Montana Water Quality 1998

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ACRONYMS AND ABBREVIATIONS

3As	Temporary pollution authorizations; short for 17.30.637(3)(a) (Administrative Rules of Montana), that allows for construction and other activities that may elevate turbidity in water for a short time. Such activities may also require permits from DEQ and the U.S. Army Corps of Engineers.
ACOE	U.S. Army Corps of Engineers
BLM	Bureau of Land Management, U.S. Department of the Interior.
BMP	Best Management Practices; actions or conditions required or recommended by governmental agencies to minimize environmental impacts. Also known as Water Quality Protection Practices.
CD	Conservation Districts; each district is a political subdivision of the state, administered by elected, unpaid supervisors. CD boundaries usually coincide with county lines. District personnel work to support sound agricultural practices at the county level.
CECRA	Comprehensive Environmental Cleanup and Responsibility Act; a state program comparable to CERCLA at the federal level.
CERCLA	Comprehensive Environmental Response, Compensation, and Cleanup Act, also called Superfund; a national program to clean up contaminated areas.
DEQ	Montana Department of Environmental Quality
DFWP	Montana Department of Fish, Wildlife and Parks
DNRC	Montana Department of Natural Resources and Conservation; predecessor agency to DEQ.
DO	Dissolved oxygen, in water.
DQO	Data quality objectives; quality control elements of a water quality monitoring or study plan, to ensure that the data collected will be sufficient to fulfill the needs of the plan.
EPA	U.S. Environmental Protection Agency.
EQC	Montana Environmental Quality Council, a legislative office.
FBC	Flathead Basin Commission; A board appointed by the governor, with representation from agencies of local, state, and federal government, Canada, and

citizens, to protect the water quality of Flathead Lake.

FERC Federal Energy Regulatory Commission.

GID Greenfields Irrigation District; a major source of nonpoint pollution in Muddy Creek, between Choteau and Great Falls.

GMP General State Agricultural Chemical Groundwater Management Plan; includes the program elements required by MACGWPA.

GWAP Montana Groundwater Assessment Program; a legislatively mandated program to determine the quality of Montana□s groundwater.

GWIC Groundwater Information Center; in which MBMG stores all well information collected under GWAP, including residential well logs and MBMG water quality analysis data

HGMA Hydrogeomorphic Functional Assessment; a method for assessing wetlands on the basis of their position in the landscape, the dominant source of water, and flow and fluctuation of the water.

IBI Index of biotic integrity; a method of evaluating wetlands on the basis of their biological health.

IJC International Joint Commission; a group representing interests of the U.S. and Canada in regard to cross-border issues.

ITFM Intergovernmental Task Force on Monitoring Water Quality.

MACGWPA Montana Agricultural Chemical Groundwater Protection Act; a law to protect groundwater from contamination by agricultural chemicals; also requires that standards be set for certain pesticides.

MBMG Montana Bureau of Mines and Geology.

MCL Maximum concentration level; the maximum concentration of a pollutant in drinking water that EPA has found to be safe for human consumption.

TCPA A phenoxy herbicide for control of broadleaf weeds.

MDA Montana Department of Agriculture.

MDT Montana Department of Transportation.

MGWP Montana Groundwater Plan as formulated by the Montana Department of Natural Resources and Conservation; part of the Montana Water Plan.

MWCC	Montana Watershed Coordination Council; an information and support network with representatives from government, business, the university system, environmental groups, and water users; to encourage voluntary local watershed work.
NPS	Nonpoint source pollution; (see nonpoint sources).
NRCS	Natural Resources Conservation Service (formerly Soil Conservation Service); a federal agency that develops and approves agricultural conservation standards.
NWI	National Wetland Inventory; an effort by USFWS to map and classify all U.S. wetlands.
PCB	Polychlorinated bi-phenyl; a toxic substance previously used in electrical transformers and other electric equipment--a long-lasting pollutant when released into the environment.
PFC	Proper Functioning Condition; used in assessing the health of a wetland by comparing the wetland's measured physical functioning to its potential.
PWS	Public water system; generally any water system that provides potable water to 25 or more persons per day, such as for a city, town, subdivision, rural restaurant, business or industrial facility.
RAMS	A permit database maintained by the U.S. Army Corps of Engineers.
RDGP	State Reclamation and Development Grant Program.
RF3	A national database containing the location of streams and lakes; it is based on USGS 1:100,000 maps.
STORET	An EPA-supported national water quality database.
TMDL	Total Maximum Daily Load: The amount of a given pollutant that a waterbody can contain and still meet legal standards and support its designated uses. The legislatively mandated TMDL process determines the concentration of pollutants in waterbodies and stipulates controls needed to improve water quality in order to support designated uses.
USFS	United States Forest Service.
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VNRP	Voluntary Nutrient Reduction Plan (Clark Fork of the Columbia); a coordinated effort to reduce excessive nutrients in the upper and middle reaches of the Clark

Fork.

WBS Montana Waterbody System, a database containing assessments of water quality.

WQB-7 A circular published by the Montana Water Quality Bureau, listing Montana water quality standards.

WWTP Wastewater treatment plant: in most cases a municipal sewage treatment facility.

401 Certifications Required under section 401 of the Clean Water Act, attesting that actions to be taken under a federal permit will not violate state water quality standards.

404 Permits Permits required in Section 404 of the Clean Water Act, to be obtained from ACOE when dredged or fill material is to be placed in Waters of the U.S., including wetlands.

GLOSSARY

Anthropogenic impacts Impacts caused by humans.

Designated Beneficial Use The uses which can be supported by the water quality in a given water body, as stipulated by the federal Clean Water Act.

Diatoms One-celled plants living on rocks in streams and lakes, commonly assessed as indicators of water quality.

Ecological taxa Classification or hierarchy of organisms; can be used to describe wetland ecology.

Fixed station monitoring Monitoring of water quality in a lake or stream through monthly or quarterly water sampling at a specific location.

Hydrogeomorphology The science relating to the geographical, geological, and hydrological aspects of waterbodies, and changes to these in response to flow variations and to natural and human-caused events, such as heavy rainfall or channel straightening.

Hypolimnetic oxygen deficits A reduction in dissolved oxygen in the depths of a lake (hypolimnion) as a result of pollution.

Intensive Surveys Systematic collection of data on water chemistry, biology, physical and streamside habitat over a one or two-day period, usually on the full length of a stream from headwaters to mouth.

Montana Riparian and Wetland Association A science-based cooperative comprising agencies and private organizations throughout Montana, formed in 1986 and housed in the University of Montana School of Forestry.

Montana Watercourse A water information center at Montana State University, Bozeman.

Montana Wetlands Trust A non-profit organization designed to promote wetland conservation through education, stewardship, and restoration projects.

Montana Wetlands Council A group representing various interests and promoting cooperative wetland management in Montana.

Nonpoint sources Pollution sources such as feedlots or logging sites where pollution comes from larger, less defined areas.

Pathogens Bacteria or other disease causing agents that may be contained in water.

Periphyton & macroinvertebrate metrics Numeric denotation of water quality, as indicated by aquatic insects and "attached" algae (rather than free-floating).

Point sources Pollution sources such as sewage treatment plants that release contaminants from a well-defined point such as an outfall pipe..

Rootwads Tree stumps with attached roots, used to stabilize eroding banks and provide fish habitat.

Secchi depth Refers to a method of determining water clarity by the depth at which a "Secchi disc," a distinctly marked and colored disc designed for the purpose, can be seen through the water.

Suspended solids Materials such as silt that may be contained in water and do not dissolve.

Flathead Lake Biological Station University of Montana Biological Station on Flathead Lake.

Volunteer Monitoring Water quality monitoring, usually at fixed stations, performed by citizen volunteers who donate their time, expertise and knowledge. Volunteers may receive training and support from DNRC, DEQ, or Montana Watercourse.

Water column chemistry The chemical characteristics of water at different depths, as an indicator of water quality.

Waterbody A lake, reservoir, stream, pond, marsh, or other year-round body of water above ground surface.

Summary

The Montana water quality assessment report (϶305(b) report) has been and continues to be used for making watershed management decisions based on identified sources and causes of pollution. It is the principal source of general water quality information available to the public. The report also fulfills the state's obligation to update the United States Environmental Protection Agency (EPA) on a biennial basis as to the status of the state's water resources.

The results of the ϶305(b) waterbody assessment process are the basis for listing waters in need of Total Maximum Daily Load (TMDL) development (the ϶303(d) list). The information stored in the Montana Waterbody System (WBS) database tracks the use support status of a waterbody before and after TMDL development. Those waterbodies that fully support all uses are also a part of this database. Assessment results collected as part of the statewide monitoring plan will be added to the existing database. The Department of Environmental Quality's (DEQ) long term goal is to have sufficient monitoring and assessment data to identify water quality trends at a watershed scale throughout the state.

Status of Surface Water Quality in Montana

Assessments
The WBS now contains water quality assessments for 897 stream segments (17,874 miles) and 183 lakes (about 800,000 acres).

Non-supporting stream segments in the WBS total 1,365 miles or about 8% of the stream mileage that has been assessed. Streams identified as partially supporting, constitute about 52% of the assessed stream mileage. The portion of the unassessed streams (151,955 miles) and lakes (about 45,000 acres) that are fully supporting their designated uses are unknown.

About 36% of the lake acres in the WBS fully support fish and aquatic life, more than 50% support swimming and 71% support drinking water use.

Sources of Impairment
Agriculture has impaired 62% of the stream miles and 46% of the lake acres that have been assessed.

The majority of stream impairment (90%) and lake impairment (80%) is from nonpoint sources (NPS) of pollution.

