorinated biphenyl compounds
pt.	Rule part
7Q10	Seven day ten-day low flow
RBSE	Risk-Based Site Evaluation
ROD	Record of Decision
SDS	State Disposal System
SONAR	Statement of Need and Reasonableness
STORET	U.S. EPA Storage and Retrieval Database
subp.	Rule Subpart
ug/L	Micrograms per liter
USC	United States Code
US EPA	United States Environmental Protection Agency
VIC	Voluntary Investigation and Cleanup Program
VPIC	Voluntary Petroleum Investigation and Cleanup Program

EXECUTIVE SUMMARY

This document is a user's guide to evaluation of risk to surface waters, as potential or actual receptors of ground water plume contamination or through surface water runoff. It is part of a larger effort to develop guidelines for evaluating potential impacts to human health and the environment at sites that may require investigation or response action.

The ground water to surface water pathway is evaluated if the surface water is identified as a potential or actual receptor. The surface water runoff pathway is analyzed if runoff discharges or could potentially discharge to a surface water body.

The user's guide is based primarily on Minnesota Rules ch. 7050, criteria, and guideline values and the February 28, 1990 *Application of Surface Water Standards to Nonpoint Sources of Pollutants* in the 1990 *Statement of Need and Reasonableness*. The primary objective of the rules is to protect and maintain surface waters in a condition allowing for maintenance of all existing beneficial uses and to protect human health, wildlife, agriculture, and aquatic life and their habitats. For some surface waters, called Outstanding Resource Value Waters (ORVWs) and Outstanding International Resource Waters (OIRWs), there is another objective, as discussed in Minnesota Rule ch. 7052. That objective is to maintain water quality at existing conditions when the quality is better than the water quality standards.

In order to protect and maintain surface waters in a condition that allows for maintenance of all existing beneficial uses, the uses of the surface water are represented by classes. There are seven classes of waters, one for each use: (1) drinking; (2) aquatic life, recreation, and habitat; (3) industry; (4) agriculture and wildlife; (5) navigation and aesthetics; and (7) limited use. Class 6 includes other uses not listed herein. Classes 1 through 4 are further divided up according to specific protections for each major use. For example, Class 2 is divided into Classes 2A, 2Bd, 2B, 2C, and 2D. The differences within Class 2 concern: (1) whether the water is protected as a drinking water source; and (2) the types of fish and other aquatic life and their habitats that are protected.

Each water body in the state has a list of multiple classes (i.e., uses). There are thirteen combinations of multiple classes and two exceptional quality designations for all surface water bodies in Minnesota. The two exceptional surface water quality designations are called ORVWs and OIRWs.

The surface water body's list of multiple classes is found in a table that is organized by basin, next by water body type, and finally alphabetically. From the list of classes in the table for which the water body is protected, the user determines whether the water body is designated as an OIRW or an ORVW. Waters from the Lake Superior Basin are the only OIRWs in the state of Minnesota. For water bodies that are not OIRWs or ORVWs, the user determines the classification group of the water body. Next, the user finds the table or spreadsheet with associated worksheets that has the same classification group as that for the water body listing. In each table or spreadsheet, the standards, criteria, and screening values are listed by chemical and class (i.e., use being protected). There are multiple numerical standards, criteria, or screening values associated with each chemical, each of which is protective for a particular use. In order to determine whether there is potential or actual exposure above standards, criteria, or screening values, the user selects the most conservative of all standards for a chemical in the table. For the simplest cases in which there is no dilution, this most restrictive standard is compared to appropriate highest ground water concentrations or potential concentrations just up gradient of ground water discharge to the surface water body. For runoff, compare results of runoff samples with the most conservative of all standards. Where standards do not exist, criteria can be used provided the circumstances of the potential or actual exposure are similar. Screening values should be used where standards and criteria are not available.

The risk evaluation consists of a tiered approach to evaluate the risk to a surface water body from site contamination. For surface waters, the tiered approach is based on the level of effort and the extent of information needed for evaluation of the site. Generally, Tier 1 requires the least level of effort and the most conservative standards, guidelines, and criteria. It is used to screen out sites that are not of concern. The majority of all evaluations will involve either a Tier 1 or the site-specific Tier 2 analysis. A Tier 3 evaluation is specific to certain risk-related situations that are different from the risk assumptions of a Tier 1 or 2 situation. It requires the greatest level of effort and greatest involvement of the Minnesota Pollution Control Agency (MPCA) Environmental Analysis and Outcomes (EAO) Division risk assessment staff. It may involve establishing additional risk related contaminant specific criteria for the potential or actual exposure that is being addressed.

MPCA site staff assigned to the site of interest or the responsible party/consultant need to fill out the form provided in Appendix 1 if there is a need to request the services of the MPCA EAO staff. For all sites or projects in which MPCA staff is assigned, the request needs to be sent through the MPCA site staff so that all assigned to the project are kept informed of the response.

This document contains one Tier 1 table (Spreadsheet Swt102.xls) in which the most restrictive of all standards and criteria are used for purposes of quick screening. There are also four Tier 2 tables (Spreadsheets Swt22a02.xls, Swt2bd02.xls, Swt22b02.xls, and Swt2702.xls) that are organized by the Class 2 or 7 standard for thirteen (of the fifteen) combinations of classes for which water bodies are protected and which are covered in this document. For more complex situations, called Tier 3, the MPCA site and EAO staff need to be involved throughout the evaluation process. The two exceptional quality designations of ORVWs and OIRWs among the list of situations in which Tier 3 evaluations need to be performed, and, therefore, are not included in this document.

For Tiers 1 and 2 situations, the types of site specific information, the quality and quantity of information, the directions, and the decision points are discussed for lakes/wetlands/ponds and for streams/rivers. Examples are presented. An example of recognizing a Tier 3 situation and some general information regarding Tier 3 also are provided.

A Tier 3 evaluation would always apply in the following situations:

- Spills or acute situations;
- A water body classified as an ORVW;
- A water body that is part of the Great Lakes Initiative (GLI). Water bodies that are part of the GLI also are part of the Lake Superior Basin and may be an OIRW or an ORVW;
- A water body 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 water body where the type of use(s) results in a significantly higher level of exposure than the basis of the numerical standards (e.g., subsistence fishing, etc.);
- Discharge to a lake or a pond that also serves as a drinking water intake, or discharge to a stream or river and the drinking water intake is located in the mixing zone of the discharge;
- Discharge to a lake or a pond and there is a beach on the same body of water or discharge to a river or stream where the standards or criteria will not be met after the mixing zone or near the beach;

- A water body that flows into a second water body with a more restrictive classification within a distance in which standards for the more restrictive classification may not be met; and

- If a site has contaminated sediment within a surface water body.

Due to the potential complexity and site-specific nature of Tier 3 situations, only general information regarding recognizing a Tier 3 situation is presented in this document. Contact the MPCA site staff if the water body and site being addressed qualifies as Tier 3.

SURFACE WATER PATHWAY EVALUATION USER'S GUIDE

1.0 INTRODUCTION

The MPCA is responsible for evaluating and managing risk and mitigating releases and threatened releases to the environment in accordance with applicable remediation program laws and statutes. Releases and threatened releases have the potential to impact surface waters of the State. This document is a user's guide that addresses the application of previously developed surface water quality rules and guidance for evaluation of risk to the environment and human health posed by remediation sites. It deals with both contaminated ground water discharge and contaminated runoff to a surface water body.

The ground water to surface water pathway is evaluated if the surface water is identified as a potential or actual receptor. The surface water runoff pathway is analyzed if runoff discharges or could potentially discharge to a surface water body.

The document presents a tiered evaluation process that is based on the level of effort devoted to site characterization and evaluation, including the degree of consultation between the MPCA site and Environmental Analysis and Outcomes (EAO) Division staff. It also provides step-by-step application procedures and three examples of these procedures.

A list of existing state regulations and guidance documents that were used to prepare the *Surface Water Pathway Evaluation User's Guide* is provided in Section 2.0. Existing rule objectives for evaluation of the surface water pathway are provided in Section 3.0 below. Section 4.0 contains descriptions of the classifications of waters and of requirements, standards, guideline values, criteria, and natural background values. Section 5.0 defines the types of surface water discharges. Section 6.0 discusses the tiered evaluation process for the surface water pathway. Section 7.0 discusses application of surface water classifications, standards, natural background values, and guideline values and criteria. Section 8.0 provides some examples of these applications. Section 9.0 discusses requests for information and assistance from the MPCA EAO staff by the MPCA site staff and the public. A glossary and list of references are provided at the end of this document.

2.0 FEDERAL AND STATE REGULATIONS AND GUIDANCE DOCUMENTS

Investigations 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 rule used to develop this document are Minnesota Rules ch. 7050 regarding surface water quality (2003) and the 1990 associated Statement of Need and Reasonableness. Minn. R. ch. 7052 is used to assist with defining some

Tier 3 situations. 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

- CERCLA: 42 U.S.C. 9601 et it. seq.;
- National Contingency Plan (NCP): 40 C.F.R. pt. 300;
- Safe Drinking Water Act: 42 U.S.C. 300f to 300j-26;
- National Primary and Secondary Drinking Water Regulations: (40 C.F.R. pts. 141-143);
- Clean Water Act: (33 U.S.C. 1251 et. it.);
- Corrective Action Requirements in various guidance documents for Resource Conservation Recovery Act;

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

- Minn. Stat. § ch. 103A;
- Water Pollution Control Act: Minn. Stat. § ch. 115;
- Minnesota Environmental Response and Liability Act (MERLA): Minn. Stat. § 115B.01 - .241;
- Petroleum Tank Release Cleanup: Minn. Stat. § 115C;
- Pollution Control Agency: Minn. Stat. § ch. 116;

Minnesota Rules: Available at http://www.pca.state.mn.us/rulesregs/index.html

- Minnesota Pollution Control Agency, Groundwater and Solid Waste Division, Priority Assessment Criteria, Minn. R. ch. 7044;
- Waters of the State: Minn. R. ch. 7050 (February 14, 2000 and February 3, 2003) and associated Statement of Need and Reasonableness (1990);
- Waters of the State: Minn. R. ch. 7052;
- Minnesota Pollution Control Agency, Water Quality Division, Mississippi River and Tributaries: Minn. R. ch. 7056;
- Underground Waters: Minn. R. ch. 7060;

Minnesota Water Quality Guidance: In Appendices.

- 1988 Guidance Manual for Applying Nondegradation Requirements for All Waters (Non-ORVW) in Minnesota, MPCA, September 1988;

- Guidance Manual For Applying Nondegradation Requirements On Outstanding Resource Value Waters, MPCA, Spegember 1988;

Minnesota Remediation Guidance: Available at http://www.pca.state.mn.us/cleanup . The primary guidance documents are the first two documents listed below.

- Guidance Documents for Underground Storage Tank (UST) and Aboveground Storage Tank (AST) Release Cleanup, 53 Documents, at http://www.pca.state.mn.us/cleanup/pubs/lustpubs.html .

- Risk-Based Site Evaluation Guidance for Comprehensive Environmental Response Compensation and Liability Act (CERCLA) and MERLA Sites available at http://www.pca.state.mn.us/cleanup/riskbasedoc.html ;

- Guidance Documents and Fact Sheets at the MPCA website http://www.pca.state.mn.us/cleanup/index.html for the following programs:

  - Storage Tank Sites;

  - Petroleum Brownfields Program (formerly VPIC);

  - Resource Conservation and Recovery Act (RCRA) Corrective Action Program;

  - Voluntary Investigation and Cleanup (VIC) Sites;

  - Voluntary Petroleum Investigation and Cleanup (VPIC) Site;

Statutes, rules, and guidance regarding surface water quality continue to be developed. The user of this document needs to determine whether any revisions were made public 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 impacts.

3.0 SURFACE WATER QUALITY RULE OBJECTIVES

Some of the primary objectives of Minnesota Rules pertaining to surface water are to:

- Protect and maintain surface waters in a condition that allows for the maintenance of all existing beneficial uses (Minn. R. 7050.0150);

- Protect human health, wildlife, agriculture, industrial uses, and aquatic life and their habitats; and

- For Outstanding Resource Value Waters (ORVWs) and Outstanding International Resource Waters (OIRWs), where surface waters have exceptional water quality, to maintain water quality at existing conditions, when the quality is better than the water quality standards. Generally, ORVWs and OIRWs are considered to be "exceptional recreational, cultural, aesthetic or scientific resources." (Minn. R. 7050.0180, subp. 1). Further discussion of ORVWs and OIRWs and their significance is provided in the next section.

4.0 OVERVIEW OF THE SURFACE WATER QUALITY RULES AND GUIDANCE

Minnesota Rules ch. 7050 sets forth classifications of the waters of the state, surface water standards, guideline values and criteria, and natural background values. Minn. R. ch. 7052 describes the OIRW and ORVW Rules, which are Tier 3 situations. The 1990 Statement of Need and Reasonableness established the point(s) of compliance for ground water discharge to a surface water receptor at the wells prior to surface water discharge.

4.1 Classifications for Waters of the State

There are seven classes of surface waters in the State of Minnesota that are protected under Minn. R. ch. 7050. The class descriptions are listed in Table 1.

Table 1. Surface Water Use Classifications

Class	Use
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.
2	*Aquatic Life and Recreation:* Waters which 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.
3	*Industrial Consumption:* Waters which are or may be used as a source of supply for industrial process 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.
4	*Agriculture and Wildlife:* Waters which are or may be used for any agriculture purpose, including stock watering and 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.
5	*Aesthetic Enjoyment and Navigation:* Waters which are or may be used for any form of 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.

Table 1. Surface Water Use Classifications	
Class	**Use**
6	*Other Uses:* Waters which are or may serve the above listed uses or any other beneficial uses not listed herein, including, without limitation any such uses in this or any other state, province, or nation of any waters flowing through or originating in this state, and for which quality control is or may be necessary for the above declared purposes, or to conform with the requirements of the legally constituted state or national agencies having jurisdiction over such waters, or any other considerations the agency may deem proper.
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. Water quantities in these waters are intermittent or less than one cubic foot per second at the once in ten year, seven-day low flow as defined in Minn. R. 7050.0210, subp. 7. These waters shall be protected so as to allow secondary body contact use, to preserve the ground water for use as a potable water supply, and to protect aesthetic qualities of the water. It is the intent of the agency (MPCA) that very few waters be classified as limited resource value waters. See Minn. R. 7050.0200, subp. 8 for the factors to use in the attainability analysis.
	Nondegradation
ORVW	*Outstanding Resource Value Waters:* There are two types of outstanding resource value waters (ORVWs): (1) restricted ("R"); and (2) prohibited ("P") discharges. A surface water is an ORVW if its classification under Minn. R. 7050.0470 includes an asterisk before the name of the water body followed by a date and a "R" or "P" in brackets. The date is the date of designation as an ORVW.
OIRW	*Outstanding International Resource Waters:* Waters in the Lake Superior Basin that are not ORVW prohibited or restricted waters. Refer to Minn. R. ch. 7052 for further details.
Footnote (1):	The sources of the class descriptions and categories are: Minn. R. 7050.0180, 7050.0200, subps. 2 – 8, 7050.0400 to 7050.0430, and ch. 7052.

Classes 1 through 4 are further divided under a main heading such as drinking water for Class 1. The differences within each Class 1 through 4 are listed in Tables 2 through 5.

Class 1 is divided into four classes, 1A, 1B, 1C, and 1D. The classes are distinguished from each other by:

(1) The type of water treatment needed so that Maximum Contaminant Levels (MCLs) and Secondary Drinking Water Standards are achieved;

(2) The exceptions to using the MCLs and Secondary Drinking Water Standards as Class 1 standards; and

(3) The types of aquifers or other drinking water resources that are in the class based on the degree of natural protection from contamination.

Table 2. Class 1 Waters (Domestic Consumption)

Class	Type Of Water Treatment Needed So That MCLs and Secondary Drinking Water Standards Are Achieved	Exceptions To Using MCLS And Secondary Drinking Water Standards As Class 1 Standards	Types Of Aquifers Or Other Drinking Water Resources
1A	No treatment	None	Underground waters with a high degree of natural protection
1B	Approved disinfection, such as simple chlorination or its equivalent	Bacteriological standards	Surface and underground waters with a moderately high degree of natural protection
1C	Coagulation, sedimentation, filtration, storage, and chlorination, or other equivalent treatment processes	Bacteriological standards Turbidity standard shall be 25 mg/L	Surface waters and ground waters in aquifers not considered to afford adequate protection against contamination from surface or other sources of pollution. Such aquifers normally would include fractured and channeled limestone, unprotected impervious hard rock where water is obtained from mechanical fractures or joints with surface connections, and coarse gravels subjected to surface water infiltration.
1D	Coagulation, sedimentation, filtration, storage, and chlorination, plus additional pre-, post- or intermediate-stages of treatment, or other equivalent treatment processes	The following are minimum levels that apply: Arsenic - 0.05 mg/L; Barium – 1 mg/L; Cadmium - 0.01 mg/L; Chromium (Hexavalent) - 0.05 mg/L; Cyanide - 0.2 mg/L; Fluoride – 1.5 mg/L; Lead - 0.05 mg/L; Selenium - 0.01 mg/L; Silver - 0.05 mg/L; Radioactive Material – Not to exceed the lowest concentrations permitted to be discharged to an uncontrolled environment as prescribed by the appropriate authority having control over their use.	Surface waters and ground waters in aquifers not considered to afford adequate protection against contamination from surface or other sources of pollution. Such aquifers normally would include fractured and channeled limestone, unprotected impervious hard rock where water is obtained from mechanical fractures or joints with surface connections, and coarse gravels subjected to surface water infiltration.

Class 2 is divided into five classes 2A, 2Bd, 2B, 2C, and 2D. The differences between the classes concerns (1) whether the surface water is protected as a drinking water source, and (2) the type of fish and other aquatic life and their habitats that are being protected.