Causes of Impairment
Nutrients, siltation, suspended solids, salinity, flow and habitat alterations, and metals are the predominant causes of stream impairment in Montana.

The primary causes of lake impairment are nutrients, water level fluctuations, metals, suspended solids, nuisance algae and organic enrichment.

Surface Water Supplies and Public Health

Approximately 329,000 people in Montana get their drinking water from the 68 public water supplies using surface water.

EPA and the Public Water Supply Section of DEQ, required public water suppliers using surface water to address new surface water treatment requirements by June 29, 1993. EPA and DEQ adopted the requirements in response to the 1986 amendments to the Safe Drinking Water Act. Unfiltered surface water sources must be filtered or meet stringent watershed protection and water quality requirements. Only five cities meet these requirements. The following communities have installed new surface water filtration plants: Pinesdale (in the Bitterroot River drainage), Seeley Lake, Libby, Neihart, and Seville Colony (near Cut Bank).

Total Maximum Daily Load Program

In 1997, the TMDL program at DEQ was strengthened by the passage of amendments to Montana's Water Quality Act that provided increased authority for TMDL development and new funds for monitoring, local planning and technical assistance.

A TMDL is the total maximum daily load of a pollutant a stream can receive from all sources and still meet water quality standards. Standards include water quality criteria for specific water uses, narrative water quality descriptions, and prohibitions against degrading high quality waters. For nonpoint sources, a TMDL is the pollutant reduction goal for a waterbody and an implementation plan. These plans often take the form of a water quality restoration plan or part of a watershed management plan.

The process of using TMDLs to restore water quality involves two major activities: 1) develop a priority list of waterbodies needing TMDLs and 2) develop water quality protection plans and discharge permits to implement the plans. Several bureaus in DEQ carry out these activities.

- The Monitoring and Data Management Bureau assesses water quality, manages the data necessary to design and implement watershed plans, and maintains the э303(d) list.
- The Water Protection Bureau writes permits designed to meet water quality standards.
- The Resource Protection Planning Bureau works with various agencies and local watershed groups, including Conservation Districts (CDs) to develop plans that serve as TMDLs for nonpoint sources.
- The Resources Protection Planning Bureau also provides grant funds and technical assistance as incentives for local nonpoint source project management agencies to develop TMDLs.

Wetlands Activities

Wetlands are "state waters" and therefore are provided the protection associated with lakes and streams. Montana has recently expanded its wetland program to provide better wetland protection and conservation through increased coordination and targeted action.

DEQ has been designated as the lead state agency regarding wetland coordination. The Montana Wetlands Council, with leadership from DEQ, completed a draft Conservation Strategy for Montana's Wetlands in July 1997. State and local governments are implementing priority wetland conservation actions identified in the draft Conservation Strategy.

Assessment of wetlands and work towards improved water quality standards for wetlands continue.

Groundwater Quality

Over 50% of Montanans get their domestic water supply from groundwater sources. The most accessible and highest quality water is from alluvial aquifers and glacial outwash deposits found throughout the state. Both of these types of aquifers are relatively vulnerable to pollution from human activities, but growth and development pose the greatest risk to the alluvial aquifers especially in the west and southwest parts of the state. The challenge for Montana is to protect, sustain, and improve groundwater quality as more people and businesses move into the river valleys and on top of their source of water.

The Department of Natural Resources and Conservation (DNRC) has led a collaborative effort to develop a Montana Groundwater Plan that will become a section of the state water plan. This groundwater plan addresses groundwater protection, education, and remediation strategies. The plan has been through extensive public review in 1998 and has been endorsed by the Environmental Quality Council of the Montana Legislature. It is expected to be adopted in January of 1999 by the Director of DNRC and will be presented to the 1999 Legislature.

Watershed Planning and Nonpoint Source Management

DEQ uses watershed management principles to address nonpoint source pollution in Montana and to meet its other water quality goals. Watershed management addresses water quality problems comprehensively by considering all pollution sources in a drainage basin, integrating water quality solutions with local landowner input, and coordinating with other agencies and DEQ programs, such as those that issue permits to point sources.

Watersheds also provide a framework for the development of TMDL implementation plans. When DEQ works with CDs and local groups on TMDL plans, it identifies local interest and lines of communication, helps decide where funding can best be targeted, and helps establish monitoring strategies to assure that water quality standards are met.

DEQ works closely with the Montana Watershed Coordination Council to coordinate its work on watershed based pollution and to communicate with other agencies on issues affecting local watershed planning. DEQ has also been involved in a new initiative in October 1998 to coordinate at the state level on watershed planning and funding local projects. This initiative is called the Clean Water Action Plan. This initiative is designed to better focus federal programs on achieving state water quality goals.

Atlas of Montana

Montana is the fourth largest state in the Union and remains sparsely populated, averaging only six people per square mile (Table 1). Urban development is primarily concentrated in the West, where recent growth has been rapid. The state's major economic base consists of recreation-tourism, agriculture, forest products and mining.

Montana contains headwater streams for the Clark Fork-Pend Oreille-Columbia, Missouri-Yellowstone-Mississippi and St. Mary-Saskatchewan-Nelson watersheds. For management purposes, the portions of those three basins in Montana have been divided into 16 sub-major basins which were further divided into 85 minor drainage basins (Figure 1 and Table 2).

Seven major ecoregions (regions with a climate, geology and vegetation, distinct from other regions) are represented in Montana (Figure 2,). Natural water quality varies considerably from region to region. Waters of alpine and inter-mountain regions have very low dissolved solids, in contrast to very high concentrations in some of the semi-arid regions.

Table 1 Atlas of Montana	
Population[1]	878,810
Surface Area (sq. miles)	145,556
River Basins	
Continental	3
Major Sub-basins	16
Minor Basins	85
Miles of Streams[2]	
Total	176,750
Perennial	53,221
Intermittent	116,608
Ditches/Canals	6,921
Acres of Lakes, Ponds and Reservoirs[2]	
Total	844,802
Significant Publicly Owned[3]	833,964
Number of Lakes, Ponds and Reservoirs[2]	
Total	10,246
Significant Publicly Owned[3]	7,004
Acres of Wetlands[4]	
Total	838,402

1 1997 estimate.
2 Derived from U.S. EPA Reach File version 3
3 Perennial lakes and reservoirs >= 5 acres.
4 Dahl, T.E. 1990. Wetlands Losses in the United States 1780s to 1980s. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C. 21 pp.

Table 2
Drainage Basins of Montana

COLUMBIA RIVER BASIN

KOOTENAI

76B Yaak River
76C Fisher River
76D Kootenai River

FLATHEAD

76I Middle Fork Flathead River
76J South Fork Flathead River
76K Swan River
76LJ Flathead River to and including Flathead Lake

UPPER CLARK FORK

76E Rock Creek tributary of Clark Fork River
76F Blackfoot River
76G Clark Fork above Blackfoot River
76GJ Flint Creek
76H Bitterroot River

LOWER CLARK FORK

76L Flathead River below Flathead Lake
76M Clark Fork between Blackfoot River and Flathead River
76N Clark Fork below Flathead River

MISSOURI RIVER BASIN

UPPER MISSOURI TRIBUTARIES

41A Red Rock River
41B Beaverhead River
41C Ruby River
41D Big Hole River
41E Boulder River tributary of Jefferson River
41F Madison River
41G Jefferson River
41H Gallatin River

MISSOURI-SUN-SMITH

41I Missouri River and tributaries above Little Prickly Pear Creek
41J Smith River
41K Sun River
41QJ Missouri River and tributaries between Little Prickly Pear Creek and the Sun River
41Q Missouri River and tributaries between the Sun River and Marias River
41U Dearborn River

MARIAS

41L Cut Bank River
41M Two Medicine River
41N Willow Creek
41O Teton River
41P Marias River

MUSSELSHELL

40A Musselshell River above Roundup
40B Flatwillow Creek including Box Elder Creek
40C Musselshell River below Roundup

MIDDLE MISSOURI

40D Dry Creek
40E Missouri River between Musselshell River and Fort Peck Dam
41R Arrow Creek
41S Judith River
41T Missouri River from Marias River to and including Bullwacker Creek
40EJ Missouri River between Bullwhacker Creek and Musselshell River

MILK

40F Milk River above Fresno Reservoir
40G Sage Creek
40H Big Sandy Creek
40I Peoples Creek
40J Milk River between Fresno Reservoir and Whitewater Creek
40K Whitewater Creek
40L Frenchman Creek
40M Beaver Creek tributary of Milk River
40N Rock Creek tributary of Milk River
40O Milk River below Whitewater Creek including Porcupine Creek

LOWER MISSOURI

40P Redwater River
40Q Poplar River
40R Big Muddy Creek
40S Missouri River below Fort Peck Dam

ST. MARY-SASKATCHEWAN-NELSON RIVER BASIN

SAINT MARY

40T St. Mary River

YELLOWSTONE RIVER BASIN

UPPER YELLOWSTONE

43A Shields River
43B Yellowstone River above and including Bridger Creek
43BJ Boulder River tributary of Yellowstone River
43BV Sweet Grass Creek
43C Stillwater River
43D Clarks Fork of the Yellowstone River
43QJ Yellowstone River from Bridger Creek to the Clarks Fork of the Yellowstone

MIDDLE YELLOWSTONE

43E Pryor Creek
43N Shoshone River
43O Little Bighorn River
43P Bighorn River
43Q Yellowstone River between Clarks Fork of the Yellowstone and Bighorn River
42A Rosebud Creek
42B Tongue River above and including Hanging Woman Creek
42C Tongue River below Hanging Woman Creek
42KJ Yellowstone River between Bighorn River and Tongue River

LOWER YELLOWSTONE

42I Little Powder River
42J Powder River below Clear Creek
42K Yellowstone River between Tongue River and Powder River
42L O'Fallon Creek
42M Yellowstone River below Powder River

LITTLE MISSOURI

39E Box Elder Creek
39F Little Missouri River above Little Beaver Creek
39FJ Little Beaver Creek
39G Beaver Creek tributary of Little Missouri River
39H Little Missouri below Little Beaver Creek
38H Belle Fourche River above Cheyenne River

Description of Surface Waters - Size and Types

During the past several years, the EPA has revised the total waterbody size estimates for the states. The EPA River Reach File (RF3) computer program, provides the most recent and best estimate of waterbody size and locational information available. It is the source of the stream and lake size estimates used in this report. The US Geological Survey (USGS) 1:100,000 topographical maps were used to identify the surface water types and sizes reported in RF3. Because the original maps were made over a period of several decades, the coverage detail varies across the state. In some regions only larger intermittent or perennial streams and lakes were identified, but in others, nearly all stream and lake types and sizes were indicated on the maps. The regional resolution differences are most apparent when comparing first and second order ephemeral and intermittent streams.

Waterbody Types and Sizes

Streams
Streams can be separated into three general categories depending on the relative position of the stream bed to the local shallow groundwater table and flow characteristics.

1. Ephemeral stream beds are always above the local shallow groundwater and flow only in response to snowmelt or rainfall. Such streams are dry most of the year and are found extensively in the semi-arid and mountain headwater regions of Montana.

2. Intermittent stream beds are below the local shallow groundwater table during part of the year and flow in response to groundwater recharge and precipitation. Most of the stream miles in Montana are small (first and second order) ephemeral and intermittent streams.

3. Perennial stream beds are always below the local shallow groundwater table and typically have surface flow throughout the year. Perennial streams have been the focus of most of DEQ's water quality monitoring and assessment activities.

Stream reaches (of any stream type) may also be categorized by the relative size of the upstream watershed, using a stream ordering technique[1]. First order streams do not have tributaries and are commonly ephemeral or intermittent. The order of a stream's reach changes at the confluence of two like order streams (i.e., a second order stream begins at the confluence of two first order streams, a third order reach begins after two second order stream meet and so on).

Table 3 shows the relative distribution of the stream orders in Montana. Figure 3 depicts the numbers of miles by stream order. The fact that Montana is a headwaters state is reflected in the large portion of the total stream miles made up by first order intermittent and perennial streams.

Lakes
The distribution of lake acres (including man-made reservoirs) by size categories (acres) is also presented in Figure 3 and 4. Lakes do not have a system similar to stream orders for indicating lake or watershed size.

[1] Strahler, A.N. 1957. Quantitative analysis of watershed geomorphology. Amer. Geophys. Union Trans. 38:913-920.

All lakes and reservoirs are part of the state's water resources, but most of the assessment emphasis has been focused on "significant publicly owned" lakes. These are lakes that have public access and recreation potential. Unfortunately, the RF3 database does not identify those lakes. Therefore, perennial lakes greater than or equal to five acres have been designated as significant publicly owned lakes for the 1998 305(b) report.

This subset of the total lake acreage may, in fact, contain private reservoirs or may exclude some small alpine or pothole lakes on public lands. Until resources are available to undertake a state-wide lakes ownership survey, DEQ will identify its "significant publicly owned" lakes for the purpose of ∍305(b) reporting as described above.

Table 3
Distribution of Montana Streams and Lakes by Size

	Order						
	First	**Second**	**Third**	**Fourth**	**Fifth**	**Sixth**	**Seventh**
Total Miles of Rivers and Streams	112,240	31,512	17,243	8,744	3,833	735	2,444
Miles of Perennial Rivers/Streams	21,842	11,105	8,203	5,579	3,425	681	2,386
Miles of Intermittent Rivers/Streams	84,283	19,884	8,816	3,138	388	0	0
Miles of Ditches/Canals	6,115	524	224	27	20	3	9
Number of Lakes/Reservoirs/Ponds	3,242	3,296	3,311	287	47	55	8
Acres of Lakes/Reservoirs/Ponds	10,838	23,461	80,254	58,331	31,443	140,280	500,195

Lake /Reservoir/Pond Sizes:
First Order - 0 to 5 acres
Second Order - 5 to 10 acres
Third Order - 10 to 100 acres
Fourth Order - 100 to 500 acres
Fifth Order - 500 to 1,000 acres
Sixth Order - 1,000 to 10,000 acres
Seventh Order - Greater than 10,000 acres

Figure 3
Distribution of Streams by Order

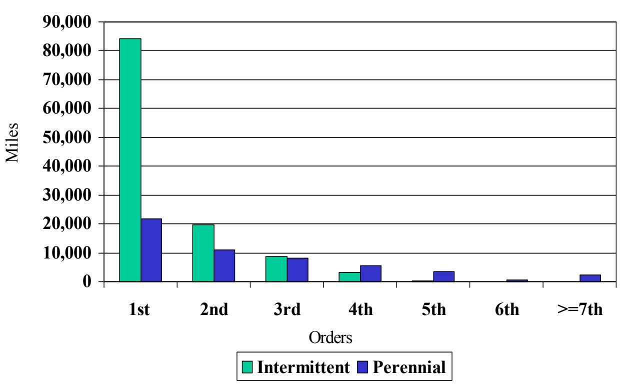
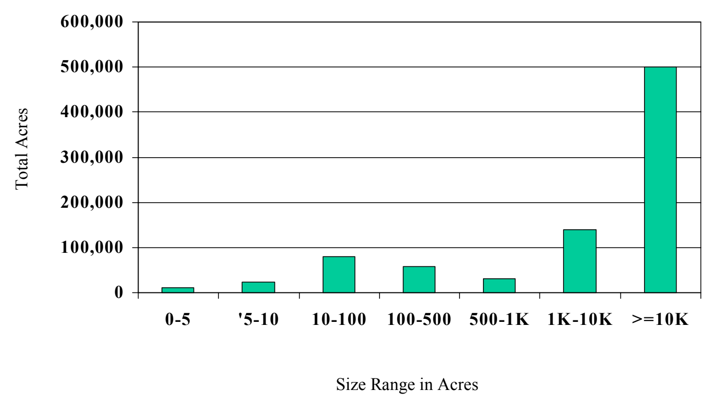


Figure 4
Acres of Perennial Lakes
by Size Category



Wetlands

Recent monitoring and assessment of more than 80 wetlands throughout the state indicates that wetlands are far more diverse than anticipated. Water chemistry has varied from very low dissolved solids, like high mountain streams and lakes, to nearly marine. The amount of water associated with wetlands is equally varied. Some have large open water areas while others are referred to as wet meadows.

On a broad scale, wetlands can be divided into three categories: little or no open water; open water is prevalent; and riverine. Water chemistry, vegetation, connection to groundwater, presence of an inlet, outlet or both, and persistence of wetness can vary widely within each category.

Unlike streams and lakes, wetlands have not been accurately mapped. As a result, the aerial extent can only be estimated (Table 1). Draining, dredging and filling activities that have occurred since settlement began have destroyed about 30% of the original wetland acreage in Montana.

The Montana Waterbody Tracking System and information database

Identifying streams, lakes or wetlands under the general "waterbody" heading provides a flexible method for tracking Montana's waters on a watershed, stream (or lake) or stream reach basis. The current waterbody tracking system was developed by the EPA for use by states. The conversion of earlier tracking system data to the present version was done by EPA contractors at Research Triangle Institute (RTI), North Carolina.

The principal use of the WBS is for maintaining information about the level of use supported by the streams and lakes of the state. Assessment of wetland use support status has only just begun and only a few wetlands have been entered into WBS. Those that have been assessed are usually referred to as lakes, for example Freezeout Lake.

In the WBS database, each of Montana's 85 minor basins (Figure 1) generally has three major waterbody designations associated with it:

1. the mainstem of the predominant stream (only);
2. the mainstem and tributaries; and
3. the lakes of the watershed.

The mainstem and tributaries waterbody is further divided into segments, which usually are tributary streams or individual lakes. For example, the waterbody identifier MT43C001-6 represents East Rosebud Creek (segment 6) of the mainstem and tributaries waterbody (001) of the Stillwater River watershed (C) of the upper Yellowstone River basin (MT43).

The data now stored in WBS represent about 17,900 stream miles and 800,000 lake acres. Because the main emphasis of WBS has been tracking impaired or threatened streams and lakes and the sources and causes of pollution, only a small portion of the database describes unimpaired waterbodies or wetlands.

Most of the information in WBS is from second order and greater intermittent and perennial streams. That subset of the state's total waters (about 64,000 miles) is most likely to have sufficient water year round to naturally support aquatic life and a fisheries (as well as all other designated uses) and have received most of DEQ’s assessment emphasis.

WBS does not accommodate analytical data. Rather, use support interpretations are made using available data and information, then those results are entered into WBS. A wide variety of information sources are used, including DEQ sponsored intensive surveys, Nonpoint source (NPS) stream reach assessments, information from CDs, a lake database maintained by the Montana Department of Fish, Wildlife and Parks (FW&P), US Forest Service (USFS) data, Bureau of Land Management (BLM) data, United States Geological Survey (USGS) data, and data retrieved from the EPA national water quality database (STORET).