Table 3. Class 2 Waters (Aquatic Life and Recreation)

Class	Protected as a Drinking Water Source?	Fish and Other Aquatic Life and Their Habitats Protected	Aquatic Recreational Uses Protected
2A	Yes	Permit the propagation and maintenance of cold water sport or commercial fish and associated aquatic life and their habitats (includes trout)	Recreational uses of all kinds, including bathing
2Bd	Yes	Permit the propagation and maintenance of cool or warm water sport or commercial fish and associated aquatic life and their habitats	Recreational uses of all kinds, including bathing
2B	No	Permit the propagation and maintenance of cool or warm water sport or commercial fish and associated aquatic life, and their habitats	Recreational uses of all kinds, including bathing
2C	No	Permit the propagation and maintenance of indigenous fish and associated aquatic life, and their habitats	Be suitable for boating and other forms of aquatic recreation for which the waters may be usable
2D	No	Permit the propagation and maintenance of aquatic and terrestrial species indigenous to wetlands and their habitats	Be suitable for boating and other forms of aquatic recreation for which the wetland may be usable

Class 3 is divided into four classes 3A, 3B, 3C, and 3D based on the industrial use being protected and the maximum degree of water treatment needed prior to use.

Table 4. Class 3 Waters (Industrial Consumption)

Class	Use Being Protected	Maximum Degree of Water Treatment Needed Prior to Use
3A	Most industrial purposes, except food processing and related uses, for which a high quality of water is required	No chemical treatment, except softening for ground water
3B	General industrial purposes, except for food processing	A moderate degree of treatment
3C	Industrial cooling and materials transport	Without a high degree of treatment being necessary to avoid fouling, corrosion, scaling, or other unsatisfactory conditions
3D	Wetlands – for general industrial purposes, except for food processing	A moderate degree of treatment

Class 4 is divided into 3 classes based on the agricultural or wildlife use that is being protected.

Table 5. Class 4 Waters (Agriculture and Wildlife)

Class	Protected Use
4A	Irrigation without significant damage or adverse effects upon any crops or vegetation usually grown in the waters or area, including truck garden crops
4B	Use by livestock and wildlife without inhibition or injurious effects
4C	Wetlands – Use for irrigation by wildlife and livestock without inhibition or injurious effects and be suitable for erosion control, ground water recharge, low flow augmentation, storm water retention, and stream sedimentation

As there are multiple uses of water bodies, classes are combined and applied to each water body in order to be protective of all uses and of human health and aquatic organisms and their habitat. Minn. R. ch. 7050 sets forth fourteen multiple use combinations of classes that are applied to waters of the State. For example, a water body with Classes 1B, 2Bd, 3A, 3B, 4A, 4B, 5, and 6 is protected for the following: as a drinking water source (Class 1); for recreation including bathing, drinking water, and warm and cool water aquatic life (Class 2Bd); for industrial use (Class 3); for agriculture and protection of wildlife (Class 4); for aesthetic enjoyment and navigation (Class 5); and for "Other Public Uses and Benefits" (Class 6). Table 6 contains the multiple use class combinations for the classification groups of water bodies, which are listed by basin in Appendix 3.

Table 6. Multiple Use Class Combinations

Fifteen Class Combinations Used	Table No. (Spreadsheet)	Referred To In Minn. R. 7050.0470 (Appendix 3) As:	Includes The Following Classes	Hence, Is Protected For:
(1)	9 (Swt22a02.xls)	1B, 2A, 3A	1B, 2A, 3A, 3C, 4A, 4B, 5, and 6	Drinking water, aquatic recreation including bathing, supporting cold-water fisheries (trout) and associated aquatic life and habitats, industrial use, agriculture and wildlife, aesthetic enjoyment, and navigation
(2)	9 (Swt22a02.xls)	1B, 2A, 3B	1B, 2A, 3B, 3C, 4A, 4B, 5, and 6	See "Hence, Is Protected For:" above in (1)
(3)	10 (Swt2bd02.xls)	1B, 2Bd, 3A	1B, 2Bd, 3A, 3C, 4A, 4B, 5, and 6	Drinking water, aquatic recreation including bathing, supporting warm and cool water fisheries and associated aquatic life and habitats, industrial use, agriculture and wildlife, and aesthetic enjoyment of scenery and navigation
(4)	10 (Swt2bd02.xls)	1B, 2Bd, 3B	1B, 2Bd, 3B, 3C, 4A, 4B, 5, and 6	See "Hence, Is Protected For:" above in (3).
(5)	10 (Swt2bd02.xls)	1C, 2Bd, 3A	1C, 2Bd, 3A, 3C, 4A, 4B, 5, and 6	See "Hence, Is Protected For:" above in (3).
(6)	10 (Swt2bd02.xls)	1C, 2Bd, 3B	1C, 2Bd, 3B, 3C, 4A, 4B, 5, and 6	See "Hence, Is Protected For:" above in (3).
(7)	11 (Swt22b02.xls)	2B, 3A	2B, 3A, 3C, 4A, 4B, 5, and 6	For 2B: Aquatic recreation including bathing, supporting cool or warm water fisheries and associated aquatic life and habitats. For All 2Bs, 2Cs, and 2Ds: Industrial Use, agriculture and wildlife, aesthetic enjoyment, and navigation.

Table 6. Multiple Use Class Combinations (Continued)

Fifteen Class Combinations Used	Table No. (Spreadsheet)	Referred To In Minn. R. 7050.0470 (Appendix 3) As:	Includes The Following Classes	Hence, Is Protected For:
(8)	11 (Swt22b02.xls)	2B, 3B	2B, 3B, 3C, 4A, 4B, 5, and 6 (listed waters)	See "Hence, Is Protected For:" above in (7).
(9)	11 (Swt22b02.xls)	2B, 3B	2B, 3B, 4A, 4B, 5, and 6 (unlisted waters)	See "Hence, Is Protected For:" above in (7).
(10)	11 (Swt22b02.xls)	2C, 3B	2C, 3B, 3C, 4A, 4B, 5, and 6	For 2C: Boating and other forms of aquatic recreation, indigenous fish and associated aquatic life and their habitats. For All 2Bs, 2Cs, and 2Ds: Industrial Use, agriculture and wildlife, aesthetic enjoyment, and navigation.
(11)	11 (Swt22b02.xls)	2C	2C, 3C, 4A, 4B, 5, and 6	See "Hence, Is Protected For:" above in (10)
(12)	11 (Swt22b02.xls)	2D	2D, 3D, 4C, 5, and 6	For 2D: Boating and other forms of aquatic recreation for which the wetland may be usable, aquatic and terrestrial species indigenous to wetlands and their habitats. For All 2Bs, 2Cs, and 2Ds: Industrial Use, agriculture and wildlife, aesthetic enjoyment, and navigation.
(13)	12 (Swt2702.xls)	7	7, 3C, 4A, 4B, and 5	Limited Use Value Water – Industrial use, agriculture and wildlife, and aesthetic qualities, navigation, protect aesthetic qualities, secondary body contact use, and ground water for use as a potable water supply.

Table 6. Multiple Use Class Combinations (Continued)

Fifteen Class Combinations Used	Table No. (Spreadsheet)	Referred To In Minn. R. 7050.0470 (Appendix 3) As:	Includes The Following Classes	Hence, Is Protected For:
(14)	TIER 3	Asterisk in front of name	ORVW	Outstanding Resource Value Water – is protected for exceptional quality, regardless of classes listed after name. Discharges prohibited or greatly restricted.
(15)	TIER 3	Asterisk in front of name	OIRW	Outstanding International Resource Water – is protected for exceptional quality, regardless of classes listed after name. Discharges prohibited or greatly restricted.

All water bodies include Class 6, which is designated as "Other Public Uses and Benefits," as assigned. This classification may include waters under other jurisdictions than the State of Minnesota (Minn. R. 7050.0226, subp. 1). There are no specific numerical standards associated with Class 6. Any standards included in Class 6 are specific to a particular water body or segment thereof and are developed by the MPCA EAO staff.

The first step in evaluating a surface water receptor is to determine its classification assigned by the Minnesota Rules. Use the instructions in Appendix 2 and the information contained in Appendix 3 to determine a surface water body's classification. Appendix 3 contains a map of the major surface water drainage basins and counties, and a list of surface water body classifications that are organized by basin.

4.2 Surface Water Promulgated Standards and Requirements

Promulgated standards and requirements can be divided into general standards and definitions and types of numerical standards and where they apply. The following definitions and promulgated standards are found in Minn. R. ch. 7050. Minn. R. ch. 7050 and other state rules can be referenced directly at the website http://www.revisor.leg.state.mn.us/arule/7050 . This guidance document does not replace Minn. R. ch. 7050 and wherever there are differences, Minn. R. ch. 7050 shall govern.

4.2.1 General Standards

General standards are found in Minn. R. 7050.0210. They include various policies and statements regarding a number of subjects as described briefly below and general standards described in greater detail as they are fundamental to application of standards to the remediation program.

4.2.1.1 Various General Standards

Untreated sewage. No untreated sewage shall be discharge into any waters of the state;

Prohibition of nuisance conditions. No sewage, industrial waste, or other wastes shall be discharged from either point or nonpoint sources into any waters of the state so as to cause any nuisance conditions, such as the presence of significant amounts of floating solids, scum, visible oil film, excessive suspended solids, material discoloration, obnoxious odors, gas ebullition, deleterious sludge deposits, undesirable slimes or fungus growths, aquatic habitat degradation, excessive growths of aquatic plants, or other offensive or harmful effects;

Inadequate treatment. Existing discharges of inadequately treated sewage, industrial waste, or other wastes shall be abated, treated, or controlled so as to comply with the applicable standards. Separation of sanitary sewage from natural runoff may be required where necessary to ensure continuous effective treatment of sewage;

Highest levels of water quality. The highest levels of water quality, including, but not limited to, dissolved oxygen, which are attainable in the waters of the state by continuous operation at their maximum capability of all primary and secondary units of treatment works or their equivalent discharging effluents into the waters of the state shall be maintained in order to enhance conditions for all specified uses;

Other requirements preserved. The requirements of Minn. Rules ch. 7050 and specifically the requirements in parts 7050.0211 to 7050.0212 are in addition to any requirement imposed on a discharge by the Clean Water Act, United States Code, title 33, sections 1251 et seq., and its implementing regulations. In the case of a conflict between the requirements of parts 7050.0110 to 7050.0220 and the requirements of the Clean Water Act or its implementing regulations, the more stringent requirement controls;

Water quality based effluent limitations. In spite of the requirements of Minn. R. 7050.0213 regarding advanced wastewater treatment requirements, and Minn. R. 7050.0214 regarding requirements for a point source discharger to limited resource value waters (Class 7), the MPCA may require a specific discharger to meet effluent limitations for specific pollutants or whole effluent toxicity which are necessary to maintain the water quality of the receiving water at the standards of quality and purity established by this chapter. Such a requirement typically must follow the requirements of Minn. R. ch. 7001 for National Pollution Discharge Elimination System and for State Disposal System permits;

Alternative waste treatment. After providing an opportunity for a public hearing, the MPCA shall accept effective loss prevention and/or water conservation measures or process changes or other waste control measures or arrangements if it finds that such measures, changes, or arrangements are equivalent to the waste treatment measures required for compliance with applicable effluent and /or water quality standards or load allocations;

Liquid substances. Liquid substances which are not commonly considered to be sewage or industrial waste but which could constitute a pollution hazard shall be stored in accordance with Minn. R. ch. 7151. Other wastes as defined by law or other substances from nonpoint sources and households, shall not be deposited in any manner such that the same may be likely to gain entry into any waters of the state in excess of or contrary to any of standards or cause pollution as defined by law;

Pollution prohibited. No sewage, industrial waste, or other wastes shall be discharged from either a point or a nonpoint source into the waters of the state in such quantity or in such manner alone or in combination with other substances as to cause pollution as defined by law.

Wetland pollution prohibited. Wetland conditions shall be protected from chemical, physical, biological, or radiological changes to prevent significant adverse impacts to the following designated uses: maintaining biological diversity, preserving wildlife habitat, and providing recreational opportunities as specified in Minn. R. 7050.0222, subp. 6; erosion control, ground water recharge, low flow augmentation, stormwater retention, and stream sedimentation as specified in Minn. R. 7050.0224, subp. 4; and aesthetic enjoyment as specified in Minn. R. 7050.0225, subp. 2;

Point source dischargers must report to the agency. All persons operating or responsible for sewage, industrial waste, or other waste disposal systems which are adjacent to or which discharge effluents to these waters or to tributaries which affect the same, shall submit a report to the agency upon request on the operation of the disposal system, the effluent flow, and the characteristics of the effluents and receiving waters. Sufficient data on measurements, observations, sampling, and analyses, and other pertinent information shall be furnished as may be required by the MPCA to adequately evaluate the condition of the disposal system, the effluent, and the water receiving or affected by the effluent;

Compliance with permit conditions. No person who is in compliance with the terms and conditions of its permit issued under Minn. R. ch. 7001 shall be deemed in violation of any water quality standard in this rule for which a corresponding effluent limitation is established in the permit. However, exceedances of the water quality standards in a receiving water shall constitute grounds for modification of a permit(s) for any discharger(s) to the receiving water that is (are) causing or contributing to the exceedances. Chapter 7001 shall govern the modification of any such permit; and

Water quality standard based ammonia effluent limitations. For the purpose of establishing limitations to meet the ammonia water quality standard, a statistic which estimates the central value (such as the mean or median) for ambient pH and temperature of the receiving water for the critical months shall be used under the Statute Authority of Minnesota Statute §115.03 and 115.44.

4.2.1.2 General Standards Critical to the Remediation Program

The following general standards are discussed in more detail as their understanding is critical to remediation sites. The general standards include nonflowing (lakes and wetlands) versus flowing (streams and rivers) systems, minimum stream flow, mixing zones, and nondegradation.

4.2.1.2.1 Nonflowing (Lakes and Wetlands) Systems

For lakes and wetlands, which are nonflowing systems, there is a general Minn. R. ch. 7050 requirement that no dilution or mixing is allowed.

4.2.1.2.2 Flowing (Streams and Rivers) Systems

Streams and rivers are flowing systems. As such, a dilution factor and mixing may be allowed if there is adequate minimum stream flow as described below.

4.2.1.2.2.1 Minimum Stream Flow

The minimum stream flow is defined in Minn. R. 7050.0210, subp. 7 as the lowest seven-day consecutive flow in a ten year span (i.e., 7Q10) and is expressed in units of cubic feet per second (cfs). The 7Q10 is an estimate of the least amount of flow provided by a river or stream during a drought situation. The source of this data is the United States Geologic Survey. The 7Q10 must be obtained from the MPCA EAO staff through the MPCA site staff. Where stream flow records are not available, the MPCA EAO staff may estimate the 7Q10 using available information including the watershed characteristics, precipitation, run-off, and other relevant data.

No dilution is allowed for streams or rivers where the 7Q10 is 0.0 cfs.

For surface waters in which the 7Q10 is greater than 0.0 cfs, the concept of dilution and the mixing zone is used. In order to be protective of surface water uses and water quality where the 7Q10 is greater than 0.0 cfs, the minimum stream flow in units of cubic feet per second (cfs) is one factor used to calculate whether the most restrictive standard for each contaminant will be exceeded downstream after mixing. It also is used to calculate the maximum concentration allowed to be discharged, if the most restrictive standard for each contaminant will be exceeded downstream after mixing. According to Minn. R. 7050.0210, subp. 7, allowance shall not be made in the design of treatment systems for low stream flow augmentation unless the flow augmentation of minimum flow is dependable and controlled under applicable laws and regulations.

4.2.1.2.2.2 Mixing Zones for Streams or Rivers

According to Minn. R. 7050.0210, subp. 5, a mixing zone provides a practicable means for expediting mixing and dispersion of contaminants in the receiving waters provided the quality of the receiving waters is maintained in accordance with applicable standards. MPCA EAO staff establishes mixing zones on a case by case basis. Where the 7Q10 is greater than 0.0 cfs and a mixing zone is allowed for a stream or river, the most restrictive standard of all classes (normally the Class 2 chronic standard) of a contaminant must be met downstream after mixing. Primary consideration is given to the following guidelines when establishing a mixing zone:

1. Mixing zones in rivers shall permit an acceptable passageway for the movement of fish;

2. The total mixing zone or zones at any transect of the stream should contain no more than 25 percent of the cross-sectional area and/or volume of flow of the stream, and should not extend over more than 50 percent of the stream width;

3. Mixing zone characteristics shall not be lethal to aquatic organisms;

4. For contaminants other than temperature changes, the Final Acute Value (FAV), as defined below, for toxic pollutants, shall not be exceeded as a one-day mean concentration at any point in the mixing zone. In addition, the FAV can not be exceeded at the point of discharge. For remediation purposes, the FAV is rarely used and for low discharges and when utilized, it must be met at the point of discharge;

5. Mixing zones should be as small as possible, and not intersect spawning or nursery areas, migratory routes, water intakes, nor mouths of rivers; and

6. Overlapping of mixing zones should be minimized and measures taken to prevent adverse synergistic effects.

4.2.1.2.3 Nondegradation

Nondegradation generally refers to the concept of maintaining water quality at its existing condition when the quality is better than the water quality standards. Its purpose is to protect Minnesota waters "from significant degradation from point and nonpoint sources and maintain existing uses, aquatic habitats, and the level of water quality to protect these uses" as stated in the "*Guidance Manual for Applying Nondegradation Requirements for All Waters (Non-ORVW) in Minnesota, MPCA, September 1988*" (Appendix 4), and the "*Guidance Manual For Applying Nondegradation Requirements On Outstanding Resource Value Waters, MPCA, September 1988*" (Appendix 5). There are additional materials to aid in a nondegradation review. EAO staff's assistance is needed for all nondegradation reviews. All nondegradation reviews are Tier 3 evaluations. The OIRWs of the Lake Superior Basin also fall into this category.