Sources of pollution are activities that produce pollutants. Municipal wastewater treatment plant and industrial discharges are common point sources and are regulated by the Montana Pollutant Discharge Elimination System (MPDES) permitting program. Agriculture, timber harvesting and resource extraction activities are common nonpoint sources of pollution. More than one source may impact a waterbody at one time (e.g., a municipal wastewater treatment plant's (WWTP) discharge and area agriculture may both produce pollutants that find their way into a lake).

The *causes* of pollution are defined as measured contributors to use impairment including heavy metals and toxics, decreased dissolved oxygen or reduced riparian habitat. Often, several causes of impairment may be generated by a single source, or the impact of an upstream cause may overlap the same cause from another source.

Because of the size of Montana's water resources and the limited monitoring and assessment capabilities available, many of the state's streams, lakes and wetlands have not been assessed and recorded in the WBS. As information becomes available about a waterbody, it will be added to the WBS database.

A large portion of Montana (approximately 25%) is owned by several federal agencies (including the USFS, National Park Service and BLM) which manage several wilderness areas, roadless areas and parks. The streams and lakes in these pristine areas as well as other remote areas are, in all likelihood, fully supporting their designated uses. However, because assessments have not been completed and the waterbody size is unknown, they are not reflected in the WBS fully supporting category.

Montana Water Classification System and Water Quality Standards

Background

The Montana Water Quality Act (including 1997 revisions) establishes requirements for water quality protection. It requires the Montana Board of Environmental Review to adopt rules to protect the quality of the state's waters, as well as present and future beneficial uses. The Act also directs the Board to establish permit and non-degradation policies. Surface and groundwater use classification systems and water quality standards and criteria are defined in the Administrative Rules of Montana, Title 17, Chapter 30, Subchapters 6 and 10, respectively.

The present use classification of each waterbody in Montana was assigned according to the actual and anticipated uses in 1955.

Surface Water Classification System

The surface water use classification system employs four basic categories: A, B, C and I (Table 4) which are based primarily on water temperature, fisheries and associated aquatic life. The B and C classifications are subdivided into cold water aquatic life, B-(1 or 2) and C-(1 or 2), and warm water aquatic life, B-3 and C-3.

A simplified comparison of water quality criteria common to each use classification is presented in Table 5, and a brief description of the surface water use classification system and associated standards follows.

The A-Closed and A-1 waters are very high quality, and the principal beneficial use is public water supply. Watershed protection and use restrictions that may be authorized by the A-Closed classification are intended to protect the principal beneficial use.

The B-(1, 2 and 3) classifications are multiple use waters suitable for domestic use after conventional treatment, growth and propagation of fish (cold water, B-1 and B-2, warm water, B-3), associated aquatic life and wildlife, and agricultural and industrial uses. Most streams in Montana have been classified as B-(1, 2 or 3).

Only four stream segments have been classified as C-1 or C-2. They are:

1. Lower Rainy Creek (C-1);
2. Clark Fork River (C-2) (from Warm Springs Creek to Cottonwood Creek);
3. Clark Fork River (C-1) (from Cottonwood Creek to the Little Blackfoot River); and
4. Ashley Creek (C-2).

The difference between B-(1 or 2) and C-(1 or 2) is that the B classifications include drinking water as a beneficial use and the C classifications do not. All other uses are common to both classifications.

C-3 streams are suitable for warm water (non-salmonid) fisheries and associated aquatic life and recreation activities. Because these streams often contain naturally high total dissolved solids (salinity), their quality is marginal for drinking, agricultural and industrial uses.

Table 4
Surface Water Use Classifications Summary for Montana

A-CLOSED CLASSIFICATION:	**Waters classified A-Closed are suitable for drinking, culinary and food processing purposes after simple disinfection.**
A-1 CLASSIFICATION:	**Waters classified A-1 are suitable for drinking, culinary and food processing purposes after conventional treatment for removal of naturally present impurities.**
B-1 CLASSIFICATION:	**Waters classified B-1 are suitable for drinking, culinary and food processing purposes after conventional treatment; bathing, swimming and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.**
B-2 CLASSIFICATION:	**Waters classified B-2 are suitable for drinking, culinary and food processing purposes after conventional treatment; bathing, swimming and recreation; growth and marginal propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.**
B-3 CLASSIFICATION:	**Waters classified B-3 are suitable for drinking, culinary and food processing purposes after conventional treatment; bathing, swimming and recreation; growth and propagation of non-salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.**
C-1 CLASSIFICATION:	**Waters classified C-1 are suitable for bathing, swimming and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.**
C-2 CLASSIFICATION:	**Waters classified C-2 are suitable for bathing, swimming and recreation; growth and marginal propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.**
C-3 CLASSIFICATION:	**Waters classified C-3 are suitable for bathing, swimming and recreation; growth and propagation of non-salmonid fishes and associated aquatic life, waterfowl and furbearers. The quality of these waters is naturally marginal for drinking, culinary and food processing purposes, agriculture and industrial water supply.**
I CLASSIFICATION:	**The goal of the State of Montana is to have these waters fully support the following uses: drinking, culinary and food processing purposes after conventional treatment; bathing, swimming and recreation; growth and propagation of fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.**

Source: Montana Surface Water Quality Standards, Administrative Rules of Montana, Title 17, Chapter 30, Subchapter 6.

Table 5
Comparison of Specific Criteria Common to Each Use Classification

			MAX INCREASE			MAX CHANGE		
Class	**Coliform Bacteria**	**Dissolved Oxygen[1]**	**Turbidity**	**Color**	**Sediment**	**Temp**	**pH[2]**	**Toxics & Carcinogens**
A-Closed	50/100ML	NC	NI	NI	NI	NI	NC	WQB-7[3]
A1	200/100 ML	6.5 mg/l	NI	2 Units	NI	1° F	0.5 pH unit	WQB-7
B1	200/100 ML	6.5 mg/l	5 Units	5 Units	NI	1° F	0.5 pH unit	WQB-7
B2	200/100 ML	6.5 mg/l	10 Units	5 Units	NI	1° F	0.5 pH unit	WQB-7
B3	200/100 ML	5.5 mg/l	10 Units	5 Units	NI	3° F	0.5 pH unit	WQB-7
C1	200/100 ML	6.5 mg/l	5 Units	5 Units	NI	1° F	0.5 pH unit	WQB-7
C2	200/100 ML	6.5 mg/l	10 Units	5 Units	NI	1° F	0.5 pH unit	WQB-7
C3	200/100 ML	5.5 mg/l	10 Units	5 Units	NI	3° F	0.5 pH unit	WQB-7
I	200/100 ML	5.5 mg/l	NI	NI	NI	NI	3	WQB-7

[1]30 day mean oncentration
[2]Maintained between 6.5 and 9.5
[3] Circular WQB-7, Montana Numeric Water Quality Standards, November 1998
NC = No Change in naturally occurring
NI = No Increase that will affect a use

Streams with an I (impacted) classification were impacted by an activity which would not allow the stream to fully support drinking, recreation or fishery uses at the time the first stream classifications were determined (1955). The state's goal is to improve the quality of these waterbodies so that they will fully support all appropriate beneficial uses.

Three stream segments have been designated as I – class waters:

Prickly Pear Creek below East Helena
Silver Bow Creek
Muddy Creek.

Water quality standards specific to lakes and wetlands have not been developed; therefore, surface water quality standards described here apply to all waterbody types. Work is progressing on water quality standards that will specifically address wetlands.

Groundwater Classification System

Groundwater is classified according to actual quality and use as of October 1982. The classifications are Class I, II, III and IV.

Class I - groundwater has a specific conductance less than 1000 μSiemens/cm at 25°C and is suitable for public and private water supplies, food processing, irrigation, etc., with little or no treatment required.
Class II - groundwater has a specific conductance range of 1000 to 2500 μSiemens/cm at 25°C and may be used for public and private water supplies where better quality water is not available. The primary use of Class II groundwater is for irrigation, stock water and industrial purposes.
Class III - groundwater has a specific conductance range of 2500 to 15,000 μSiemens/cm at 25°C and is used primarily for stock water and industrial purposes.
Class IV - groundwater has a specific conductance greater than 15,000 μSiemens/cm at 25°C. Class IV groundwater is used primarily for industrial purposes.

The numeric criteria for surface water and groundwater quality previously referenced in the "Gold Book" and other EPA documents have been consolidated into a single department circular, WQB-7, *Montana Numeric Water Quality Standards* (November 1998).

If detailed information about the Montana Water Quality Act or the Administrative Rules is needed, please contact the DEQ, Planning, Prevention and Assistance Division, Metcalf Building, P.O. Box 200901, Helena, MT, 59620.

Designated Uses and Use Support

Aquatic life support, fisheries, swimming, and drinking water are designated uses that have the highest water quality requirements. When they are fully supported, it is reasonable to expect that all other existing and future designated uses (e.g., agricultural and industrial) will also be fully supported. Most waterbody assessments focus on these uses and they are the only ones presented in this report in order to simplify the summary tables.

Aquatic Life Support

Aquatic life support is a broad use descriptor intended to protect fish and other aquatic animals and plants normally associated with a high quality ecosystem. Aquatic life support may be impaired by chemical pollutants, sediment, riparian habitat degradation, stream channel modifications, excessive water withdrawal for irrigation or return flows and other actions that disrupt the biological integrity of the waterbody.

Fisheries

In Montana, fisheries have been divided into cold water (salmonid) and warm water (non-salmonid) fisheries. Cold water fisheries are commonly mountain or foothill streams and lakes that support trout and associated game and non-game fish.

The eastern prairie streams and lakes and the lower Missouri and Yellowstone rivers are warm water fisheries. These waterbodies are naturally warm, with high suspended sediment and total dissolved solids. They typically support sauger, catfish and a wide variety of non-game fish.

Fisheries use is a focused element of the more general aquatic life support use. Water that is impaired for fisheries is also impaired for aquatic life.

Swimming

Swimming use, in this report, includes secondary contact recreation, such as boating. Usability for swimming may be impaired by noxious algae growth or health concerns such as fecal coliform bacteria.

Drinking Water

Water is suitable for drinking if it falls below Maximum Contaminant Levels (MCL) for all health-threatening contaminants. The MCL for a pollutant is the maximum concentration that EPA has found to be safe for human consumption. The MCL numbers are derived from studies of cancer and toxicity and take into consideration the availability of technology to treat the water prior to consumption to reduce or remove contaminants.

Human health criteria refer to the concentration of a carcinogen such as arsenic or a pesticide that has been correlated to a specific level of increased cancer risk as a result of life-long exposure to the carcinogen through drinking the contaminated water and consuming fish from the same waters. The Montana Legislature has legislated the acceptable risk level to be one case of cancer per 100,000 persons exposed for all carcinogens except arsenic, for which the acceptable level is one cancer per 1,000 persons exposed (MCA 75-5-301(2)(b)).

Guidelines for Determining Use Support

DEQ has used EPA adopted guidelines for making waterbody use support decisions[2] discussed in this report. The guidance considers the natural variability of water quality parameters and provides for a margin of safety when a complete or extensive database is not available. Data types used in the assessment process are toxics and carcinogens, and conventionals and non-traditional parameters. Each of the data types has individual guidelines for interpretation and decisions regarding a waterbody's level of use support.

Toxics and Carcinogens
Use support decisions based on toxics or carcinogen data have generally been the most conservative. It has been DEQ's position that it is better to be overly protective in the assessment process than to fail to identify a potentially harmful waterbody.

For example, if the human health criterion of a carcinogen is below the analytical detection limit (say, 1 μg/L and analysis indicates a level of 2 μg/L) the waterbody would be assessed non-supporting of drinking water use. Most acute toxicity criteria are above the normal analytical detection limits, so a pollutant level equal to or greater than the criteria is an exceedance and the waterbody is designated non-supporting for the uses affected.

Because the sample database for toxic pollutants for most waterbodies is very limited, a single sample that exceeds a numeric standard usually results in the waterbody being assessed as not supporting the affected uses. If sufficient data are available that show the natural variability of a waterbody, EPA guidelines allow one exceedance of standards in a 3-year period before a non-support assessment is made. If the exceedance results in a fish kill or is of long duration, a non-support decision would result.

Conventional Pollutants
The conventional pollutants (dissolved oxygen, pH, temperature, turbidity and sediment) are usually not toxic to aquatic life or people when exposure is for a short duration. A healthy ecosystem can normally be allowed a small number of criteria exceedances (less than 10 percent of a large database) without failing to fully support its designated uses. If a waterbody has more than 10 percent, but less than 25 percent of the database exceeding standards, the waterbody is designated as partially supporting. When 25 percent or more of the data for each parameter exceed the criteria, the waterbody will be designated as non-supporting the affected use or uses.

Non-Traditional Water Quality Parameters
Consideration of non-traditional water quality parameters (reduced riparian vegetation, decreased stream depth, increased stream width) is increasing as understanding of their impacts on aquatic communities is better understood. These non-conventional parameters are assessed by comparing conditions on an unimpaired or least impaired reference waterbody to the conditions of the waterbody being assessed. Comparison of upstream conditions to downstream conditions on the same stream is also used in the assessment process.

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[2] Guidelines for Preparation of the Comprehensive State Water Quality Assessments (305(b) Reports) and Electronic Updates: Contents and Supplement, 1997, EPA-841-B-97-002A and B

The condition of the waterbody being assessed is determined by the percent similarity between the assessed waterbody and a reference stream (or site), based on indices calculated from the species present, number of individual organisms, and relative distribution of the organisms. The critical values ($\sum$(test/reference metric)/number of metrics) used are:

>75 percent of the reference = non-impaired or fully supporting,
25-75 percent of the reference = impaired or partially supporting,
<25 percent of the reference = severely impaired or non-supporting.

Because macroinvertebrate and periphyton assemblages may be exposed to effects of several stressors over time, they are good long-term indicators of general water quality. Conditions indicated by the comparisons above are especially accurate when a closely matched reference stream or upstream control site is used for comparison.

Periphyton and macroinvertebrate metrics and their interpretation are described in greater detail in the Periphyton Bioassessment Methods for Montana Streams[3] and Rapid Bioassessment Protocols for Use in Streams.[4]

Use Support Categories
Four categories of use support describe Montana's waters:

1. **Fully supporting**: waters are at their natural condition or best practical condition and water quality standards are not being violated.
2. **Threatened but fully supporting**: uses are fully supported, however there is a downward trend in water quality or a new activity or an increase in existing activities not using Best Management Practices (BMPs) may result in violations of water quality standards or use impairment.
3. **Partially supporting**: This is a broad designation for situations in which a waterbody is in the range between “slightly impaired” to “barely supporting” a designated use. For the purposes of the state's reporting requirements, the degree of partial impairment is not indicated in the summary tables.
4. **Non-supporting**: a waterbody that has acute toxics or human health criteria violations, where biological or physical data indicate severe degradation, or where other data indicate that water quality standards are violated and one or more uses cannot be attained. EPA has recommended a 3-year study and observation period before a non-support designation is removed. The reason for the period is that time is needed for most biological systems to recover after exposure to acutely toxic substances, and for the aquatic community to re-establish after a severe disturbance.

All waters of Montana are classified for multiple users. Therefore, the level to which water quality supports each designated use must be determined. The support decision for each use is independent of the other designated uses (e.g., a waterbody may partially support aquatic life because of excess nutrients, not support drinking water because of arsenic, but fully support agriculture and industrial uses).

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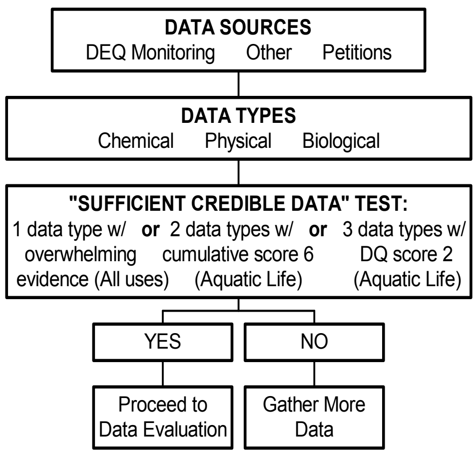
[3] Bahls, L.L. 1993, revised. Periphyton bioassessment methods for Montana streams. Montana Dept. of Health and Environmental Sciences, Water Quality Bureau, Helena, MT.
[4] Plafkin, J.L., M.T. Barbour, K.D. Porter, S.K. Gross and R.M. Hughes. 1989. Rapid bioassessment protocols for use in streams and rivers: benthic macroinvertebrates and fish. U.S. EPA/440/4-89/001.

Proposed Future Use Support Decision Guidelines

Sufficient Credible Data
DEQ is proposing to use data quality objectives (DQOs) to determine if available water quality data are sufficient and credible. Sufficient credible data are necessary to make accurate beneficial use support decisions and ∍303(d) (TMDL) listing. Any beneficial use support determinations that are made using data not collected by a DEQ-sponsored entity (e.g., data collected independently by industrial or environmental groups) that result in listing or de-listing a waterbody may be put on a priority list to be reassessed by DEQ. A decision tree has been developed for determining if data is sufficient and credible (Figure 5, Data Quantity and Quality Evaluation).

Figure 5
PROPOSED WATER BODY ASSESSMENT DECISION TREE
DATA QUANTITY & QUALITY EVALUATION:



EPA Guidelines
Tables 6 through 8 summarize tables that were assembled by the Intergovernmental Task Force on Monitoring Water Quality (ITFM)[5]. The ITFM, currently in existence as the National Water Quality Monitoring Council, developed a model for stream monitoring for different types of designated uses based on a combination of biological, physical, and chemical monitoring. The model defines the relationship among the parameters that directly measure the condition of the biotic community. EPA recommends that states incorporate ITFM's suite of parameters in its monitoring programs to evaluate attainment of beneficial uses. For example, ITFM recommends that monitoring for aquatic life use support should include community level biological data, habitat, and physical/chemical field parameters in water and sediment.

Proposed Minimum Level of Information for Aquatic Life Use Support Determination
ITFM has assembled tables to evaluate the level of information (DQOs) necessary to determine if aquatic life is supported. DEQ is proposing to adopt these tables with modifications (Tables 6 through 8 summarizing the ITFM tables). DEQ will use the ITFM tables to establish the minimum level of information (score) required to make aquatic life use determinations for Montana waterbodies. The following scoring/criteria are used to determine sufficient credible data:

1. Under certain circumstances the use of only one data category (e.g., biology, habitat/physical or chemical) may be considered sufficient and credible regardless of the score. However, there must be overwhelming evidence that a waterbody is impaired (e.g., significant exceedances of numeric water quality standards over an extended period of time, obvious destruction of riparian habitat for the entire stream reach, etc.).

[5] 1997 305(b) Report Guidelines; EPA-841-B-97-002A

2. In most cases, for data to be considered sufficient and credible a minimum score of 6 is required for the evaluation of aquatic life use support. The score of 6 is cumulative and is the sum of the scores from the biology (Table 6), habitat/physical (Table 7) and chemistry (Table 8) tables.