Nondegradation is applied in three different ways in Minn. R. ch. 7050.

(1) Minn. R. 7050.0185, subp. 1, contains the following policy statement for all waters of the State. "It is the policy of the state of Minnesota to protect all waters from significant degradation from point and nonpoint sources and wetland alterations, and to maintain existing water uses, aquatic and wetland habitats, and the level of water quality necessary to protect these uses." This objective is stated also in Section 3.0. The uses described in Table 1 include existing or potential uses, and are generally risk-based. There are aesthetic components also.

(2) Minn. R. 7050.0180 has nondegradation narrative language that potentially prohibits discharges to ORVW waters. The rules prohibit certain ORVW waters, such as the Boundary Waters Canoe Area and Voyageur's National Park, from receiving any discharge. ORVW waters that are not prohibited from receiving any discharge are called restricted. ORVW waters within a restricted category could receive a discharge, but only after EAO staff conducts a review of other possible discharge alternatives (including hauling) and issue a written determination that there is no prudent and feasible alternative to the discharge and that the discharge is reasonable. Because of the complex nature of an ORVW review and that an ORVW review must be conducted by EAO staff, discharges into ORVW waters require a Tier 3 evaluation. To determine whether a surface water body is an ORVW, refer to Appendix 2 regarding the instructions for determining the classification of a water body and Appendix 3 for referencing the classification of the water body. General information regarding ORVWs is included in Appendix 5.

(3) Minn. R. ch. 7052 applies to the Great Lakes Initiative (GLI) in the Lake Superior Basin. In addition to the ORVW rules in Minn. R. ch. 7050, there are additional nondegradation restrictions for OIRWs. All waters in the Lake Superior Basin, except Class 7 waters, are OIRWs. Like ORVWs, discharges to OIRWs are complex in nature and require a Tier 3 evaluation. To determine whether a surface water body is an OIRW, refer to Appendices 2 and 3 regarding the instructions for and determining the classification of the water body.

4.2.1.2.4 Point(s) of Compliance and When Evaluation of the Ground Water to Surface Water Pathway is Needed

The 1990 Statement of Need and Reasonableness that was part of the 1990 Minn. R. ch. 7050 rule revision established the point(s) of compliance for ground water discharge to a surface water body as the well(s) prior to discharge. A specific distance from the well(s) in which the plume is detected upgradient of the surface water receptor and the surface water receptor was not established in the rule.

The ground water to surface water pathway is evaluated if the surface water is identified as a potential or actual receptor. The surface water runoff pathway is analyzed if runoff discharges or is sloped and could potentially discharge to a surface water body.

Ground water discharge to surface waters can not exceed the applicable standards, criteria or screening values in the well(s) just up gradient and prior to ground water discharge for both stable and unstable plumes. Potential impacts above the appropriate standards, criteria, or screening values also need to be addressed so that they do not become actual impacts. For the Superfund, RCRA, and VIC programs, potential impacts of ground water discharge to a surface water body need to be evaluated, at a minimum, if the contaminated ground water is at or within a two year ground water travel time to the surface water receptor. In general, the ground water must be monitored at sufficient locations so that the extent and magnitude of potential and actual impacts to surface water bodies are adequately characterized and remediated, if needed.

4.2.1.3 Numerical Standards for Classes 1 through 7

In Minn. R. 7050.0220 through 7050.0227, numerical water quality standards are established for Classes 1 through 7 waters as described in Section 4.1. The standards for each class or subclass of waters are provided below. This section is followed by a section regarding what to do if there is no standard for a particular contaminant.

4.2.1.3.1 Class 1 Standards

Standards for Class 1 include the MCLs and Secondary Drinking Water Standards established by the U.S. Environmental Protection Agency (EPA) and adopted into Minn. R. 7050.0221. There are four classes: 1A; 1B; 1C; and 1D. The differences between these classes were outlined in Table 2.

4.2.1.3.2 Class 2 Standards

Class 2 standards are intended to protect aquatic life and their habitats and wildlife and humans who consume fish and other edible aquatic organisms. The standards provide protection for any carcinogenic or systemic exposure from toxic pollutants, for bioaccumulation and include taste and odor criteria.

4.2.1.3.2.1 Sources of Standards and Criteria

The sources of the standards and criteria listed as Class 2 include the following:

- United States Environmental Protection Agency (US EPA) national aquatic life criteria;
- Toxicity-based aquatic life criteria;
- Human health-based criteria;
- Bioaccumulation;
- Taste and Odor Criteria; and
- Wildlife-based Criteria.

A brief discussion follows regarding each source and its reference in Minn. Rules ch. 7050.

US EPA National Aquatic Life Criteria. The US EPA established aquatic life criteria under Section 304(a)(1) of the Clean Water Act, United States Code, title 33, Section 1314. The US EPA has described the national methods for developing aquatic life criteria in "*Guidelines for deriving national numerical water quality criteria for the protection of aquatic organisms and their uses*".

Many standards for Class 2 are adopted unchanged for trout waters and modified for cool and warm water fisheries habitats from the United States Environmental Protection Agency (US EPA) national aquatic life criteria. A description of this process is provided in Minn. R. 7050.0218, subp. 4.

Toxicity-Based Aquatic Life Criteria. Toxicity-based aquatic life criteria are generated where no US EPA national aquatic life criteria are available. See Minn. R. 7050.0218, subp. 5 for the procedure to generate toxicity-based aquatic life criteria.

Human Health-Based Criteria. Human health-based criteria, in Class 2, protect humans from potential adverse effects of eating fish and edible aquatic organisms for Class 2 waters. Criteria are designed to protect humans from either systemic or carcinogenic exposure. Reference doses for noncarcinogens and cancer potency factors, for carcinogens, are obtained from the US EPA's Integrated Risk Information System. For equations used and procedures, see Minn. R. 7050.0218, subp. 6.

Bioaccumulation. Highly bioaccumulative contaminants include lipophilic organic contaminants that accumulate in the tissues of an aquatic organism. Bioaccumulation is described by a bioaccumulation factor (BAF) or by a bioconcentration factor (BCF). Both a BAF and a BCF involve the concentration of a pollutant in one or more tissues of an aquatic organism and both are divided by the average concentration in the solution in which the organism had been living. The BAF and BCF differ regarding the type of exposure. The BAF includes exposure from any source of the pollutant but primarily from the diet and from a contaminated bottom sediments environment in addition to contaminants suspended or dissolved in the water column while the BCF includes exposure only to the contaminants suspended or dissolved in water as the source of the pollutant. A final BAF can be determined from field bioaccumulation measurements or from laboratory bioconcentration experiments. Criteria for the field measurements and experiments and other information are presented in Minn. R. 7050.0218, subp. 7. If measured BAFs and BCFs are not available for lipophilic organic chemicals, then a final BAF can be estimated using the procedure described in Minn. R. 7050.0218, subp. 7.D. This procedure uses a relationship between bioconcentration and the log of the octanol to water partition coefficient (log K_{ow}).

Examples of highly bioaccumulative contaminants are PCBs, mercury, and DDT.

Taste and Odor Criteria. The MPCA uses US EPA national organileptic criteria, as described in Section 304(a)(1) of the Clean Water Act, United States Code, Title 33, Section 1314, for establishing concentrations above which unacceptable tastes and odors could be imparted to aquatic organisms.

Wildlife-Based Criteria. The MPCA uses the procedures in Minn. R. 7050.0218, subp. 9 to establish wildlife-based criteria. Wildlife-based criteria are intended to protect wildlife consumers of freshwater aquatic organisms from adverse effects of toxic pollutants. Pathways include ingestion through drinking and feeding and through gavage.

4.2.1.3.2.2 Class 2 Classes and Standards

There are five Class 2 classes: 2A, 2B, 2Bd, 2C, and 2D. The classes each provide protection for different types of fish and other aquatic life. Classes 2A and 2Bd waters are protected as a source of drinking water also. Consequently, there are different standards, as shown in Tables 9 through 11 (Spreadsheets Swt22a02.xls, Swt2bd02.xls, and Swt22b02.xls, respectively). Tables for Classes 2B, 2C, and 2D waters are combined as Table 11 (Spreadsheet Swt22b02.xls) and, where differences between these three classes exist, they are footnoted. The following standards apply to Classes 2A, 2Bd, 2B, 2C and 2D. Their application is discussed in Section 7.0.

The Chronic Standard (CS) is defined as the highest concentration of a toxic pollutant to which organisms can be exposed without causing chronic toxicity. For chronic toxicity to occur, the exposure must occur over a long period of time, often one-tenth the life span or more. Chronic toxicity effects can include: mortality; reduced growth; reproduction impairment; harmful changes in behavior; and other nonlethal effects.

The Maximum Standard (MS) is defined as the highest concentration of a toxic pollutant in water to which aquatic organisms can be exposed for a brief time with zero to slight mortality. The MS equals the final acute value divided by two.

The Final Acute Value (FAV) is the acute toxicity limitation that is intended to prevent immediate toxicity of organisms at the point of discharge to a river or stream. Acute toxicity means an exposure severe enough to cause a rapid response, generally less than 96 hours. The FAV is defined in Minn. R. 7050.0218, subp. 3.O as an estimate of the concentration of a pollutant defined as corresponding to the cumulative probability of 0.05 in the distribution of all the acute toxicity values for the genera or species from the acceptable acute tests conducted on a pollutant.

Highly bioaccumulative contaminants and carcinogens include contaminants such as PCBs, mercury, 2,3,7,8-Dibenzo-p-dioxin, DDT, acrylonitrile, benzene, and several chlorinated volatile organic hydrocarbons, among others. They are marked with an asterisk in the Class 2 columns of Tables 9 through 12. Minn. R. 7050.0222, subp. 7.E. requires adjustment of the MSs and FAVs for highly bioaccumulative contaminants and carcinogens to be protective. Specifically, if the ratio of the CS to the MS of a highly bioaccumulative chemical or a carcinogen is greater than 100, then the CS multiplied by 100 shall be substituted for the MS. For the FAV if the ratio of the chronic standard to the FAV of a highly bioaccumulative contaminant or carcinogen is greater than 200, then the CS multiplied by 200 shall be substituted for the FAV.

Additivity for Multiple Contaminants with the Same Endpoint is an equation used to evaluate mixtures of more than one chemical, where the chemicals have the same mode of toxic action. Additivity typically is used for determining acutely toxic conditions and has not been used, for the most part, for chronic conditions with the same endpoint. The following formula is used to calculate the acute additivity, and thus, the toxicity of the mixture:

$(C_1/FAV_1) + (C_2/FAV_2) + \ldots + (C_n/FAV_n) = 1$ or more, an acutely toxic condition exists (Equation 1)

where: $C_1 \ldots C_n$ = the concentration of the first to the n^{th} toxicant;

$FAV_1 \ldots FAV_n$ = the FAV for the first to the n^{th} toxicant; and

/ = "divided by."

If the sum of the fraction in Equation 1 is greater than one, an acutely toxic condition is indicated. The above evaluation can be very labor intensive and is intended for waste water treatment plant type outfalls. For ground water remediation, the MPCA EAO staff conducts a quick surrogate evaluation that involves simply comparing the toxicant concentration to the MS. It should be noted that this is not a conservative approach.

Carcinogenic Contaminants, whether singly or a mixture, shall not exceed a risk level of one chance in 100,000 in surface waters. Carcinogenic chemicals are considered additive in their effect according to the following formula unless an alternative model is supported by available scientific evidence. This additive formula applies to chemicals that have a human health-based standard calculated with a cancer potency factor.

If $(C_1/CC_1) + (C_2/CC_2) + \ldots + (C_n/CC_n) = 1$ or more, the 10^{-5} cancer risk level is exceeded: (Equation 2)

where: $C_1 \ldots C_n$ = the concentration of the first to the n^{th} carcinogen;

$CC_1 \ldots CC_n$ = the drinking water plus fish consumption criterion (dfCC) or fish consumption criterion; and

(fCC) for the first to the n^{th} carcinogenic chemical.

If the sum of the fractions in Equation 2 is greater than or equal to one, then the 10^{-5} risk level is likely exceeded. The 10-5 risk level is the level of acceptable risk used for carcinogens in the State of Minnesota. This equation is rarely used by MPCA EAO staff as it is data intensive. It is used for sites with mixtures of extremely highly bioaccumulative carcinogenic compounds.

4.2.1.3.2.3 Classes 3 through 5 and 7 Standards

These standards are based on uses described in Tables 1, 4, and 5. The standards and uses being protected are listed in Tables 9 through 12 (Spreadsheets Swt22a02.xls, Swt2bd.xls, Swt22b02.xls, and Swt2702.xls, respectively). Use of these tables is discussed in Sections 7.0 and 8.0.

4.2.1.3.2.4 Minnesota Site-Specific Criteria

Although they are listed as criteria, Minnesota Site-Specific Criteria are promulgated for Class 2 waters, but can only be used on a site-specific basis. If there is a Minnesota Site-Specific Criterion for a contaminant, then the user must contact the surface water quality standards development staff in the EAO Division to obtain the number. The EAO staff will evaluate if the site is similar to other sites for which the Minnesota Site-Specific Criterion was developed.

4.2.1.3.2.5 Great Lakes Initiative Wildlife Values for the Lake Superior Watershed Basin

Any numbers in the GLI Wildlife column are standards if they are being evaluated for the Lake Superior Basin. There are standards for mercury, PCBs, 2,3,7,8-tetrachlorodibenzo-p-dioxin, and DDT. These numbers were promulgated as Minn. R. ch. 7052, for highly bioaccumulative contaminants in an OIRW. These numbers may be used as criteria for other basins. If criteria for the protection of wildlife from bioaccumulative chemicals are needed for other watershed basins, then the MPCA EAO staff shall be consulted as there are specific assumptions used for these numbers that may or may not apply to the water body in question.

4.2.1.3.2.6 Best Available Technology Numbers

Best available technology (BAT) numbers may be used as compliance values in the place of water quality standards in National Pollution Discharge Elimination System or State Disposal System permits where surface water or ground water receiving water is of sufficient quality that additional protection is needed from further degradation. They are developed using the best professional judgment protocol provided in the Code of Federal Regulations and generally are more restrictive than surface water standards. BAT numbers are defined by the MPCA staff person assigned to draft the National Pollution Discharge Elimination System (NPDES)/State Disposal System (SDS) permit or if only the substantiative portions of a permit are required, as under Superfund, by the MPCA staff person assigned to draft the substantiate portions of a permit. BAT numbers are applied typically after treatment and prior to surface water discharge.

4.2.2 Surface Water Criteria and Screening Numbers

Surface water criteria need to be considered before screening numbers are used. The types of surface water criteria and when they are used are discussed below in Sections 4.2.2.1 through 4.2.2.3. Where a promulgated standard, a Minnesota Site Specific Criterion or a GLI Wildlife Value for the Lake Superior Basin are not available in Tables 8 through 12, the MPCA EAO staff shall be contacted. A list of the types of guideline values, criteria, and screening numbers are provided below.

4.2.2.1 Surface Water Criteria

If a promulgated standard is not available for a particular contaminant, a number of options exist for use of surface water criteria. Prior to use of these numbers, contact MPCA EAO staff to determine if there is sufficient information to generate a criterion or if a criterion is present in the tables, to be sure that the assumptions of the criterion or screening value are similar enough to be used in the user's situation. For example, contact MPCA EAO staff if there is a new or updated MCL that is available for Class 1 but is not adopted into Minn. R. ch. 7050 yet or if the conditions exist for use of the GLI Wildlife Value in a watershed basin other than the Lake Superior Basin.

4.2.2.1.1 Criterion Developed by MPCA EAO Staff

A cleanup number for contaminant with no existing standard and where a Minnesota Site-Specific Criterion or a GLI Wildlife Value (for the Lake Superior Basin only) is not applicable or does not exist, can be generated by MPCA EAO staff where there is sufficient risk information to generate such a number. Criteria shall be developed according to the requirements of Minn. R. 7050.0218 and they will be specific to the surface water body being addressed. 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.

4.2.2.1.2 New MCL Available for Class 1 but Not Yet Adopted

The United States Environmental Protection Agency (EPA) periodically revises existing and adopts new MCLs. There is a delay between the EPA's adoption of revised and new MCLs and their promulgation into Minn. R. ch. 7050. When this situation occurs, the MPCA EAO staff shall be contacted through the MPCA site staff, where applicable, for further guidance regarding use of the new or revised MCL.

4.2.2.1.3 Use of GLI Standards for Watershed Basins Other Than the Lake Superior Basin

Standards were developed in Minn. R. ch. 7052 for the protection of wildlife from bioaccumulative chemicals in the Lake Superior Basin. For watershed basins other than the Lake Superior Basin, consult the MPCA EAO staff prior to use of these numbers as there are specific assumptions used for these numbers that may or may not apply to the water body in question.

4.2.2.2 Surface Water Aquatic Life and Wildlife-Based Screening Numbers

If standards do not exist, a Minnesota Site-Specific Criterion can not be generated, a GLI Wildlife Value can not be applied to the water body in question and that water body is not part of the Lake Superior Basin, then there are three sources of aquatic life and surface water wildlife-based screening values that can be used for screening. Aquatic life and surface water wildlife-based screening values are used to determine if a contaminant has the potential to affect aquatic life and habitat. Situations vary whereby they can be used. There are three types of screening numbers:

- EPA Chronic National Ambient Water Quality Criteria (AWQC);
- Tier II Secondary Chronic Value developed by Suter and Tsao (1996) using the Tier II method described in EPA's water quality guidance for the Great Lakes System (Suter and Tsao, 1996); and
- EPA Chronic lowest observed effect level (LOEL) values reported by EPA when insufficient data exists to calculate a National Ambient Water Quality Criterion (EPA, 1986).

A list of the specific screening numbers is provided in Tables 9 through 12 (Spreadsheets Swt22a02.xls, Swt2bd02.xls, Swt22b02.xls, and Swt2702.xls, respectively). Section 7.0 described how to use these screening numbers. Use these screening numbers only after consulting with the MPCA project and EAO staff. There are specific assumptions used for these numbers that may or may not apply to the water body in question.

4.2.3 Natural Background Values in a Surface Water Body

4.2.3.1 Natural Background Values for Metals

The natural background metal(s) concentrations are used for several purposes. The purposes are described below.

According to Minn. R. 7050.0170, "The waters of the state may, in a natural condition, have water quality characteristics or chemical concentrations approaching or exceeding the water quality standards. Where background levels exceed applicable standards, the background levels may be used as the standards for controlling the addition of the same pollutants from point or nonpoint source discharges in the place of the standards."

Minn. R. 7050.0170 also discusses where background levels do not exceed applicable standards.

"Where natural background levels do not exceed applicable standards, the addition of pollutants from human activity and resulting point or nonpoint source discharges shall be limited such that, in total, the natural background levels and the additions from human activity shall not exceed the standards. When reasonable justification exists to preserve the higher natural quality of a water resource, the commissioner may use the natural background levels that are lower than the applicable site-specific standards to control the addition of the same pollutants from human activity. The reasonable justification must meet the requirements under Minn. R. 7050.0180 and 7050.0185."

For a mixing zone situation in a stream and river with a 7Q10 greater than zero, a mass balance equation may be used to calculate if the most restrictive standard is being exceeded downstream after mixing. In situations where a mass balance equation is used, background concentrations of metals can be used to determine the downstream concentrations. As stated above, there are surface water bodies in which the natural background concentrations for aluminum, iron, or manganese naturally exceed the standard or criterion in question. If ground water discharge has iron or manganese in the plume, the MPCA site staff needs to consult the MPCA EAO staff.

Consult with MPCA EAO and site staff to obtain representative natural background values for all metals from the STORET database for a particular surface water body. The information contained on the STORET data base is retrieved based on a statistical evaluation of data as part of the Ambient Surface Water Monitoring Program at the MPCA. Alternatively, site-specific data can be used if there is a sufficient amount of background data and it has good quality assurance. This data will be compared to any STORET data to determine how adequate it is. If MPCA EAO staff determines the field data is inadequate, STORET data will be used until and if site-specific data that meets the above criteria are generated.

4.2.3.2 Natural Hardness (as CaCO3) Background Values for Hardness-Dependent Metal Standards and Natural pH Background Values for pH-Dependent Pentachlorophenol Standards

The toxicity of certain metals (cadmium, trivalent chromium, copper, lead, nickel, silver, and zinc) depends on the hardness of the surface water. Standards for these metals must be adjusted for hardness. Similarly, the toxicity of pentachlorophenol depends on the pH of the surface water receptor. Therefore, the pentachlorophenol standard must be adjusted for the pH.

For Tier 1, refer to the maps in Appendix 3 for conservative natural hardness values that can be used for screening hardness-dependent metals. As Tier 2 screenings are site-specific, consult with the MPCA EAO and site staff to obtain representative natural hardness (as $CaCO_3$) and natural pH values from the STORET database for a particular section of water body. The information contained on the STORET data base is retrieved based on a statistical evaluation of data as part of the Ambient Surface Water Monitoring Program at the MPCA. Alternatively, site-specific data can be used if there is a sufficient amount of background data (at least ten measurements over sufficient time) and it has good quality assurance. This data will be compared to any STORET data to determine how adequate it is. If MPCA EAO staff determines the field data is inadequate, STORET data will be used until and if site-specific data that meets the above criteria are generated.

5.0 TYPES OF DISCHARGES

5.1 Point Source Discharges

Point source discharges are end of pipe and direct discharges to a surface water body as defined in Minn. Stat. § 115.01, subd. 11. Point source discharges include ground water pump out or surface water discharge systems. Point source dischargers must obtain a National Pollution Discharge Elimination System/State Disposal System (NPDES/SDS) permit prior to discharge. A permit application can be obtained from the website http://www.pca.state.mn.us/water/permits/index.html #gravel. All NPDES/SDS permits shall be drafted by MPCA permit staff in the Industrial Division.

5.2 Nonpoint Source Discharges

A nonpoint source discharge is a land management or land use activity that contributes or may contribute to ground water and surface water pollution as a result of runoff, seepage, or percolation and that is not defined as a point source under Minn. Stat. § 115.01, subd. 11. The most common nonpoint discharge is ground water discharge to a surface water body. For a discussion of how the standards are applied, refer to Section 7.0. Also, refer to Appendix 6 of the 1990 Statement of Need and Reasonableness (SONAR) discussion associated with the 1990 revisions to Minn. R. ch. 7050 as a reference regarding how the surface water standard is addressed and where the surface water standard is applied using Minn. R. ch. 7050.

6.0 OVERVIEW OF TIERED SURFACE WATER AND SEDIMENT EVALUATION PROCESS

6.1 Surface Water Contamination Sites

A three-tier scheme has been developed to evaluate risk posed to human health and the environment from nonpoint discharges from remediation sites to surface water. The different tiers are based on the level of effort devoted to the site characterization and risk evaluation, as well as the required degree of consultation from MPCA EAO staff.

- A Tier 1 evaluation is a screening tool based on the most conservative target risk levels for individual compounds for any class of surface water body excluding OIRWs and ORVWs. It involves the least level of effort towards site characterization and evaluation.

- A Tier 2 evaluation demands a greater site characterization effort and may often require consultation of the MPCA site and EAO staff.

- A Tier 3 evaluation of complex risk-related situations requires involvement by the MPCA EAO staff, or, for spills, the Minnesota State Duty Officer. Tier 3 situations are listed in Section 7.1.1 below. They are usually surface water body specific and, consequently, are not addressed in this guidance document.

6.2 Contaminated Sediment Sites

The Agency in recent years has become more involved with the remediation of contaminated sediment sites in Minnesota. If a site has contaminated sediment within a surface water body, this is an automatic Tier 3 level and EAO staff needs to be consulted. At this time, there is no broad policy on addressing contaminated sediment sites. Instead, the Remediation Division and the EAO Division of the MPCA are working together to resolve remediation of contaminated sediment sites on a site-by-site basis, so that human health and the environment are protected.

7.0 APPLICATION OF SURFACE WATER RULES AND GUIDANCE

The following discussion assumes that ground water is contaminated and has the potential to discharge or is discharging to a surface water body receptor. Alternatively, the surface water runoff pathway is analyzed if runoff discharges or could potentially discharge to a surface water body.

7.1 Tier 1 Evaluation

7.1.1 Application

A Tier 1 analysis can be used for any simple sites having the potential to impact a surface water body in which only a quick screening of numerical standards is needed and for which a Tier 2 or Tier 3 level of effort is not needed. All ORVW and OIRW classified surface water bodies require a Tier 3 evaluation. Tier 1 numbers consist of the most conservative of all standards for all classes for a particular contaminant. For Class 2, the chronic standard (CS) is used. Where standards are not available, the most restrictive of all available criteria is used. If there are no standards or criteria, use the screening numbers.

A Tier 2 evaluation is a water body and site-specific evaluation using the appropriate Table 9, 10, 11, or 12. All screening values and criteria used must be determined by the MPCA site and EAO staff to be acceptable for the site in question. A Tier 2 evaluation is used when:

1. Tier 1 was evaluated, and the Tier 1 screening value was exceeded. The Tier 1 screening value represents the most conservative of all Tier 2 standards;

2. The Tier 1 table refers the user to Tier 2 for a particular chemical; or

3. A more detailed evaluation is needed and none of the Tier 3 situations listed below, in this part, exists for the site being evaluated.

Tier 3 evaluations are complex and involve MPCA EAO staff as well as MPCA site staff. A Tier 3 evaluation needs to be performed in the following circumstances:

- Spills or acute situations;

- A water body classified as an ORVW;

- Water bodies that are part of the GLI. These water bodies are part of the Lake Superior Basin and may also be OIRWs or ORVWs;

- Presence of endangered species whose habitat includes the water body in question. Endangered species are listed by the Minnesota Department of Natural Resources and the United States Fish and Wildlife Service;

- When the level of use(s) of a water body results in a significantly higher level of exposure than the basis of the numerical standards (e.g., subsistence fishing, etc.);

- When the discharge is to a lake or a pond that also serves as a drinking water intake or when the discharge is to a stream or a river and the drinking water intake is within the mixing zone of the discharge;

- When the discharge is to a lake or a pond and there is a beach on the same body of water or when the discharge is to a river or a stream and the standards or criteria will not be met after the mixing zone or near the beach;

- When the water body flows into a water body with a more restrictive classification within a distance in which standards for the more restrictive classification may not be met. This case requires time-travel analysis in which the discharge may have to comply with the more restrictive classification if an analysis of the specific situation shows that standards or criteria might be exceeded by the time the water flows into the water body with the more restrictive classification. The MPCA EAO staff will provide the standards and criteria to be met and the point(s) of compliance. They also will perform the time-travel analysis; and

- If a site has contaminated sediment within a surface water body.

For spills, or acute or emergency situations, contact the Minnesota State Duty Officer at (651) 649-5451 or 1-800-422-0798 and MPCA site staff.

For other Tier 3 applications, contact the MPCA site staff, who will contact the appropriate MPCA EAO staff for further guidance.

7.1.2 Minimal Data Needs

7.1.2.1 Types of Site-Specific Information

The minimal data needs for Tier 1 would include:

- Identification of the surface water body as a potential or actual receptor of the ground water plume or of surface water runoff;

- A complete list of contaminants of potential concern (COPCs);

- The highest actual and potential concentrations for each contaminant at the location(s) just up gradient of the plume's discharge to a surface water body;

- A definition of the geology;

- A definition of the ground water plume; and

- Knowledge that the source has been removed, contained, or treated so that it will not affect plume stability in the future.

Ideally, the plume's stability and the three dimensional ground water flow direction and velocity(ies) including the highest velocity and definition of the vertical gradient to confirm discharge to a surface water body should be determined as part of Tier 1. However, the reality is that the user typically identifies the site as having a contamination problem through collection of ground water, surface water runoff, or soil data. If ground water data is not collected initially and a problem is discovered in the soils, then ground water data is usually collected shortly thereafter. The general direction of ground water flow in the contaminated aquifer also is usually defined through well installation and measuring water levels at this time. From this information, a surface water body may be identified as a potential receptor.

From this point forward, the ground water data is typically used for screening purposes even though the temporary and permanent wells may be located close to the source and some distance from the potential surface water receptor body. The user should be cautioned that ground water data from near the source may not be the data with the highest concentrations. There may have been an old release with high initial concentrations of a particular contaminant that has traveled downgradient and the source may have been cleaned up or little remains at the source for very permeable soils. Therefore, the plume needs to be defined sufficiently to show the highest concentrations with distance between the site and potential surface water body receptor.

Also, the highest concentrations can vary within an aquifer with depth, so samples from temporary wells or push probes may need to be collected from several depths or nested wells may need to be installed to define the vertical, as well as the spatial, distribution. The plume stability also needs to be defined and this definition occurs with time. Using the minimal information listed above only works for determining if the user should proceed to Tier 2 or should determine that the concentrations being released from the site are not a concern for the surface water body. The user also can go to Tier 2 or skip Tier 1 at any time.

Alternatively, the user could determine that the surface water body is not a receptor by defining a vertical gradient near the potential surface water body receptor and in doing so, determine that the ground water does not discharge to the surface water body. In addition, the surface water body could be too far away to likely be a receptor and there are other ground water receptors or the plume is stable and the source is removed or treated and it is not close to impacting a surface water body.

The user should be cautioned that at NO time, is sample data of the surface water body itself a substitute for the list of the minimal data above to determine that a site with a release is NOT posing a contamination risk to a surface water body. Sampling of the surface water body directly allows for dilution and it is difficult to monitor surface water bodies at the exact location where a ground water plume discharges into a surface water body at the highest concentrations.

7.1.2.2 Quality and Quantity of Information

The quality and quantity of information shall be no less than that for other major pathway decisions. A larger number of sampling events and more sampling locations are needed for more complex situations, and for situations in which seasonal or other periodic effects make a difference. All samples must be representative. Therefore, all samples shall be collected in accordance with the *Risk-Based Site Characterization and Sampling Guidance* for Superfund, RCRA, and VIC sites and Guidance Document 4-05, titled *Ground Water Sample Collection and Analysis Procedures*, for Petroleum Remediation sites. The website for the *Risk-Based Site Characterization and Sampling Guidance* is http://www.pca.state.mn.us/cleanup/riskbasedoc.html and the website for Petroleum Remediation Guidance Documents is http://www.pca.state.mn.us/cleanup/pubs/lustpubs.html . Quality assurance/quality control policies can be found at the website http://www.pca.state.mn.us/programs/qa_p.html .

7.1.2.3 Determination of Site Exposure Concentration(s)

Representative ground water samples need to be collected that represent the maximum ground water concentrations of all contaminants and enough samples should be taken to define the lateral and vertical extent of the plume. This work is performed from the source to the downgradient extent of the plume and prior to the surface water receptor. Surface water runoff sampling locations also shall be representative.

7.1.3 Tier 1 Evaluation Procedure

1. Use the instructions in Appendix 2 and the information contained in Appendix 3 to determine the classification of the water body.

2. If a Tier 1 analysis can be performed, then go to Table 8 (Spreadsheet Swt102.xls), the Tier 1 Surface Water Screening Table. Table 8 consists of a single number for each contaminant with which the user compares the highest contaminant concentrations from all the ground water sampling points located in the site's plume and up gradient of surface water discharge. The single compliance number for each contaminant represents the most conservative of all Tier 2 standards and criteria.

3. Compare the highest concentration(s) for all contaminants detected in water samples collected from the ground water sampling points located in the site's plume and up gradient of discharge to the surface water body with the Tier 1 value. The highest concentrations from all ground water sampling points located within the site's plume are used for comparison as this is a Tier 1 analysis and the stability of the plume has not been determined.

4. Obtain any natural background metal(s) concentrations, as needed, from the MPCA EAO staff. Alternatively, site-specific data can be used if there is a sufficient amount of background data and it has good quality assurance. This data will be compared to any STORET data to determine how adequate it is. If MPCA EAO staff determines the field data is inadequate, STORET data will be used until and if site-specific data that meets the above criteria.

5. Refer to the maps in Appendix 3 for conservative natural hardness values that can be used for screening hardness-dependent metals.

6. The current un-ionized ammonia standard is based on aquatic toxicity to fish and invertebrates. Ammonia toxicity is dependent on the temperature and pH of the receiving water. The ammonia migrating toward a surface water body from a contaminated ground water site needs to be measured in the permanent or temporary wells within the plume and up gradient to surface water discharge. Permanent or temporary wells that are closer to the surface water body receptor are preferred to more distant wells as the ammonia concentration (i.e., form of nitrogen) will change based on the oxidation-state. Ammonia needs to be measured as TOTAL ammonia. The pH and temperature of the surface water receptor also need to be measured in the field at the same time as the ammonia sample is being collected. See the Notes attached to Tables 8 (Spreadsheet Swt102.xls) and the Ammonia Worksheet attached to Spreadsheet Swt102.xls for calculating the percent un-ionized ammonia from the total ammonia concentration using the temperature and pH of the receiving surface water.

7.1.4 Tier 1 Evaluation Outcomes

7.1.4.1 Decision Points

No remediation is needed if:

- The highest ground water concentrations in the plume do not and will not exceed the values listed in Table 8 (Spreadsheet Swt102.xls) as the source has been removed or treated and the plume is and will remain stable (or decreasing in concentration) for all contaminants and degradation products; or

- The surface water body is not a receptor of the plume or contaminated surface water runoff.

For all other situations, proceed to Tier 2 or Tier 3, or if the situation is a spill or for acute or emergency situations, contact the State Duty Officer at (651) 649-5451 or 1-800-422-0798 and MPCA site staff.

If any of the lowest standards or criteria listed in Table 8 (Spreadsheet Swt102.xls) is exceeded or a contaminant contains instructions to go to Tier 2, use a Tier 2 analysis.

If natural background metal concentrations obtained as described in Section 4.2.3.1 are higher than plume concentrations or metals standards, then consult with the MPCA site and EAO staff.

A ground water plume may discharge to a stream or river and then the streams or river may recharge ground water downflow of the plume discharge location. For this situation or for ground water recharge in one part of a nonflowing water body and then discharge in another part, ground water standards need to be applied at the point of ground water recharge. Refer to the *Ground Water Guidance Document* in the RBSE Manual for Superfund, RCRA, and VIC sites. For Petroleum Remediation sites, refer to Guidance Document 1-01, titled *Petroleum Remediation Program General Policy*.

7.1.4.2 Documentation Requirements

All programs must ensure that all pathways of exposure are adequately evaluated and that such evaluations are adequately documented. Documentation of pathway screening will be provided through reports involving the *Risk Based Site Evaluation (RBSE)* process that is available at the MPCA website http://www.pca.state.mn.us/cleanup/riskbasedoc.html for Superfund, RCRA, and VIC sites. For Petroleum Remediation sites, use Guidance Document 4-06, the *Investigation Report Form*, available at the MPCA website http://www.pca.state.mn.us/cleanup/pubs/lustpubs.html . For other remediation sites, provide the appropriate evaluation in a report. Also, the decision regarding screening will be summarized in the appropriate decision document that provides the decision-making rationale for each pathway. For Superfund sites, the document is the Minnesota Decision Document (MDD) or the Record of Decision (ROD). For other Remediation programs, the document may be a letter.