The following describes the minimum score required for each category:

Table 6

Aquatic Life Use Support: Biological

Score	Methods	Data Quantity	Data Quality
1	Visual observation; no reference	Limited	Unknown or low; no specialist
2	1 group; use reference	Single time/site	Low to moderate; some specialist guidance
3	1 group or more; use reference	Target sites; 1 season	Moderate; specialist makes assessment
4	2 groups; use reference	Broader coverage	High; all work done by specialist

Table 7

Aquatic Life Use Support: Habitat

Score	Methods	Data Quantity	Data Quality
1	Visual observation	Increasing	Unknown or low; no specialist
2	Visual observation; map study	Increasing	Low; some guidance followed
3	Visual, uses SOP's, photo points used	Increasing	Moderate; specialist trains field worker and makes assessment
4	Quantitative	Increasing	Specialist

Table 8

Aquatic Life Use Support: Chemical Data

Score	Methods	Data Quantity	Data Quality
1	• grab • old data • best professional judgement	• once	Unknown/Low
2	• grab • automated samplers • modeling (uncalibrated)	• Quarterly or more • targeted seasonal • quarterly & include sediment/chlorophyll	Low/Moderate
3	• grab series • calibrated model	• broad coverage • monthly or more long period of record	Moderate/High
4	• grab series • sediment sampling	• broad spatial and for more than three years • at least monthly during key seasons	High

A. If data are collected for all three categories the score for each category shall be at least 2.

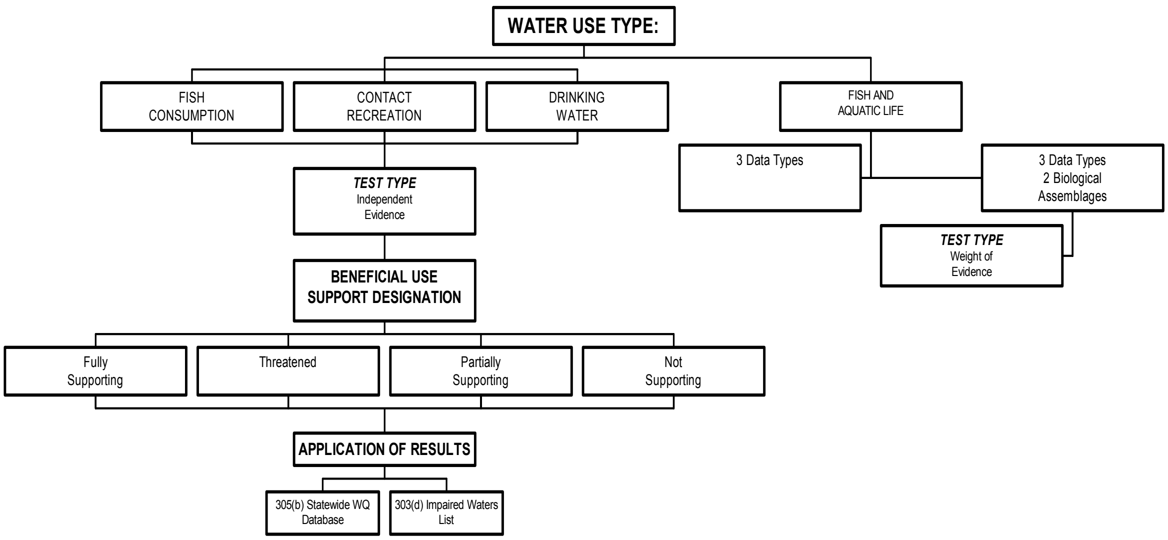
B. If data are collected for only two of the three categories the cumulative score categories shall be at least 6.

Proposed Minimum Level of Information for Other Beneficial Uses

Biological condition and physical habitat indicators will not be used to evaluate beneficial uses such as drinking water and contact recreation. A sample of water from a waterbody, which shows exclusions of human health standard, will be sufficient to demonstrate impairment, provided that the sample was collected using DEQ's Standard Operating Procedures (SOP) and the analysis was performed by a laboratory using DEQ approved QA/QC protocols and analytical methods. A stream that is listed on the ∍303(d) list as impaired for drinking water uses will not be removed from the list unless or until there is at least quarterly sampling for three consecutive years with no more than one exceedance of human health water quality standards.

Proposed Use Support Decision Criteria
DEQ is developing proposed beneficial use support decision guidelines following EPA 305(b) guidance. The beneficial use support decision guidelines would be used after the data is determined to be sufficient and credible. A decision tree has been proposed for evaluating beneficial use support decisions using the new guidelines (Figure 6).

Figure 6
PROSPOSED WATERBODY ASSESSMENT DECISION TREE
BENEFICIAL WATER USE SUPPORT EVALUATION



Independent Evidence Test
An independent evidence test requires data from only one data category (i.e., chemistry or toxicity, biology, and habitat/physical) to show impairment leading to a decision that a beneficial use is partially supported or non-supported. Independent evidence would be used in making use support decisions for drinking water, contact recreation and fish consumption. Aquatic life use support decisions would also be made using independent evidence if only one or two data categories are used (i.e., chemistry or toxicity, biology or habitat/physical) or if three data categories are used, but only one biological assemblage is assessed (e.g., fish). If any data category indicates impairment the waterbody would be rated as not fully supporting its beneficial uses.

Fish and Aquatic Life Beneficial Use Support
Aquatic life use support is a broad descriptor intended to protect aquatic plant and animal communities (e.g., game and non-game fish and other aquatic animals and plants) normally associated with a high quality ecosystem. Making a beneficial use support determination for aquatic life usually requires the evaluation of at least two of the following categories: 1) biology, 2) habitat/physical, or 3) chemistry or toxicity (bioassay).

Montana has the following narrative water quality standards that apply to most of the state surface waters:

1. Waters are suitable for the growth and propagation of fishes and associated aquatic life, waterfowl and furbearers
2. No increases are allowed above naturally occurring concentrations of sediment, settable solids, oils or floating solids, which are harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, fish or other wildlife.

DEQ is proposing guidelines that use reference condition to assist in interpreting the above narrative standards for making aquatic life use support decisions.

Beneficial use support determinations often are made by comparing the conditions of a stream to the expected reference condition. Reference condition may be determined using:

1. A least-impaired stream within the same region having similar geology, hydrology, and morphology
2. Historical data
3. An upstream control or paired watershed approach; or
4. A literature review.

Beneficial use determinations for aquatic life are made following one of two methods. First, if there are sufficient credible data for only one or two of the three data categories, independent evidence is used. The assessment is made using bioassay (toxicity), chemistry, biological and habitat/physical data independent of one another. Or when there are sufficient credible data for all three data categories and two biological assemblages were collected, use support decisions based on a weight-of-evidence test is used to produce the final determination employing the following guidelines:

Weight-of-Evidence Test

A. **Fully supporting:** Limited to no more than one determination of "moderately impaired" for chemistry/toxicity, biology or habitat/physical evaluations; or no more than one biological assemblage which indicates the waterbody is moderately impaired (the average of the two biological assemblages must be greater than or equal to 75 percent of the reference condition).

B. **Partially supporting:** requires a minimum of two determinations of "moderately impaired" or one determination of "severely impaired" for chemical or bioassay (toxicity), biological or habitat/physical evaluations with the remaining data categories indicating that the waterbody is least impaired; or two biological assemblages indicate that the waterbody is moderately impaired; or the average of the two biological assemblages is 26-74 percent of the reference condition.

C. **Not supporting:** requires a minimum of one determination of "moderately impaired" and one determination of "severely impaired" for chemical or bioassay (toxicity), biological or habitat/physical evaluations; or two biological assemblages indicate that the waterbody is "severely impaired"; or the average of two biological assemblages is less than 25 percent of the reference condition.

The weight of evidence test requires a high level of information that includes chemical, biological, and habitat/physical data. At least two biological assemblages must be evaluated. At least two of the three data categories (chemical or bioassay, biological and habitat) or two biological assemblages (e.g., periphyton and macroinvertebrates) are required to indicate impairment in order to make a determination that the water body is not fully supporting aquatic life use.

Surface Water Quality Assessment Programs

Stream assessment is the process of gathering information about a stream to determine if it meets water quality standards and criteria and supports the beneficial uses specified by the Montana Water Quality Act and Administrative Rules.

Assessment Types
Two general categories of water quality assessments are used in Montana based on the quality and quantity of available data. These categories are "evaluated assessments" and "monitored assessments." Evaluated assessments include best professional judgement, land use information, stream reach assessments and volunteer monitoring data and are used when site specific data are marginal, old or lacking. Monitored assessments use recent high quality data and include fixed station monitoring and intensive surveys (Figure 7). Each approach is intended to provide quality information about Montana's water resources.

Monitored Assessments
Monitored assessments are data intensive and often use fixed station monitoring or intensive surveys as the principal data source.

Fixed station monitoring
Fixed station monitoring takes place quarterly or monthly at specific sampling sites, usually for several years. DEQ fixed station monitoring has concentrated on the Clark Fork of the Columbia River Basin, including Flathead Lake and its tributaries.

The headwaters of the Clark Fork originate near Butte, Montana. The river flows northwest, draining approximately 25,000 square miles of Montana west of the Continental Divide. Three major rivers (Bitterroot, Blackfoot and Flathead) join the Clark Fork to make it the largest river flowing out of the state. Water quality in the basin varies from streams severely polluted by heavy metals to extremely pure mountain streams with excellent trout fisheries.

Approximately 30-40 fixed monitoring stations along the Clark Fork and many of its tributaries have been sampled for heavy metals, nutrients and suspended sediment at least monthly since 1988. Macroinvertebrate (aquatic insects) and periphyton (algae attached to rocks) have also been collected each summer from most of the stations. The data acquired have become the foundation of a basin-wide management plan for the Clark Fork and a TMDL for nutrients entering the stream.