7.1.4.3 Uncertainty Discussion

Include a complete discussion of all uncertainties and assumptions used to reach the decision regarding the Tier 1 screening for a contaminant plume discharging or having the potential to discharge to a surface water body in the document providing the decision-making rationale for each Remediation program. Include a copy of Table 8 (Spreadsheet Swt102.xls) with a completed "Enter Site Concentration" column.

7.2 Tier 2 Evaluation

7.2.1 Application

A Tier 2 evaluation is a water body and site-specific evaluation using the appropriate Table 9 through 12. Criteria or screening values use needs prior approval by the MPCA site and EAO staff for the site in question. A Tier 2 evaluation is used when:

1. Tier 1 was evaluated and the highest plume concentrations exceed the Tier 1 values, as presented in Table 8 (Spreadsheet Swt102.xls);

2. The Tier 1 table refers the user to Tier 2 for a particular chemical; or

3. A more detailed evaluation is needed and none of the Tier 3 situations listed in Section 7.1.1 already apply. Some example reasons for more detailed evaluations include:

    - unstable plumes with potential or with actual impacts to surface waters;

    - sites where sources are not removed and there is the potential for or there are impacts to surface waters. The plumes may or may not be stable at these sites; and

    - stable plumes with impacts to surface waters and the source removed or treated so that plume stability will not be affected in the future.

Tier 3 Evaluations are complex and involve more time and effort of the MPCA EAO staff as well as the MPCA site staff. Situations for which Tier 3 should be used instead of Tier 2 are listed in Section 7.1.1.

For spills, or acute or emergency situations, contact the Minnesota State Duty Officer at 1-800-422-0798 or 1-651-649-5451 and MPCA site staff. A staff directory is located at the website http://www.pca.state.mn.us/pca/staff/index.cfm . For other Tier 3 applications, contact the MPCA site staff, who will contact the appropriate MPCA EAO staff for further guidance.

7.2.2 Minimal Data Needs

7.2.2.1 Types of Site Specific Information

The discussion of the minimal data needs in Section 7.1.2 would be the same for Tier 1 or 2 when a quick site screening is the main objective. Site screening includes determining if contamination from a site may have the potential to or may be impacting a surface water body. Therefore, refer to Section 7.1.2 for a list of minimal data needed if the main objective when using Tables 9 through 12 is a quick site screening using minimal data only. The highest concentrations from all monitoring locations in the site's plume and up gradient of the potential surface water receptor are used for this simple screening. There are a few differences between a Tier 1 and a simple Tier 2 screening. The differences are that a surface water-specific hardness and pH values for calculation of hardness-dependent metals and pentachlorophenol standards need to be obtained. In addition, the stability of the plume is typically known. As Tier 2 screenings are site-specific, consult with the MPCA EAO and site staff to obtain representative natural hardness (as $CaCO_3$) and natural pH values from the STORET database for a particular section of water body. The information contained on the STORET data base is retrieved based on a statistical evaluation of data as part of the Ambient Surface Water Monitoring Program at the MPCA. Alternatively, site-specific data can be used if there is a sufficient amount of background data and it has good quality assurance. This data will be compared to any STORET data to determine how adequate it is. If MPCA EAO staff determines the field data is inadequate, STORET data will be used until and if site-specific data that meets the above criteria are generated.

If a more detailed and site-specific Tier 2 screening procedure is needed, the following additional site-specific Tier 2 information shall be obtained:

- The three-dimensional ground water flow direction and velocity including the highest velocity and definition of the vertical gradient to confirm ground water discharge to a surface water body. Use field-measured hydraulic conductivity values to calculate the ground water velocity; and

- The plume's stability.

The following work likely needs to be performed for a more detailed Tier 2 screening:

1. Monitoring wells likely need to be installed, if not already in place, at a minimum, at the locations and depths of the highest temporary well or push probe plume concentrations in the plume. Also, monitoring wells likely need to monitor the extent and magnitude of contamination. An example monitoring system design, for nonflowing waters (i.e., lakes and wetlands) is shown in Figure 1. An example monitoring well network for flowing waters (i.e., streams and rivers) is shown in Figure 2. For surface water runoff, sampling locations identified for each site prior to discharge become the compliance points.

Figure 1
Ground Water Discharge to a Lake, Pond or Wetland

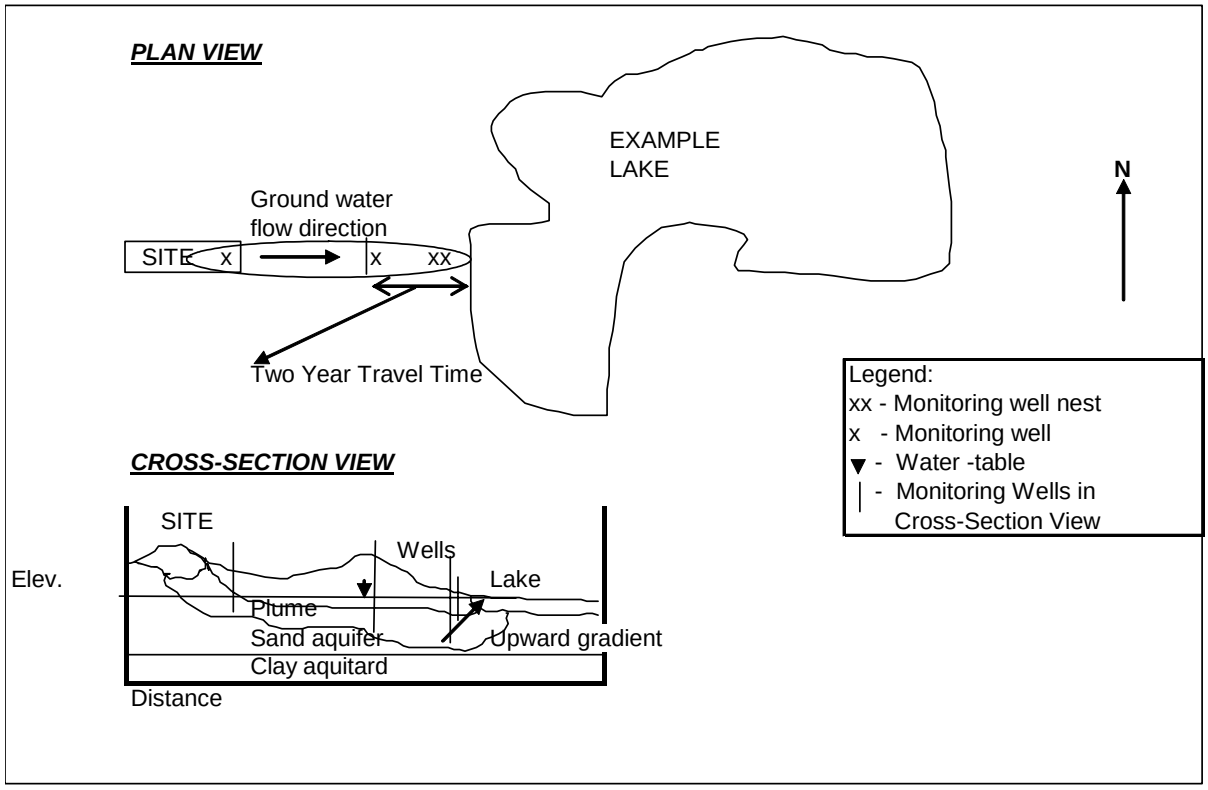
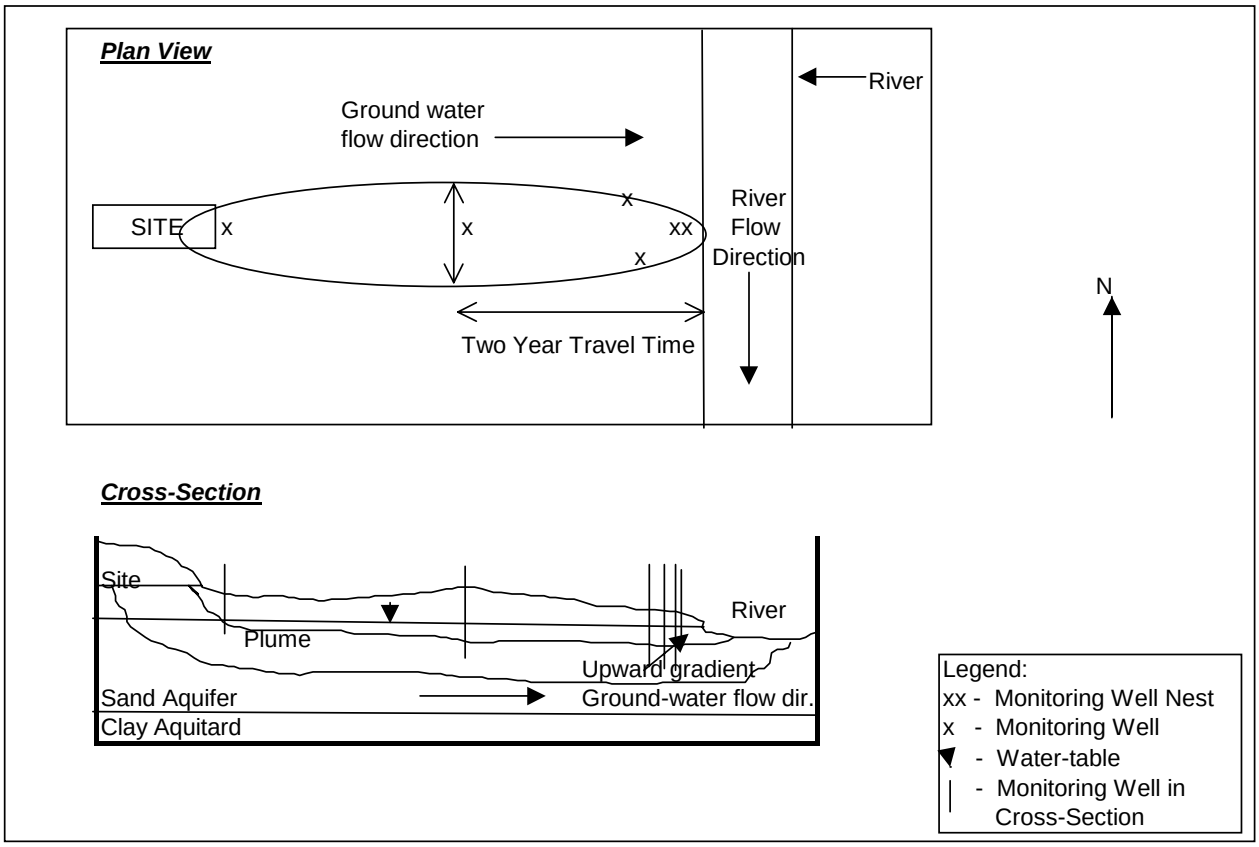


FIGURE 2
GROUND WATER DISCHARGE TO A STREAM OR RIVER



Through multiple sampling events, the ground water plume should be defined as stable or unstable as described in the *Ground Water Guidance Document* in the RBSE Manual for Superfund, RCRA and VIC sites. For Petroleum Remediation sites, use Guidance Documents-1-01, titled *Petroleum Remediation Program General Policy*, and 4-01, titled *Soil and Ground Water Assessments Performed during Site Investigations.* Other remediation programs also are using the concept of stable and unstable plumes.

For flowing systems such as streams or rivers, the following additional stream or river information is needed to define the degree of potential or actual impact and to determine discharge concentrations where the 7Q10 is sufficient to allow for mixing.

- the 7Q10 of the surface water receptor;
- the plume width (w), measured in feet;
- the plume thickness (h), measured in feet;
- the hydraulic gradient (dh/dl), measured in ft/ft; and
- the hydraulic conductivity (k), measured in gal/day/ft^2.

The plume width and thickness shall be defined at well location(s) just up gradient of discharge to the surface water body. The hydraulic gradient and the hydraulic conductivity shall be representative of the area within the two-year travel time up gradient and prior to surface water discharge. Use this information to determine the discharge using the equation:

Q = [h * w * k * (dh/dl)]/1440 in gal/min. (Equation 3) where:

Q = discharge, gallons per minute (gem);

w, h, (dh/dl), and k are defined above; and

* = multiplication sign.

At NO time is sample data of the surface water body receptor itself a substitute for the list of the minimal Tier 2 screening data above to determine that a site with a release is NOT posing a contamination risk to a surface water body. Sampling of the surface water body receptor directly allows for dilution and it is difficult to monitor surface water bodies at the exact location(s) where a ground water plume discharges into a surface water body at the highest concentrations. However, sampling surface waters can be useful when determining if the ground water sampling location just up gradient of the surface water body is providing representative samples. For example, if the concentrations of contaminants are higher in the surface water body receptor than in the up gradient ground water sample location and all other sources are ruled out as being contributing factors, then the location from which the ground water sample was collected needs to be re-evaluated. Other sources include the other side of the stream or river, an upstream source, or a source from a deeper aquifer that is not being monitored.

7.2.2.2 Quality and Quantity of Information

The quality and quantity of information shall be no less than that for other major pathway decisions. A larger number of sampling events and more sampling locations shall be needed for more complex situations, and for situations in which seasonal or other periodic effects make a difference. All samples must be representative. Therefore, all samples shall be collected in accordance with the appropriate guidance document, site-specific Quality Assurance Project Plan or fact sheet, as specified in the program's requirements. For Superfund, RCRA, and VIC sites, the guidance document is titled *Risk-Based Site Characterization and Sampling Guidance*. For Petroleum Remediation Sites, use Guidance Document 4-05, titled *Ground Water Sample Collection and Analysis Procedures*. The website for the *Risk-Based Site Characterization and Sampling Guidance* is http://www.pca.state.mn.us/cleanup/riskbasedoc.html and the website for Petroleum Remediation Guidance Document is http://www.pca.state.mn.us/cleanup/pubs/lustpubs.html . General quality assurance/quality control policies can be found at the website http://www.pca.state.mn.us/programs/qa_p.html .

7.2.2.3 Determination of Site Exposure Concentration(s)

Ground water samples shall be collected that represent the maximum ground water concentrations discharging or with the potential to discharge to a surface water receptor. Surface water runoff sampling locations also shall be representative.

7.2.3 Tier 2 Detailed Evaluation Procedures and Outcomes

The following procedures need to be used for the more detailed and site-specific Tier 2 screening evaluation as discussed in Section 7.2.2.1.

7.2.3.1 General Directions

1. Use the directions in Appendix 2 and the information presented in Appendix 3 to determine the classifications of the water body.

2. Based on these classifications, pick the appropriate Tier 2 Table 9 (Spreadsheet Swt22a02.xls), Table 10 (Spreadsheet Swt2bd02.xls), Table 11 (Spreadsheet Swt22b02.xls), or Table 12 (Spreadsheet Swt2702.xls).

3. Using the appropriate Tier 2 Table 9, 10, 11, or 12, do the following:

    a. The maximum ground water plume concentrations that are expected or are just upgradient prior to discharging to a surface water receptor need to be entered for each contaminant into the column heading "Enter Site Concentration." This requires some professional judgment. For surface water runoff to a surface water body, enter the maximum runoff concentrations.

    b. Obtain any natural background metal(s) concentrations, natural background hardness and pH values as discussed in Section 4.2.3 of this document. The natural background metal(s) concentrations and hardness and pH values are used for calculation of standards for hardness-dependent metals and pentachlorophenol. Do not use the Tier 1 hardness values on the maps in Appendix 3 as they are conservative numbers intended for Tier 1 use only. Tier 2 numbers should be specific to the part of the receptor surface water body with the potential to be impacted. Use the appropriate worksheets in Spreadsheets Swt22a02.xls, Swt2bd02.xls, Swt22b02.xls, or Swt2702.xls to calculate Class 2 standards for hardness-dependent metals and pH-dependent pentachlorophenol.

    c. The current un-ionized ammonia standard is based on aquatic toxicity to fish and invertebrates. Because of the potential to oxidize, ammonia values should be used that are just upgradient of the surface water body receptor. Ammonia needs to be measured as TOTAL ammonia. The pH and temperature of the receiving body of water needs to be measured at the same time as the ammonia sample is being collected. See the Notes attached to Tables 9 through 11 (Spreadsheets Swt22a02.xls, Swt2bd02.xls, and Swt22b02.xls) and the appropriate Ammonia Worksheet 3 attached to these spreadsheets for calculating the percent un-ionized ammonia from the total concentration using the temperature and pH of the receiving water.

    d. As stated previously, at NO time, is contaminant sample data of the surface water body receptor itself a substitute for the list of the minimal data located above to determine that a site with a release is NOT posing a contamination risk to a surface water body receptor. Sampling of contaminants in the surface water body directly allows for dilution and it is difficult to monitor surface water bodies at the exact location where a ground water plume discharges into a surface water body at the highest concentrations.

e. For lakes or ponds that recharge ground water at a location other than the ground water discharge location, ground water standards need to be applied at the point of ground water recharge. Refer to the *Ground Water Guidance Document* in the RBSE Manual at the MPCA website http://www.pca.state.mn.us/cleanup/riskbasedoc.html for Superfund, RCRA, and VIC program sites and Guidance Document 1-01 for Petroleum Remediation Sites at the MPCA website http://www.pca.state.mn.us/cleanup/pubs/lustpubs.html .

f. For lakes, ponds, or wetlands, go to Section 7.2.3.2 for further guidance.

g. For streams or rivers, go to Section 7.2.3.3.1 for further guidance.

h. For Class 7 waters, go to Section 7.2.3.3.2 for further guidance.

7.2.3.2 Tier 2 Evaluation Procedures and Outcomes for Lakes, Wetlands, or Ponds

7.2.3.2.1 Evaluation Procedures for Lakes, Wetlands, or Ponds

As stated in Section 4.2.1.2.1, no dilution is allowed as these bodies of water have no flowing water actively moving through them. Therefore, follow the steps listed below.

a. Follow the general directions provided in Section 7.2.3.1 above.

b. For each row in the pertinent Table 9, 10, 11, or 12 (Spreadsheets Swt22a02.xls, Swt2bd02.xls, Swt22b02.xls or Swt2702.xls), compare the most restrictive standard for each pollutant to the concentrations in the "Enter Site Concentration" column. Frequently, the most restrictive standard is the Class 2 CS.

c. If a standard, is not available, use a criterion and next a screening value. Do not use a criterion or a screening value unless a standard is not available and only after checking with the MPCA EAO staff and the MPCA site staff to insure that use of the criterion or screening value is appropriate for this site and water body.

d. If no standard, criterion, or screening value is available for a COPC, consult with MPCA staff for further guidance. A criterion for a specific contaminant can be developed if sufficient risk information exists.

e. If the natural background metal concentrations for iron, manganese, or aluminum obtained from the MPCA EAO staff are higher than plume concentrations or numerical standards for these metals, then consult with the MPCA site and EAO staff.

7.2.3.2.2 Decision Points for Lakes, Wetlands, and Ponds

Remediation is not needed at the present time to mitigate surface water impacts or prevent potential impacts from unacceptably impacting a surface water receptor if none of the concentrations in the "Enter Site Concentration" column exceed surface water standards and appropriate criteria and screening values.

If the contaminant concentrations exceed the most restrictive standard, criterion, or screening value, then remedial actions need to be evaluated so that the surface water quality rule objectives listed in Section 3.0 are complied with.

7.2.3.3 Tier 2 Evaluation Procedures and Outcomes for Streams or Rivers

7.2.3.3.1 Directions for Streams or Rivers that Include Class 2 Waters

Because these water bodies have flowing water constantly moving through them, dilution from the river or stream is provided in most cases when a contaminated plume is entering the river or stream in question. 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 as discussed in No. 3a of Section 7.2.3.1. For a stream or river in which the 7Q10 is 0.0 cfs, the CS is used for Class 2 instead of the MS.

Follow the procedure below for streams or rivers that have a 7Q10 greater than 0.0 cfs.

1. Follow the General Directions in Section 7.2.3.1 above.

2. If a standard is not available for a specific COPC, consult with MPCA staff for further guidance. A criterion for a specific contaminant can be developed if sufficient risk information exists.

3. Highly bioaccumulative chemicals are identified from the asterisks after their MS and FAV numerical standards for Class 2. Carcinogens are defined by the "(C)" after the chemical name. For a pollutant with an asterisk next to the FAV and the MS, the following standard modifications apply. For carcinogenic or highly bioaccumulative chemicals with bioaccumulation factors (BCFs) greater than 5000 or low octanol-water partition coefficient (K_{ow}) values greater than 5.19, the human health CS may be two or more orders smaller than the acute toxicity-based MS. In these cases if the ratio of the MS to the CS is greater than 100, then the product of the CS multiplied by 100 shall be substituted for the applicable MS. If the ratio of the FAV to the CS is greater than 200, then the product of the CS multiplied by 200 shall be substituted for the applicable FAV. The source of these modifications to the FAV and MS for highly bioaccumulative or carcinogenic chemicals is Minn. R. 7050.0222, subp. 7.

   In addition, site specific modification of a standard/criterion for a highly bioaccumulative, noncarcinogenic chemical can be performed provided there is site-specific information on the fish species and the percent lipid data found in fish fillets. Site-specific modification of a standard or criterion is a Tier 3 level of effort, so MPCA EAO staff as well as MPCA site staff will need to be involved to a greater degree in the decision-making process.

4. Determine potential or actual ground water discharge rates (Q) of contaminants in the plume to the surface water body in question using Equation 3, which is located in Section 7.2.2.1.

5. Use the following mass balance equation to determine if the most restrictive standard for each contaminant (Use the CS for Class 2) will be exceeded down stream after mixing:

   [(Pc * Pf) + (Rc * Rf)]/[Pf + Rf] = Downstream Concentration (Equation 4)

   where:Pc = Plume Concentration in ug/L (Use the concentrations in the "Enter Site Concentration" column);

   * = Multiplication sign;

   Pf = Plume discharge in liters/day;

   Rc = Natural river background concentration in ug/L; and

   Rf = low flow 7Q10 of the river or stream in liters/day.

   Note that the 7Q10 data shall be obtained from the MPCA EAO staff through the MPCA site staff. The MPCA EAO staff obtains this data from the United States Geologic Survey data base and other sources.

6. If the most restrictive standard is not exceeded down stream, then compare the MS for Class 2, or any lower value for a standard in the other applicable classes, to the concentrations in the "Enter Site Concentration" column.

7. The FAV for a pollutant may possibly be used as the Class 2 standard in the place of the MS when:

   a. There is only one COPC in the plume;

   b. There is an adequate amount of dilution available (7Q10) to ensure the CS will not be exceeded after mixing;

   c. There are no other point or nonpoint sources of pollution immediately downstream of the site;

   d. The single contaminant is neither highly bioaccumulative nor a carcinogen; or

   e. There are no special areas immediately downstream of the site that include:

      - drinking water intakes;
      - fish spawning areas;
      - ecologically sensitive areas; or
      - other similar sensitive areas.

The MPCA EAO and site staff must approve any use of FAVs for any ground water contamination site in which surface water is an actual or potential receptor.

7.2.3.3.2 Decision Points for Class 2 Streams or Rivers

No remediation for protection of a stream or river is needed when the concentration of each contaminant does not and will not exceed the most restrictive standard after mixing as defined by Equation 4.

If the contaminant concentrations exceed the most restrictive standard, criterion, then remedial actions need to be evaluated so that the surface water quality rule objectives listed in Section 3.0 are complied with.

If the most restrictive standard (using the CS for Class 2) is or will be exceeded downstream after mixing has occurred using the calculation in Equation 4, then this equation needs to be re-arranged. The re-arranged form is provided in Equation 5. Equation 5 is used to determine the concentration that must be achieved for each pollutant in the well(s) just prior to surface water discharge and up gradient to the surface water body, so that the downstream concentration does not exceed the most restrictive standard.

(Concentration that must be achieved) = [MRS * (Pf + Rf) - (Rc * Rf)]/Pf
(Equation 5)

where:

MRS = Most restrictive standard in ug/L;

* = Multiplication sign;

Pf = Plume flow in liters/day;

Rf = River flow (low flow 7Q10) in liters/day; and

Rc = Natural background river concentration in ug/L.

If the concentration derived from the above equation exceeds the most restrictive surface water standard in the well(s) just prior to and up gradient of surface water discharge, then remediation 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.

If natural background metal concentrations for iron, manganese, or aluminum obtained from the MPCA EAO staff are higher than plume concentrations or numerical standards for these metals, then consult with the MPCA EAO and site staff.

For streams or rivers that recharge ground water downflow of the plume discharge location or a ground water plume that recharges a lake on one side and the lake recharges ground water on another side, ground water standards need to be applied at the point of ground water recharge. Refer to the *Ground Water Guidance Document* for Superfund, RCRA, or VIC sites for further information and go to Tier 3. For Petroleum Remediation sites, refer to Guidance Document 1-01.

7.2.3.3.3 Directions for Streams or Rivers that Include Class 7 Waters

Class 7 waters are limited resource value waters that, at best, may support aquatic life only on a seasonal basis. An example is a ditch with ephemeral flow. The 7Q10 is 0.0 cfs. All waters of the state that are classified as Class 7 are listed in Minn. R. 7050.0470 (See Appendix 3). There are no unlisted Class 7 waters. Waters that are not wetlands and are not listed in Appendix 3 default to being a Class 2B, 3B, 4A, 4B, 5, and 6 water.

The MPCA staff has a policy of applying the Class 2 MS to any pollutant entering a Class 7 waterway, except under the following conditions:

- The pollutant in question is highly bioaccumulative. Note that most of these chemicals have an asterisk after the Class 2 MS or FAV standards;
- The pollutant is a carcinogen and does not quickly volatilize into the air;
- The discharge point is close enough to where the Class 7 water joins a Class 2 water, that the use of the Class 2 water will be impaired by the upstream plume; or
- The Class 7 water may unfavorably impact ground water recharge.

If any of these conditions occur, the Class 2 chronic standards will be applied. A list of standards for Class 7 waters is found in Table 12 (Spreadsheet Swt2702.xls).

If a standard or criterion is not available for specific COPC, consult with the MPCA site and EAO staff for further guidance. A criterion for a specific contaminant can be developed if sufficient risk information is currently available.

Do not use a screening value or a criterion unless there is no standard available and only after checking with the MPCA EAO and site staff to insure that use of the criterion or screening value is appropriate for this site and water body.

7.2.3.3.4 Decision Points for Class 7 Waters

As Class 7 waters have 0.0 cfs 7Q10 flow, there are no mixing zones allowed.

If the contaminant concentrations exceed the most restrictive standard, then remedial actions need to be evaluated so that the surface water quality rule objectives listed in Section 3.0 are complied with.

For Class 7 waters, check to see if the Class 7 water is a tributary to a Class 2 water within a short distance of the discharge. When this scenario occurs, the standards for the higher class receiving water may need to be met at the discharge point to the Class 7 waters and the reviewer would need to consult the MPCA site and EAO staff.

As stated previously, at NO time, is contaminant sample data of the surface water body itself a substitute for the list of the minimal data above to determine that a site with a release is NOT posing a contamination risk to a surface water body. Contaminant sampling of the surface water body directly allows for dilution and it is difficult to monitor surface water bodies at the exact location(s) where a ground water plume discharges into a surface water body at the highest concentrations.

7.2.3.4 Documentation Requirements

Ensure that all pathways are adequately evaluated. The decision regarding screening will be summarized in the appropriate decision document that provides the decision-making rationale for each pathway. Documentation of pathway screening will be provided in the following documents through referral to the *Risk Based Site Evaluation (RBSE) Manual* that is available at the MPCA website http://www.pca.state.mn.us/cleanup/riskbasedoc.html for Superfund, RCRA, and VIC sites. For CERCLA and MERLA sites, the document is the Minnesota Decision Document (MDD) or the Record of Decision (ROD). For Petroleum Remediation sites, use Guidance Documents 4-02, titled *Potential Receptor Surveys and Risk Evaluation Procedures at Petroleum Release Sites* and 4-06, titled *Investigation Report Form*, located on the web at http://www.pca.state.mn.us/cleanup/pubs/lustpubs.html . For other Remediation programs, the document may be a letter.

7.2.3.5 Uncertainty Discussion

Include a complete discussion of all uncertainties and assumptions used to reach the decision regarding the Tier 2 screening for a contaminant plume discharging or having the potential to discharge to a surface water body in the document providing the decision-making rationale for each Remediation program. Include a copy of Table 9, 10, 11, or 12 with the "Enter Site Concentration" column filled in.

7.3 Tier 3 Evaluation

A Tier 3 evaluation is needed for complex situations where MPCA EAO staff needs to be involved as a team member with the MPCA site staff. Refer to Section 7.1.1 for the conditions in which Tier 3 evaluations need to be conducted.

For spills, or acute or emergency situations, contact the Minnesota State Duty Officer at (651) 649-5451 or 1-800-422-0798 and MPCA site staff.

8.0 EXAMPLES OF APPLICATIONS

8.1 Example 1: Centerville Lake

8.1.1 Background Site Characterization Information

Site X is a MERLA site with a known release of benzene, trichloroethene, and the metals cadmium, lead, and zinc. The site was characterized through temporary and permanent well sample results and was found to only have impacted the surficial sand aquifer. The sand, that contains the surficial aquifer, is approximately 35 feet thick. It overlies a 50-foot thick silty clay aquitard. No contamination of the confined sand aquifer underlying the aquitard was detected based on several sampling events of monitoring wells screened in the downgradient direction for the confined aquifer. The ground water flow direction in the surficial aquifer is to the east, while the ground water flow direction in the confined aquifer is to the southwest.

The water table in the surficial aquifer is located approximately 5 to 10 feet below the ground surface. Ground water in the surficial aquifer is found to discharge to Centerville Lake. There is an upward gradient between two nested wells; one screened at the water table and the deeper well screened in the most-contaminated zone in the same aquifer. The generic example of the plume is defined by Figure 1 in Section 7.2.2.1.

8.1.2 Tier 1 Site Evaluation

8.1.2.1 Minimal Data Needs

The following data was collected so that the site could be evaluated for Tier 1.

a. To start with, three water table wells were installed at the site. The wells were logged and top of casings surveyed. Based on water level measurements, the water table is located approximately 5 to 10 feet below the ground surface. The ground water flow direction is eastward towards Centerville Lake.

b. A complete list of contaminants that comprise the plume was obtained by comprehensive sampling of the three permanent wells and temporary wells during initial site characterization. These contaminants include benzene, trichloroethene, cadmium, lead, and zinc. Temporary well locations were chosen to define the plume and determine the best locations and depths for additional well installation. Centerville Lake was identified as a potential receptor of the plume.

c. There is no direct discharge, such as runoff or spills, to Centerville Lake from the site. Had there been any surface water runoff, it would need to be characterized by discharge volume and analysis of chemical constituents.

8.1.2.2 Tier 1 Evaluation Procedure

1. A 7.5-minute topographic map was used to find the township and range (i.e., T31, R22) of Centerville Lake. Using the information presented in Appendix 3, and the township and range of Centerville Lake, the Lake was found to be located in the Upper Mississippi River Drainage Basin and, under the heading of "Lakes", is listed as Classes 1C, 2Bd, 3B. According to Minn. R. 7050.0410, listed waters also include Classes 3C, 4A, 4B, 5, and 6. Based on this classification grouping, the lake is protected for the following uses: drinking water (1C), recreational uses of all kinds, including bathing, cool and water sport or commercial fish and associated aquatic life and their habitats, and drinking water (2Bd), industrial use (3B and 3C), agriculture (4A and 4B), aesthetic enjoyment and navigation (5) and other (6). There was no asterisk in front of the Centerville Lake name in Appendix 3, so it is not classified as an ORVW. During site characterization, it was determined that there were no known receptors other than contaminated ground water discharge to Centerville Lake. Also, none of the Tier 3 situations exist as listed in Section 7.1.1.

2. Based on a check with the MPCA EAO staff, there were no background concentrations detected for the metals cadmium, lead, and zinc for Centerville Lake.

3. Cadmium, lead, and zinc are all hardness-dependent metals. The hardness value given on Map 9 in Appendix 3 was inserted into the worksheet labeled "Metals" that is attached to Spreadsheet Swt102.xls. Next, the standards that were calculated from the worksheet labeled "Metals" are inserted into Table 8 (Spreadsheet Swt102.xls).

4. The highest concentrations detected in all monitoring wells in the ground water plume associated with the site and up gradient of the discharge location to the surface water body receptor were inserted into the "Enter Site Concentration" column.

5. There were Tier 1 numbers for all contaminants. Therefore, it was not necessary to consult MPCA EAO staff to determine if additional risk information has become available since rulemaking so that criteria could be generated.

8.1.2.3 Tier 1 Decision Points

1. No dilution is allowed for a lake, wetland, or pond. Therefore, any contaminant concentrations that exceed the Tier 1 standards in the site plume located up gradient to the surface water body receptor, would prompt a need for proceeding to Tier 2.

2. If all of the highest concentrations in wells throughout the plume are less than the Tier 1 numbers, then no remediation is needed. For the Centerville Lake example, all of the Tier 1 numbers were exceeded. Therefore, it is necessary to go to Tier 2 for a more detailed site evaluation.

3. There were no uses that would have required the user to proceed to a Tier 3 analysis, based on a review of the conditions for using a Tier 3 analysis, as presented in Section 7.1.1.

8.1.3 Tier 2 Site Evaluation

8.1.3.1 Minimal Data Needs

The following additional work was performed and information obtained for Tier 2. The results of the work also are described below.

1. Additional wells were installed and borings logged in the water table aquifer at the locations of highest contaminant concentrations defined in the temporary well installation, sampling, and abandonment work. As the plume extended to Centerville Lake, at least one well nest was installed just prior to surface water discharge. The shallow well was screened at the water table and the deeper well was screened at a greater depth in the water table aquifer, where the plume was at its maximum concentration with depth. The vertical gradient in the well nest was found to be upward toward Centerville Lake.

2. The source of the contamination was defined and treated so that it no longer was a concern.

3. Monitoring wells were installed and their borings logged in the confined aquifer underlying the silty clay aquitard. The surficial aquifer was found to be 35 feet thick and the silty clay aquitard to be 50 feet thick.

4. A monitoring and water level measurement program was implemented for at least two sampling events. In addition to defining trends in water quality data, the plume was determined to be stable, so higher concentrations were no longer migrating further downgradient. No contamination was detected in the confined aquifer. The ground water flow direction in the confined aquifer was defined to be to the southwest.

5. The MPCA site staff requested and obtained a hardness value for Centerville Lake. This information will be used for calculating hardness-dependent metals standards.

8.1.3.2 Tier 2 Evaluation Procedure

The Tier 2 evaluation procedure, for this example, is the same as the Tier 1 evaluation procedure with the exception that the table to be consulted is Table 10 (Spreadsheet SWT2bd02.xls) and the hardness value is a value specific to Centerville Lake.

1. Because the plume is stable, the highest of all concentrations in the well nest just up gradient of discharge to the surface water body and within the plume or with the potential to discharge from contaminated ground water within the plume are entered into the "Enter Site Concentration" column.

2. Hardness-dependent metals standards are calculated for cadmium, lead, and zinc.

3. Next, the most restrictive of all class standards (use the CS for Class 2) for each contaminant in Table 10 (Spreadsheet Swt2bd02.xls) is compared to the contaminant concentrations listed in the "Enter Site Concentration" column.