Flathead Lake and its tributaries also have an extensive fixed station monitoring program sponsored by DEQ and other agencies and carried out by the University of Montana Biological Station.

Flathead Lake is an important resource in northwest Montana and is one of the last large oligotrophic (low productivity) lakes, left in the United States. The lake monitoring program has been designed to document change in water quality and has become the basis for the development of a nutrient TMDL (cooperatively with the Confederated Salish and Kootenai Tribes) and a basin-wide management plan for Flathead Lake.

A more complete discussion of Flathead Lake may be found in the lake section of this report and in reports produced by the Flathead Basin Commission.

Figure 7

Assessment Types

Evaluated Assessment
(Used when site-specific data are marginal, old or lacking)

Based On

- Best Professional Judgement
- Land Use Information
- Volunteer Collected Data (Minimally Supervised)
- Complaints (Substantiated)
- Models That Have Not Been Ground Truthed
- Stream Reach Assessments (Only)

Monitored Assessment
(Used when recent, high quality data are available)

Based On

- Fixed Station Monitoring
  - Quarterly or More Often
- Intensive Surveys
  - Water Column Chemistry
  - Macroinvertebrate/Algae
  - Stream Reach Assessment

Intensive Surveys

Intensive surveys are multimedia, single-visit assessments and are usually categorized as monitored assessments. A combination of water column chemistry (major cations and anions and nutrients), macroinvertebrate (aquatic insects) and periphyton (attached algae) samples may be collected depending on the apparent condition of the stream. A stream reach habitat assessment is also made for each reach type of the stream. Macroinvertebrate samples are usually collected using the Rapid Bioassessment III techniques[6]. The combination of these data types yields a comprehensive picture of the stream's condition at the time of the assessment and in the recent past.

Biological information is becoming the principal component in the assessment process because macroinvertebrate and algal communities are reliable indicators of certain water quality parameters such as pesticides, heavy metals, or nutrients. When a biological community is exposed to stress, the sensitive species may die out and tolerant species dominate.

As more biological and corresponding habitat data are collected, the accuracy of the data interpretation and our understanding of the water chemistry-habitat-biological community interrelationships will improve.

Selection of streams for intensive surveys has followed a modified rotating basin approach. The number of streams and lakes in Montana makes it impossible to study each submajor or minor basin in great depth on a 5- or even 10-year cycle. However, by dividing the state into five regional watersheds (everything west of the Continental Divide in one watershed, everything east divided into northwest, northeast, southeast and southwest) and intensively surveying four or five streams in each region every year (20-25 total streams per year), most minor basins will be studied within 5 years. Detection of water quality trends will be slow at best with this system. The biological and habitat information collected may prove to be the best index of trends.

Evaluated Assessments

Evaluated assessments are based on a less extensive data set and are the most common type of assessment used in Montana. Examples of evaluated assessments include land use information, complaints and models that have not been ground truthed.

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[6] Plafkin, J.L., M.T. Barbour, et al., Rapid Bioassessment Protocols For Use In Streams And Rivers: Benthic Macroinvertebrates And Fish, May 1989, Office of Water, EPA/440/4-89/001.

Stream Reach Assessments
The nonpoint source (NPS) stream reach habitat assessment procedure has become important for identifying steams impaired by NPS pollution. The procedure relies on evaluation of riparian habitat and streambed condition as indicators of whether aquatic life is being supported. This method is based on the premise that a stream with high quality riparian habitat, stable stream channel and no obvious NPS pollution sources will fully support a healthy aquatic life community. The assessment procedure works best with smaller streams (i.e., fourth order or less) that are not affected by point source discharges.

Stream reach habitat assessments have been used on waters throughout Montana including western mountain streams affected by logging and eastern plains streams affected by grazing. DEQ realizes that the stream reach assessment process has several subjective elements which are open to interpretation, so the information is used primarily as a first-round evaluation and for watershed prioritization or to support conventional chemical and biological sampling.

Proposed Future Stream Assessment Protocols for DEQ

Future stream assessments by DEQ will include both intensive surveys and stream reach assessments. The goal of the stream assessments will be to collect sufficient and credible data that can be used to make beneficial use support determinations.

Due to limited resources, DEQ is proposing to assess streams through one field visit. Therefore, a considerable amount of effort will be made prior to and during the field visit to coordinate with the CDs, landowners, and any other interested parties to collect data that reflect water quality over time. For example, macroinvertebrate and algae community structure, habitat evaluations, sediment chemistry, and chlorophyll *a*, all may reflect both the conditions of a stream at the time of sampling and also provide a historical perspective (e.g., macroinvertebrates can reflect water quality for up to one year prior to sampling). An attempt also will be made to evaluate historical data and fishery information from the Montana FWP.

Data will be collected to evaluate biology (fish, macroinvertebrates, algae), chemistry (water column and sediment) and habitat characteristics (aquatic and riparian). All sampling locations will be documented using GPS, legal description, site description and dated still photography. Each stream will be sampled near the mouth and near the headwaters. Streams will be sampled approximately every 20 miles usually at sites located near reach transitions such as changes across ecoregions or different land uses. A stream reach habitat assessment will be conducted for each stream reach.

Volunteer Monitoring
Volunteer monitoring of Montana's water resources has been growing. The Montana Watercourse at Montana State University currently has §319 nonpoint source funding to coordinate and develop training materials in a statewide effort to assist citizen volunteer water quality monitors. In addition, the Montana Natural Resource Information System--Water Information System is developing a database that can be used by citizen water quality volunteer monitors to share and compare data.

The Flathead Basin Commission started a lake volunteer monitoring program in 1992. A similar program was begun by the Kalispell office of the Montana FWP in 1993. Together, the two programs are collecting data on more than 30 lakes in northwest Montana.

Volunteer monitoring programs in the Kootenai, Yellowstone and Bitterroot river basins are in various stages of development.

Other Sources of Assessment Data

Water quality studies and monitoring programs are also sponsored in Montana by several other agencies including the U.S. Forest Service, US BLM, Natural Resource Conservation Service and Montana DNRC. Information obtained from those agencies has been welcomed and incorporated into DEQ's Waterbody System database.

Montana Statewide Monitoring Plan

Montana DEQ currently is coordinating with the USGS to develop a new water quality monitoring plan for Montana. The plan will include stream assessments and the monitoring of fixed stations and reference sites.

Approximately 35-40 fixed station sites will be monitored. The fixed station sites will be located at active USGS flow gaging stations and will include the mainstream of rivers and their major tributaries. Fixed station monitoring will include four water column samplings per year. The water column will be analyzed for total suspended sediment, nutrients, metals, common ions, pH, temperature and conductivity. Samples that represent the macroinvertebrate and algae communities will be collected once per year (late summer). Sediment chemistry and periphyton chlorophyll samples may also be collected annually during the late summer. One of the objectives of the fixed station monitoring is to determine statewide water quality trends.

Stream assessments and the monitoring of reference sites will be conducted using a rotating basin approach. The state will be divided into four regions, Upper Missouri, Lower Missouri, Yellowstone and West Slope. Monitoring will be rotated annually so that each basin will be monitored once every four years.

DEQ will work with local groups and agencies to establish the location of the reference sites, and will attempt to select reference sites that represent the major stream types found in Montana. Reference site monitoring will include the sampling and analysis of the water column and sediment (streambed) chemistry, periphyton chlorophyll and community structure and macroinvertebrates. DEQ also intends to conduct stream reach habitat assessments that would include a combination of qualitative evaluations with photo points, and quantitative measurements of the stream geomorphology and riparian vegetation. One objective of monitoring the reference sites is to improve the beneficial use support decision criteria that DEQ uses to determine if a stream segment is water-quality limited.

Stream assessments will be conducted on approximately 20-30 additional stream segments that are selected randomly. These stream assessments will include monitoring similar to that proposed for the reference sites. The objectives of the randomized stream assessments are: 1) To determine the overall condition of the water quality of a region, 2) To determine trends in water quality, and 3) To identify stream segments that are water quality limited or are similar to the expected reference condition.

Status of streams

To date, Montana's Waterbody System (WBS) contains assessments for 897 stream segments totaling 17,874 miles, of which, only 3,377 miles have been identified as fully supporting all uses (Table 9). Evaluated stream segments outnumber monitored segments by about two to one. The stream mileage indicated to be fully supporting all uses in the WBS is not representative of the true condition of Montana's waters because assessment emphasis has been on impaired water and most of the healthy stream miles have not been assessed and entered into the WBS. Non-supporting, as well as, impaired stream mileage figures may be overestimated because the total length of any given impaired stream reach is counted in the total, though the actual pollution problem may affect only a portion of the reach.

Table 9 Use Summary Report: Aquatic Life Support, Rivers & Streams			
Total Number of Stream Segments Assessed	896		
Number Monitored	314		
Number Evaluated	582		
	Miles		
Degree of Use Support	Evaluated	Monitored	Total
Fully Supporting – all uses	2,084	1,292	3,377
Supporting but Threatened – for at least one use	2,749	1,168	3,917
Partially Supporting – at least one use	5,821	3,395	9,215
Not Supporting – at least one use	850	515	1,365
Total Size Assessed	**11,504**	**6,370**	**17,874**

Level of Use Support

Non-supporting stream segments total 1,365 miles or about 8 percent of the stream mileage that has been assessed. Partially supporting stream miles constitute about 52 percent of assessed stream miles. About 3,400 assessed stream miles (nearly 20 percent) were found to be fully supporting all uses. The uses most commonly impaired are aquatic life support (which includes fisheries), drinking water, swimming/recreation and agriculture (Figure 8).