8.1.3.3 Tier 2 Decision Points

1. Remediation is not needed at the present time to mitigate surface water impacts or prevent potential impacts from unacceptably impacting a surface water receptor if none of the concentrations in the "Enter Site Concentration" column exceed surface water standards and appropriate criteria and screening values.

2. If the contaminant concentrations exceed the most restrictive standard, criterion, or screening value, then remedial actions need to be evaluated so that the surface water quality rule objectives listed in Section 3.0 are complied with. In this example, the highest concentrations of benzene and lead significantly exceed any of the lowest class standards (using the CS for Class 2) for a stable plume.

8.2 Example 2: Rice Creek

8.2.1 Background Site Characterization Information

Site Y is a small old dump with a known release of trichloroethene, benzene, toluene, ethylbenzene, total xylenes, and the metals cadmium, and lead. The dump was characterized and removed. It was found to only have impacted the water table aquifer. The sand that contains the water table aquifer is approximately 50 feet thick. Based on well logs for the area obtained from the Minnesota Geologic Survey, the sand bed overlies a 60-foot thick clay aquitard. The ground water flow direction in the water table aquifer is to the east.

The water table is located approximately 10 to 15 feet below the ground surface. Ground water in the water table aquifer is found to discharge to Rice Creek and there is an upward gradient between wells screened at the water table and at greater depth in the most-contaminated portion of the plume. Monitoring wells define the plume and that the plume is discharging to Rice Creek. There are no drinking water intakes, beaches, etc. located immediately downstream.

A generic example of the contaminant plume and ground water discharge to a stream or river is shown on Figure 2 (See Section 7.2.2.1). The width (w) of the plume is 50 feet. The plume thickness (H) is 30 feet. The hydraulic gradient is 0.007 ft/ ft. and the vertical gradient is upward. The hydraulic conductivity of 100 gallons/day/ft^2 was defined from a pumping test performed using one of the monitoring wells screened in the most contaminated portion of the aquifer and within the two-year travel time up gradient of surface water discharge.

8.2.2 Tier 1 Site Evaluation

8.2.2.1 Minimal Data Needs

The following data was collected so that the site could be evaluated for Tier 1.

1. Initially, three water table wells were installed at the site after a push probe survey defined the plume. The wells were logged and the tops of the well casings were surveyed. Based on water level measurements, the water table is located approximately 10 to 15 feet below the ground surface and the ground water flow direction is eastward towards Rice Creek.

2. A complete list of contaminants that comprise the plume, was obtained by collecting and analyzing ground water samples for an extensive list of parameters from the three water table wells and the temporary wells during initial site characterization. The ground water contaminants include benzene, toluene, ethylbenzene, total xylenes, trichloroethene, cadmium, and lead. Temporary well locations were chosen to define the plume and determine the best locations and depths for additional permanent well installation. Rice Creek was identified as a potential receptor of the plume.

3. There was no direct discharge, such as runoff or spills, to Rice Creek from the site. Had there been any surface water runoff, it would need to be characterized by discharge volume and analysis of chemical constituents.

8.2.2.2 Tier 1 Evaluation Procedure

1. A 7.5-minute topographic map was used to find the township and range (i.e., T30, R24) of Rice Creek. Using the information presented in Appendix 3, and the township and range of Rice Creek, it was found to be located in the Upper Mississippi River Drainage Basin and, under the heading of "Streams," was listed as Classes 1C, 2Bd, 3B. According to Minn. R. 7050.0410, listed waters also include Classes 3C, 4A, 4B, 5, and 6. Based on this classification grouping, Rice Creek is protected for the following uses: drinking water (1C); recreational uses of all kinds, including bathing, cool or warm sport or commercial fish and associated aquatic life and their habitats, and drinking water (2Bd); industrial use (3B and 3C); agriculture (4A and 4B); aesthetic enjoyment and navigation (5); and other (6). There was no asterisk in front of the Rice Creek name, so it is not classified as an ORVW. During site characterization, it was determined that there were no known exposure routes other than the uses listed in this paragraph.

2. The MPCA site staff checked with MPCA EAO staff and found that there were no natural background concentrations for cadmium or lead for Rice Creek.

3. Cadmium and lead are hardness-dependent metals. Therefore, values for total hardness in Rice Creek were obtained from Map 9 in Appendix 3.

4. The concentration for total hardness obtained from Map 9 in Appendix 3 was inserted in to the worksheets attached to Spreadsheet Swt102.xls and the resulting standards were inserted into Table 8 (Spreadsheet Swt102.xls).

5. The highest contaminant concentrations for the entire plume were entered in to the "Enter Site Concentration" column and compared to the standard/guideline value or criteria column.

6. There were Tier 1 numbers for all contaminants. Therefore, it was not necessary to consult MPCA EAO staff to determine if additional risk information has become available since rulemaking so that guideline values could be generated.

8.2.2.3 Tier 1 Decision Points

1. If the highest concentrations anywhere in the plume did not exceed or were not expected to exceed the Tier 1 numbers, then no remediation would be needed. For the Rice Creek example, benzene, ethylbenzene, trichloroethene, and lead exceeded the Tier 1 numbers. Consequently, a Tier 2 analysis is needed.

2. There were no conditions that would have required the user to proceed to a Tier 3 analysis (See Section 7.3).

8.2.3 Tier 2 Site Evaluation

8.2.3.1 Minimal Data Needs

Additional work needed to be performed and data obtained to complete a Tier 2 site evaluation. The work and its results are summarized below.

1. Additional wells were installed and borings logged in the water table aquifer at the locations of highest contaminant concentrations defined by the temporary well installation, sampling and sealing work. As the plume extended to Rice Creek, wells were installed throughout the plume and just up gradient of discharge to Rice Creek. Some of these wells include the wells shown on Figure 2 in Section 7.2.2.1. Two wells were installed just up gradient of Rice Creek to define the width of the plume. Also, at least one well nest was installed just up gradient of Rice Creek. The shallow well in the nest was screened at the water table from 14 to 19 feet depth below ground surface. The deeper well was screened from 20 to 25 feet below the water table where the plume was at its maximum concentration with depth. The deepest well was screened 30 to 35 feet below the water table and no detection of contaminants were found at this depth. The vertical gradient was determined to be upward towards Rice Creek. Based on borings, the thickness of the sand bed that contains the water table aquifer is 50 feet.

2. A monitoring and water level measurement program was implemented. Sufficient data was collected over time to determine that the plume was stable, so higher concentrations were no longer migrating further downgradient. The basis for deciding if a plume is stable is presented in the *Ground Water Guidance Document* for Superfund, RCRA, and VIC sites. For Petroleum Remediation sites, use Guidance Document 1-01, titled *Petroleum Remediation Program General Policy*, and 4-01, titled *Soil and Ground Water Assessments Performed During Site Investigations*. No contamination was detected in the confined aquifer. The ground water flow direction in the confined aquifer was defined to be to the southwest.

3. A pumping test was conducted using a monitoring well screened in the most contaminated part of the water table aquifer and within a two year travel time of Rice Creek. The hydraulic conductivity was determined to be 100 gal/day/ft^2.

4. The discharge to the surface water body from the plume is calculated as:

   $Q = [H * W * K * (dh/dl)]$ (Equation 6)

   $Q = [(30 \text{ feet}) * (50 \text{ feet}) * (100 \text{ gal/day/ft}^2) * (0.007 \text{ ft/ft})]$

   $Q = 1050 \text{ gal/day} = 0.73 \text{ gal/min.} = 0.00163 \text{ cfs} = 0.046 \text{ liters/sec.}$

   where:

   Q = discharge in gal/day (divide numerator by 1440 min/day to convert units to gal./min.);

   h = plume thickness in feet;

   w = plume width in feet;

   k = the hydraulic conductivity in gal/day/ft ^{2};

   dh/dl = the hydraulic gradient in ft/ft;

   * = multiplication sign; and

   gal/min. = gallons per minute (One cubic foot = 7.481 gallons) (1 liter = 0.03532 cubic feet).

This information is only needed for Tiers 2 and 3 evaluations for discharge to a river or stream.

8.2.3.2 Tier 2 Evaluation Procedure

The Tier 2 evaluation procedure, for streams and rivers, involves several additional steps beyond the Tier 1 procedure and some modifications of Steps 3, 4, 5, and 6 in Section 8.2.2.2 for the Tier 1 procedure. All Tier 2 steps are listed below.

1. A 7.5 minute topographic map was used to find the township and range (i.e., T30N, R23W, Section 4) of Rice Creek. Using the information presented in Appendix 3 and the township and range of the potential discharge area to Rice Creek, Rice Creek was found to be located in the Upper Mississippi River Drainage Basin and, under the heading of "Streams," was listed as Classes 1C, 2Bd, 3B. According to Minn. R. 7050.0410, listed waters also include Classes 3C, 4A, 4B, 5, and 6. Based on this classification grouping, Rice Creek is protected for the following uses: drinking water (1C); recreational uses of all kinds, including bathing, cool or warm sport or commercial fish and associated aquatic life and their habitats, and drinking water (2Bd); industrial use (3B and 3C); agriculture (4A and 4B); aesthetic enjoyment and navigation (5); and other (6). There was no asterisk in front of the Rice Creek name, so it is not classified as an ORVW. During site characterization, it was determined that there were no known exposure routes other than the uses listed in this paragraph.

2. The MPCA site staff checked with the MPCA EAO staff for the information listed below by filling out the form in Appendix 1. The information discussed under Sections 8.2.1 and 8.2.2.1 was included as part of form in Appendix 1. This information included the discharge rate for the plume to Rice Creek, as calculated in Equation 6 of Section 8.2.3.1.

   The requested information and the responses from the MPCA EAO staff are:

   a. Any natural background concentrations for cadmium or lead for Rice Creek. There were none. For organics, assume that the natural background concentrations are 0.0 ug/L;

   b. Cadmium and lead are hardness-dependent metals. A value for total hardness in Rice Creek was requested from the MPCA EAO staff. The total hardness value is 155 mg/L.

   c. The 7Q10 for Rice Creek is 1.03 cfs (1 liter = 0.03532 cubic feet) or 29.16 liters/sec.

3. A quick check was made of Table 10 (Spreadsheet Swt2bd02.xls) to ensure that all plume contaminants and their degradation products had standards and to determine whether the contaminants are carcinogens or bioaccumulatives. Checking to see if the contaminants are carcinogens or bioaccumulatives only needs to be performed when the MS or FAV will be used. Because the MS is the Class 2 standard used for streams and rivers with multiple contaminants and a 7Q10 greater than 0.0 cfs, the check needs to be performed.

4. Based on the information in Table 10 (Spreadsheet Swt2bd02.xls), all contaminants had standards. Contaminants that are carcinogens or are highly bioaccumulative have an asterisk next to their maximum standard number and their final acute value number (See Class 2 standards in Table 9). Carcinogens are distinguished from highly bioaccumulatives by the "(C)" after the name of the contaminant. Some contaminants, such as PCBs, can be both carcinogenic and bioaccumulative.

5. None of the contaminants of concern are highly bioaccumulative. However, benzene and trichloroethene are carcinogens. The MSs for benzene and trichloroethene need to be adjusted to be 100 times the CSs. The MS is adjusted from 4487 to 1100 ug/L for benzene. For trichloroethene, the MS changes from 6988 ug/L to 2500 ug/L. Replace these two values in Table 10 (Spreadsheet Swt2bd02.xls) for this example. Modification of the FAV to 200 times the CS is not discussed as there are multiple contaminants and the FAV is only applied in cases of a single contaminant being present.

6. For cadmium and lead, the concentration for total hardness is inserted in to the worksheets attached to Spreadsheet Swt2bd02.xls and the resulting standards are inserted into Table 10 (Spreadsheet Swt2bd02.xls) for Class 2.

7. The maximum plume concentration for each contaminant, as measured in the wells and temporary wells just up gradient to surface water discharge of the plume or with the potential to discharge to Rice Creek, is entered in to the "Enter Site Concentration" column.

8. Compare the most restrictive standard of all classes for each pollutant to concentrations in the column, "Enter Site Concentrations."

9. For streams and rivers, a mixing zone is allowed. Use the mass balance Equation 7 below to determine if the most restrictive standard for each contaminant (Use the CS for Class 2) will be exceeded down stream after mixing. The following example is for benzene. The same Equation 7 would be used for other contaminants that exceed the CS at the monitoring wells just up gradient of the discharge location.

   BENZENE EXAMPLE:

   [(Pc * Pf) + (Rc * Rf)]/[Pf + Rf] = Downstream Concentration (Equation 7)

   where:

   Pc = Plume Concentration. For Rice Creek for benzene, the maximum plume concentration in the monitoring wells just up gradient of surface water discharge is 5000 ug/L; No higher concentrations are expected to migrate this far;

   * = Multiplication sign;

   Pf = Plume discharge. As noted in Section 8.2.3.1, is 0.00163 cfs or 0.046 liters/sec;

   Rc = Natural river background concentration. As noted in Section 8.2.3.2 above, it is 0.0 ug/L for all four contaminants; and

   Rf = low flow 7Q10 of the river or stream. As noted in Section 8.2.3.2 above, it is 1.03 cfs or 29.16 liters/sec.

   For Rice Creek, the downstream concentration is [(5000 ug/L)(0.046 liters/sec.) + (0 ug/L)(29.16 liters/sec.)]/[(0.046 liters/sec.) + (29.16 liters/sec.)] = 230/29.206 = 7.875 ug/L.

10. For benzene, the lowest applicable standard in Table 10 (Spreadsheet Swt2bd02.xls) is the Class 1 standard of 5 ug/L.

8.2.3.3 Tier 2 Decision Points

If the most restrictive standard is a Class 2 standard and it is not exceeded down stream, then apply the MS at the monitoring wells just up gradient to surface water discharge of the ground water plume.

If the Class 2 CS is exceeded downstream, the mass balance equation can be re-arranged to determine the concentration a pollutant has to be reduced to at the wells just up gradient of ground water discharge to the surface water body. The concentrations at these locations need to be reduced in order to meet the CS downstream (see benzene example for the equation used). If the well concentration number from the re-arranged mass balance equation is larger than the MS, then remedial actions need to be evaluated so that the surface water quality rule objectives listed in Section 3.0 are complied with. For the Rice Creek example, remediation would be needed as the downstream concentration of benzene at 7.9 ug/L exceeds the lowest applicable standard of 5 ug/L.

The FAV for a pollutant is not used as the Class 2 standard in the place of the MS most of the time for ground water discharges. The only time the FAV can possibly be used for ground water discharge is when there is only one pollutant in the plume. The use of the FAV needs prior approval by the MPCA EAO and site staff.

If the most restrictive standard is a Class 1, 3, 4, 5, or 6 standard, use the mass balance equation to see if this standard is met downstream. Regardless of whether or not the standard is exceeded, re-arrange the mass balance equation to determine how high the concentrations can be at the wells just up gradient to ground water discharge of the plume to a stream or river. Compare the well concentrations determined from the re-arranged mass balance calculation to the Class 2 MS. Use the lower of the two numbers at the wells. If there is no Class 2 MS to compare, contact MPCA EAO staff through the MPCA site staff.

For instance, if the most restrictive standard (i.e., 5 ug/L) is exceeded downstream as it is for benzene in this example, then remedial actions need to be evaluated. The Mass Balance Equation needs to be re-arranged and re-calculated to determine the standard that needs to be applied at the wells just up gradient of plume discharge to the surface water body. The wells just up gradient of plume discharge to the surface water body can not exceed the 5.0 ug/L benzene standard downstream.

The Re-arranged Mass Balance Equation is:

(Concentration that must be achieved = [MRS * (Pf + Rf) - (Rc * Rf)]/Pf
(Equation 8)

at the monitoring wells located just up gradient of plume discharge to a stream or river,

where:

MRS = Most restrictive standard. For benzene, it is 5 ug/L (Class 1);

* = Multiply by;

Pf = Plume flow. As noted above, it is 0.046 liters/sec.;

Rf = River flow (low flow 7Q10). As noted above, it is 29.16 liters/sec.; and

Rc = Natural background river concentration. This value is 0.0 ug/L.

The concentration for benzene is:

[5 ug/L * (0.046 liters/sec. + 29.16 liters/sec.) - (0.0 ug/L)(29.16 liters/sec.)]/0.046 liters/sec. = 3,175 ug/L.

As the calculated concentration of 3,175 ug/L exceeds the adjusted Class 2 MS of 1100 ug/L for carcinogens, the well concentration just prior to discharge needs to be lowered to the Class 2 MS. Therefore, the standard that is applied to the wells just up gradient of discharge to Rice Creek for benzene is 1100 ug/L.

All conditions for the use of a Tier 2 analysis were present. As stated in Section 8.2.2.3, there were no uses that would have required the user to proceed to a Tier 3 analysis.

8.3 Example 3: Rum River

8.3.1 Background Site Characterization Information

Site Z is a VIC site with a known release of trichloroethene. The site was characterized and was found to only have impacted the water table aquifer. The sand, that contains the water table aquifer, is approximately 40 feet thick. It overlies a 30 foot thick silty clay aquitard and contamination of the confined sand aquifer underlying the aquitard was not detected based on a number of sampling events of monitoring wells screened in the downgradient direction for the confined aquifer. The ground water flow direction in the water table aquifer is to the east, while the ground water flow direction in the confined aquifer is to the northwest.

The water table in the surficial aquifer is located approximately 10 to 15 feet below the ground surface. Ground water in the surficial aquifer is found to discharge to the Rum River and there is an upward gradient between wells screened at the water table in this aquifer and wells screened in the middle, most-contaminated zone in this aquifer.

The contaminant plume is shown generically on Figure 2 in Section 7.2.2.1. The width (w) of the plume is 50 feet. The plume thickness (H) is 30 feet. The hydraulic gradient is 0.007 ft/ft and is an upward gradient. The hydraulic conductivity was defined as 100 gallons/day/ft^2 by a pump test using one of the monitoring wells in the most contaminated portion of the aquifer.

8.3.2 Tier 1 Site Evaluation

8.3.2.1 Minimal Data Needs

1. Based on site characterization work, the water table aquifer was found to be the only aquifer contaminated and the ground water flow direction was found to be to the east towards the Rum River.

2. Wells were installed at the most contaminated depths throughout the plume. One well nest was installed just prior to discharge to Rum River in the most contaminated part of the plume, as shown on the generic example in Figure 2. The well was located in a well nest with a water table well screened in the water table aquifer. Water levels from the two wells confirmed an upward gradient and discharge to the Rum River. In addition, two wells were located on the edges of the plume just prior to discharge to the Rum River and were screened in the plume at the most contaminated depth. As shown in the generic example on Figure 2 in Section 7.2.2.1, these two wells define the width of the plume.

3. A complete list of contaminants that comprise the plume was obtained during site characterization by comprehensive sampling during site characterization.

4. There was no direct discharge, such as runoff or spills to the Rum River from the site.

8.3.2.2 Tier 1 Evaluation Procedure

A 7.5 minute topographic map was used to find the township and range (i.e., T36N, R26W, Sections 33 and 34) of the discharge location for the Rum River. Using the information presented in Appendix 3 and the township and range of the discharge location for the Rum River, the River was found to be located in the Upper Mississippi River Drainage Basin. Under the heading of "Streams," there was an asterisk in front of the Rum River name, so it is classified as an ORVW, that is a Tier 3 evaluation.

8.3.2.3 Tier 1 Decision Point

The evaluation would proceed under Tier 3. At this point, use the form provided in Appendix 1 as a basis for contacting the MPCA site staff and the MPCA EAO staff. General information on ORVWs is provided in Appendix 5.

9.0 PROCEDURE TO CONSULT MPCA EAO STAFF

The assessment form and this guidance can be used by all MPCA staff to evaluate the environmental risks to surface waters near the contamination site themselves, or it can be used to request help with the assessment from Water Standards Unit staff.

The primary information needed for staff to complete the assessment themselves is listed below:

1. Classification of the impacted or threatened surface waters from Minn. R. 7050.0400 through 7050.0470. If the water is not listed in Minn. R. 7050.0470, it is classified 2B, 3B, 4A, 4B, and 5.

2. Numerical water quality standards for the appropriate use class from Minn. R. 7050.0220. Standards for Class 2 waters will control the need for treatment or remediation in most instances. Most class 2 standards for toxics have three parts: chronic standard (CS), maximum standard (MS) and final acute value (FAV).

3. Concentrations of pollutants in the ground water as measured in the well(s) in the plume prior to surface water discharge.

4. Allowable dilution. If the water of concern is a river or stream, dilution of the plume may be allowed at the specified low flow ($7Q_{10}$).

    a. Large rivers usually provide ample dilution for ground water plumes or seeps. Plume quality may be compared to MSs or, in some cases, to FAVs.
    b. No dilution is allowed for plumes threatening low-flow streams, lakes or most wetlands. Plume quality is compared to CSs.
    c. Allowable concentrations in plumes threatening small streams can be determined through a mass balance calculation or simple dilution ratio calculation. These situations should be submitted to MPCA EAO staff for assessment.

5. Actual or predicted exceedance of the appropriate standard in the plume and/or the receiving water is an indication of unacceptable impacts on the surface waters. Treatment or remedial action is probably needed.

REQUESTING REVIEW BY MPCA EAO STAFF

If staff have questions, are unsure of provisions in Minn. R. ch. 7050, or in the situations listed below, the form should be forwarded to the head of the Water Standards Unit, Water Assessment and Environmental Information Section, Environmental Analysis and Outcomes Division.

1. Review by MPCA EAO staff is needed if:

    a. The threatened surface water in an Outstanding Resource Value Water as listed in Minn. R. pt. 7050.0180;
    b. a $7Q_{10}$ must be calculated;
    c. background water quality data are needed, or total hardness is needed for hardness dependent metal standards;
    d. criteria are needed for pollutants for which standards are not available;
    e. multiple toxics are present in the plume or seep at acutely toxic levels (exceed FAVs);
    f. highly bioaccumulative pollutants such as mercury or PCBs are involved; and
    g. the situation may become controversial, or there are complicating factors.

The person initiating the assessment should complete Parts A (except date received). The requester should complete Part C unless this information is tabulated separately and attached to the form. Also, the name of the receiving water in Part B should be provided by the requester.

The remainder of Part B and all of Part D can be completed by the person initiating the assessment if MPCA EAO staff help is <u>not</u> needed, otherwise MPCA EAO staff will complete these parts when the form is sent to the MPCA EAO staff.

Any pertinent information such as monitoring results, maps showing well locations with respect to the surface water, contamination source, ground water flow direction, etc. should be attached to the form when submitted to the MPCA EAO staff.

Assessment requests will be completed within <u>three weeks</u> of receipt, or the requester will be contacted. If the assessment is needed sooner than three weeks, the requester should indicate this on the form or contact the MPCA EAO staff directly. The completed original form will be returned to the requester, a copy will be filed in the MPCA EAO Division. If staff completes the form without EAO involvement, please forward a copy of the form to EAO (Supervisor of the Water Standards Unit, Water Assessment and Environmental Information Section) for our files.

Revised 3/29/96

DEFINITIONS

CHRONIC STANDARD (CS)	The highest concentration of a toxic pollutant to which organisms can be exposed without causing chronic toxicity. For chronic toxicity to occur, the exposure must occur over a long period of time, often one-tenth the life span or more. Chronic toxicity effects can include: mortality; reduced growth; reproduction impairment; harmful changes in behavior; and other nonlethal effects.
MAXIMUM STANDARD (MS)	The highest concentration of a toxic pollutant in water to which aquatic organisms can be exposed for a brief time with zero to slight mortality. The MS equals the final acute value divided by two.
FINAL ACUTE VALUE (FAV)	The acute toxicity limitation that is protective of organisms from acute toxicity (mortality) at the point of discharge to a river or stream. Acute toxicity means an exposure severe enough to cause a rapid response, generally less than 96 hours. The FAV is defined in Minn. R. 7050.0218, subp. 3., item O as an estimate of the concentration of a pollutant defined as corresponding to the cumulative probability of 0.05 in the distribution of all the acute toxicity values for the genera or species from the acceptable acute tests conducted on a pollutant.
ACUTE TOXICITY	A stimulus severe enough to rapidly induce a response. In toxicity tests, a response is normally observed in 96 hours or less. Acute effects are often observed in terms of mortality or other debilitating effects (Minn. R. 7050.0218, subp. 3., item B).
BIOACCUMULATION FACTOR	The concentration of a pollutant in one or more tissues of an aquatic organism, exposed from any source of the pollutant but primarily from the diet and bottom sediments in addition to the water column, divided by the average concentration in the solution in which the organism had been living (Minn. R. 7050.0218, subp.3., item D).
BIOCONCENTRATION FACTOR	The concentration of a pollutant in one or more tissues of an aquatic organism, exposed only to the water as the source of the pollutant, divided by the average concentration in the solution in which the organism had been living (Minn. R. 7050.0218, subp. 3., item E).
ORVW	Outstanding Resource Value Water. "Exceptional recreational, cultural, aesthetic or scientific resources" (Minn. R. 7050.0180, subp. 1) where water quality shall be maintained at existing conditions when the quality is better than the water quality standards. There are restricted ("R") and prohibited ("P") types. A surface water is an ORVW if its classification under Minn. R. 7050.0470 includes an asterisk before the name of the water body followed by a date and a [R] or [P]. The date is the date of designation of the ORVW.

DEFINITIONS (Continued)

OIRW	Outstanding International Resource Waters of exceptional quality. Refers to waters in the Lake Superior Basin that are not ORVW prohibited or restricted waters. Refer to Minn. R. ch. 7052.
COPCs	Contaminants of Potential Concern
CERCLA	Comprehensive Environmental Response Compensation and Liability Act; 42 U.S.C. 9601 *et. Seq.* – the Federal Superfund Law
MERLA	Minnesota Environmental Response and Liability Act, Minn. Stats. §§ 115B.01 – 0.241 – the State Superfund Law
GLI	Great Lakes Initiative. Water bodies that are part of the Lake Superior Basin
TROUT WATERS	All trout waters are classified as Classes 1B, 2A, 3B, 3C, 4A, 4B, 5 and 6. Refer to the Classifications in Appendix 3 (Minn. R. 6264.0500, subps. 2 and 4 and Minn. R. 7050.0470) for a list of trout waters.
7Q10	A term used to define the minimum stream flow as "at least 90 percent of the seven consecutive daily average flows of record (i.e., the lowest weekly flow within a once in ten year recurrence interval) for the critical month(s)" (Minn. R. 7050.0210, subp. 7).
MIXING ZONE	A term used for streams and rivers. Mixing zones provide a practicable means for expediting mixing and dispersion of contaminants in the receiving waters provided the receiving waters is maintained in accordance with applicable standards. There are several rules for allowing mixing zones and mixing zones are established by the MPCA staff on a case by case basis. The Most Restrictive Standard for a contaminant must be met downstream after mixing.
NONDEGRADATION	Maintaining water quality at its existing condition.
NONPOINT SOURCE	A land management or land use activity that contributes or may contribute to ground and surface water pollution as a result of runoff, seepage, or percolation and that is not defined as a point source under Minn. Stat. § 115.01, subd. 11, (Minn. R. 7050.0130, subp. C).
SURFACE WATERS	Waters of the state excluding ground water as defined in Minn. Stat. § 115.01, subd. 6, (Minn. R. 7050.0130, subp. E).

DEFINITIONS (Continued)

WETLANDS	Those areas that are inundated or saturated by surface water or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. Constructed wetlands designed for wastewater treatment are not waters of the state. Wetlands must have the following attributes: (1) a predominance of hydric soils; (2)inundated or saturated by surface water or ground water at a frequency and duration sufficient to support a prevalence of hydrophytic vegetation typically adapted for life in a saturated soil condition; and (3) under normal circumstances support a prevalence of such vegetation (Minn. R. 7050.0130, subp. F).
NOAEL	No observed adverse effect level. The highest concentrations that did not cause a statistically significant occurrence of an adverse effect in comparison with a control when no lower test concentration caused an injurious or adverse effect (Minn. R. 7050.0218, subp. 3.W).
K_{ow}	Octanol to water partition coefficient is the ratio of the concentration of a substance in the octanol phase to its concentration in the aqueous phase of a two-phase octanol to water system after equalibrium of the substance between the two phases has been achieved (Minn. R. 7050.0218, subp. 3.X).
STANDARD	A number or numbers established for a pollutant or water quality characteristic to protect a specified beneficial use as listed in Minn. R. 7050.0221 to 7050.0227. The standard for a toxic pollutant includes the CS, MS, and FAV. Some pollutants do not have a MS or a FAV due to insufficient data. For these pollutants, use the CS (Minn. R. 7050.0218, subp. 3.CC).
PETROLEUM REMEDIATION	The MPCA program is administered under Minn. Stat. ch. 115C (Petroleum Tank Release Cleanup).
EAO	Environmental Analysis and Outcomes. One of the MPCA Divisions.
MCLs	Maximum Contaminant Levels set by the U.S. Environmental Protection Agency
NPDES/SDS	National Pollution Discharge Elimination System/State Disposal System are types of federal and state point source discharge permits.
CHRONIC TOXICITY	A stimulus that lingers or continues for a long period of time, often one-tenth the life span or more. A chronic effect can be mortality, reduced growth, reproduction impairment, harmful changes in behavior, and other nonlethal effects (Minn. R. 7050.0218, subp. 3., item G).

DEFINITIONS (Continued)

MDD	Minnesota Decision Document. Used in State Superfund to document the remedy cleanup criteria and standards and other pertinent information for cleanup of a site.
ROD	Record of Decision. The federal equivalent of a MDD.
Cfs	Cubic feet per second.
AST	Above Ground Storage Tank. Their investigation and remediation is part of the Petroleum Remediation Program.
RCRA	Resource Conservation and Recovery Act
MPCA	Minnesota Pollution Control Agency
TEMPORARY MONITORING WELL	A well that is abandoned immediately after ground water sampling, typically within 48 hours of drilling and installation
UST	Underground Storage Tank. Their investigation and remediation is part of the Petroleum Remediation Program.
VOCS	Volatile Organic Compounds

REFERENCES

References include the following.

1. Emerson, K.; R.C. Russo; R.E. Lund; and R.V. Thurston, 1975. Aqueous ammonia equilibrium calculations; effect of pH and temperature. Journal of the Fisheries Board of Canada 32: 2379-2383.

2. Minnesota Pollution Control Agency, Division of Water Quality, 1988. Policy Manual.

3. Minnesota Pollution Control Agency, 1988. Guidance Manual for Applying Nondegradation Requirements on Outstanding Resource Value Waters in Minnesota, Division of Water Quality, Program Development Section, September, 6 pages.

4. Minnesota Pollution Control Agency, 1990. Application of Surface Water Standards to Nonpoint Sources of Pollutants, February 28, 1990.

5. Minnesota Pollution Control Agency, 1996. Guidance for Completing or Requesting Surface Water Toxics Impact Assessment, March 29, 1996.

6. Minnesota Pollution Control Agency, Minn. Rules ch. 7037.

7. Minnesota Pollution Control Agency, Minn. Rules ch. 7050 (2000 and 2003) (Waters of the State) and associated Statement of Need and Reasonableness (1990).

8. Minnesota Pollution Control Agency, Minn. Rules ch. 7052 (International Waters).

9. Minnesota Pollution Control Agency, Minn. Rules ch. 7056 (Mississippi River and Tributaries).

10. Minnesota Pollution Control Agency, Guidance Documents for Underground Storage Tank (UST) and Aboveground Storage Tank (AST) Release Cleanup, April 2005.

11. Minnesota Pollution Control Agency, Minn. R. ch. 7060 (Underground Waters).

12. Minnesota Pollution Control Agency, Risk-Based Site Evaluation Guidance for Comprehensive Environmental Response Compensation and Liability Act (CERCLA) and MERLA Sites in the Risk-*Based Site Evaluation Manual* at the website, http://www.pca.state.mn.us/cleanup/riskbasedoc.html .

13. State of Minnesota, Minn. Stat. ch. 103A;

14. State of Minnesota, Minn. Stat. ch. 115 (Water Pollution Control Act);

15. State of Minnesota, Minn. Stat. § 115B.01 - .241 (Minnesota Environmental Response and Liability Act (MERLA));

16. State of Minnesota, Minn. Stat. ch. 115C (Petroleum Tank Release Cleanup);

17. State of Minnesota, Minn. Stat. ch. 116;

REFERENCES (Continued)

18. Suter, G.W. II, and C.L. Tsao, 1996. Toxicological Benchmarks for Screening of Potential Contaminants of Concern for Effects on Aquatic Biota on Oak Ridge Reservation: 1996 Revision. Oak Ridge National Laboratory, Health Sciences Research Division, Oak Ridge, TN. 104 pp, ES/ER/TM-96/R2.

19. United States Congress, Clean Water Act: 33 U.S.C. 1251 et. it.

20. United States Congress, Safe Drinking Water Act: 42 U.S.C. 300f to 300j-26;

21. United States Congress, Comprehensive Evaluation Response Compensation and Liability Act (CERCLA): 42 U.S.C. 9601 et it. seq.;

22. United States Environmental Protection Agency, 1986. Quality criteria for water. EPA 440/5-86-001 (for EPA LOELS and AWQC).

23. United States Environmental Protection Agency, Office of Water, March 1995. Great Lakes Water Quality Initiative Criteria Documents for the Protection of Wildlife: DDT; Mercury; 2,3,7,8-TCDD; PCBs. EPA-820/B-95-008.

24. United States Environmental Protection Agency, 1995. Great Lakes Quality Initiative criteria document for the protection of wildlife. EPA-820-B-95-008.

25. United States Environmental Protection Agency, 1996. Ecotox thresholds. ECO Update 3(2). EPA 540/F-95/038. OSWER. (Source for biphenyl (92524), tetrachloromethane (56235), and tribromomethane (75252) Tier 2 Secondary Chronic Values).

26. United States Environmental Protection Agency, National Primary and Secondary Drinking Water Regulations: (40 C.F.R. pts. 141-143);

27. United States Environmental Protection Agency, National Contingency Plan (NCP): 40 C.F.R. pt. 300;

28. Van den Berg, et.al., Toxic Equivalency Factors (TEFs) for PCBs, PCDDs, PCDFs for Humans and Wildlife. Env. Health Perspect. 106(12) 775-792, 1998.

Tab le 7. WEB PAGES AND TELEPHONE NUMBERS

WEB PAGES AND TELEPHONE NUMBERS

MPCA staff	http://www.pca.state.mn.us/pca/staff/index.cfm
MPCA toll free	1-800-657-3864 (Out state only)
MPCA Petroleum Remediation Program	http://www.pca.state.mn.us/cleanup/pubs/lustpubs.html
MPCA Info Request	http://www.pca.state.mn.us/about/inforequest.html
MPCA VIC program	http://www.pca.state.mn.us/cleanup/vic.html
MPCA Petroleum Brownfields Program	http://www.pca.state.mn.us/programs/vpic_p.html
MPCA SRS guidance documents	http://www.pca.state.mn.us/cleanup/riskbasedoc.html
Quality Assurance Information	http://www.pca.state.mn.us/programs/qa_p.html
NPDES/SDS Permit Application	http://www.pca.state.mn.us/water/permits/index.html#permits
Minnesota Rules	http://www.revisor.leg.state.mn.us.html
MDH HRLs	http://www.health.state.mn.us/divs/eh/groundwater/hrltable.html
MDH DW hotline	1-800-818-9318
State Duty Officer	**651-649-5451 or 1-800-422-0798**