Figure 8
Support by Category of Use

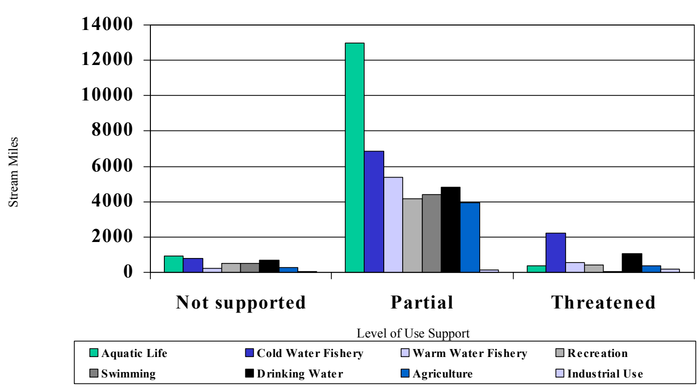

Figure 9
Impact of Major Pollution Sources on Streams

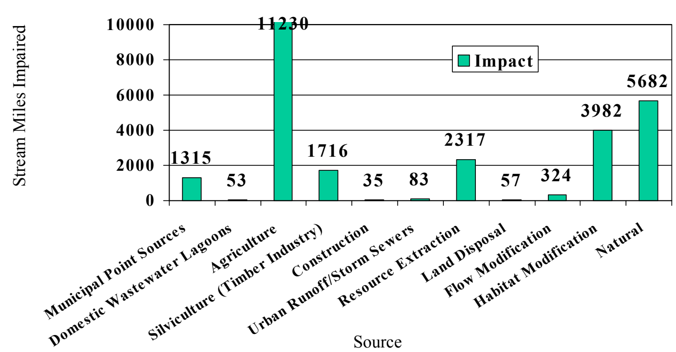

Table 10
Summary of Sources

Source Categories	Miles Impacted	Source Categories	Miles Impacted
INDUSTRIAL POINT SOURCES	339	Dredge mining	191
MUNICIPAL POINT SOURCES	1315	Petroleum activities	435
DOMESTIC WASTEWATER LAGOON	53	Mill tailings	343
AGRICULTURE	11230	Mine tailings	322
Non-irrigated crop production	1809	**LAND DISPOSAL**	57
Irrigated crop production	7220	Wastewater	32
Pasture land	916	Landfills	13
Range land	6653	Industrial land treatment	3
Animal Operations	102	On-site wastewater systems(septic tanks)	139
Aquaculture	9	Septage disposal	15
Off-farm animal holding/management areas	171	**FLOW MODIFICATION**	324
SILVICULTURE (Timber Industry)	1716	Channelization	793
Harvesting, restoration residue	247	Dredging	19
Logging road construction/maintenance	259	Dam construction	481
CONSTRUCTION	35	Flow regulation/modification	1941
Highway/road/bridge construction	1269	Bridge construction	6
Land development	309	**HABITAT MODIFICATION**	3982
URBAN RUNOFF/STORM SEWERS NPS	83	Removal of riparian vegetation	521
Non-industrial permitted	38	Streambank modification/destabilization	3762
Other urban runoff	23	Atmospheric deposition	7
RESOURCE EXTRACTION	2317	Highway maintenance and runoff	148
Surface mining	214	**CONTAMINATED SEDIMENTS**	4
Sub-surface mining	545	**NATURAL**	5682
Placer mining	309	Upstream impoundment	372

Sources

Each of four major source categories have been identified as contributing to the impairment of more than 2000 miles of Montana's rivers and streams (Figure 9). The general categories in Figure 9 have been subdivided into more specific categories (Table 10). Agriculture has affected over 60 percent of the assessed stream miles. The amount and intensity of data collected during most stream assessments has not been sufficient to isolate the impacts of each source, and the impacts of individual sources usually overlap. A common scenario in the western mountain-foothill ecoregion could be as follows:

A stream originates in a mountainous region managed by federal land agencies with scattered private inholdings. The area is used for recreation and has had some logging and grazing by livestock. Farther downstream all of the land is privately owned and land use is a combination of agriculture and residential (including a small town).

Assessment of the stream indicates aquatic life use is impaired by sediment and nutrients. Each land use is contributing sediment and nutrients but identifying where the impact of one source ends and another begins and how much overlap exists is not possible with the data collected in the assessment. Therefore, for the purposes of section 305(b) reporting, each source and cause would be assigned a mileage equal to the whole stream length. The TMDL process would use this general information as a basis, to improve upon the assessment and describe the controls appropriate for each source. The sources that affect the vast majority of stream miles (nearly 90 percent) are nonpoint sources.

Causes

The causes of use impairment that have been identified are listed in Table 11. Several of the causes affect more than 5,000 stream miles, which indicates that most streams are affected by more than one cause. Very few causes are specific to a single source. Therefore, the individual causes cannot be linked to a source without more information than is normally collected in the assessment process. For example, natural sources, forest practices, grazing and irrigated crop production may be sources of suspended sediment and nutrients in a stream. However, to isolate and quantify the pollutants that each source produces will require a more intense monitoring or modeling program. Some of this information will be collected as TMDL development progress in a watershed.

Table 11
Summary of Causes

Cause Categories	Miles Impacted
Metals	4,377
Other inorganics	3,208
Nutrients	6,095
Siltation	6,997
Salinity/TDS/chlorides	4,786
Thermal modifications	2,550
Flow alteration	7,125
Other habitat alterations	6,344
Pathogens	1,605
Suspended solids	6,386

Fish Kills

Fish kills that have been reported to the Montana FW&P from 1994 through 1998 are described below.

1. Ruby River below the Ruby Reservoir, September 1, 1994. The state-owned (DNRC administered) reservoir was completely drained on this day. As a result of the draining, the river began to erode a channel through the lake sediments, resulting in about 3,000 cubic yards of mud being washed into the river downstream of the reservoir. It was estimated that about 10,000 to 15,000 rainbow and brown trout were killed between the dam and 2 miles downstream. About 90% of the dead fish were rainbow trout, and most of them had been washed out of the reservoir. Measurements taken the next day below the dam indicated that turbidity values were off the scale (>999 NTU) and dissolved oxygen levels were not detectable.
2. Nevada Creek below the Nevada Creek Reservoir, April 3, 1995 (Blackfoot River drainage.) An individual reported more than one hundred dead brown and rainbow trout, but Don Peters, the local fisheries biologist, could not verify this. When he visited the site later that day, flows in the stream were less than 1 cubic feet per second (cfs). Apparently the reservoir outflow had been turned off or reduced considerably in the 2-3 days previous to the kill. It is not known if the reduced flows left fish stranded on the banks, but this is a possible explanation.

3. Tongue River below the Tongue River Reservoir, October 11, 1995. On this day, DNRC performed its annual dam safety inspection. To inspect the outlet tunnel, they had to shut down the outflow for four hours. U.S. Bureau of Reclamation and Fish and Wildlife Service personnel were on site and observed many dead fish -- hundreds, perhaps thousands -- in the first 1/3 of a mile below the dam. The fish were primarily crappie, but included bullheads, stonecats, dace, green sunfish and smallmouth bass.
4. Tongue River Reservoir, February 16, 1996. This was the first day that dead fish were observed in the reservoir along the face of the dam and in the plunge pool below the dam. Most of the fish were young-of-the-year crappie. Phil Stewart, Fisheries Manager in Miles City, speculated that the cause of the die-off was natural. The fish may have been stressed prior to the kill from low dissolved oxygen levels persisting throughout the winter. The warm spell in February brought warm water to the reservoir (high 40s to low 50s) which overlaid the colder water (32-33^{o}) and could have caused temperature shock. The combination of low oxygen and temperature shock may have triggered the kill.
5. Clark Fork River, March 16, 1998. Two dead mountain whitefish each about eight inches long were found 0.5 mile below the Racetrack Creek bridge. The cause of death is unknown. A possible reason for the fish kill may be that this was close to an area on the river where unvegetated streamside mine tailings deposits were unbermed and runoff from the area during the preceding warm weather washed metals into the river resulting in the death of the fish.
6. Cut Bank Creek, July 28, 1998. Several hundred mountain whitefish, one mountain sucker and one longnose dace were killed below the City Dam in Cut Bank. The reason for the fish kill probably was high water temperature.
7. Mill Creek, August 14, 1998. Twenty-four brown trout (12-15 inches long) and a large number of mottled sculpins were found dead below Sheridan. The reason for the fish kill is not known but may be because of high water temperature or an unreported acrolein spill.

Additional information about fisheries or fish kills may be obtained from the FW&P.

Toxics and Carcinogens

Catch-and-release fishing regulations remain in effect for Silver Creek (tributary to Hauser Lake) because of mercury contamination from past mining activities. Meal guidance for fish with the level of contamination found in Silver Creek is to not eat any of the fish in Silver Creek. The source of mercury in Silver Creek is probably from the historic use of mercury to recover gold from ore taken from mines in the upper part of the drainage. Current fishing regulations do not allow fish from this stream to be harvested or eaten. This is the only fish consumption related closure in the state.

The total waterbody size affected by toxins is presented in Table 12. The principal man-caused toxins impacting water quality are heavy metals and arsenic associated with mining of metals and coal.

Table 12
Assessed Waterbody Size Affected by Toxics

Waterbody Type	Size Assessed for Toxics	Size with Elevated Levels of Toxics
Streams(miles)	7,660	4,923
Lakes(acres)	374,514	321,524

Natural sources of arsenic cause most toxic impacts on waterbodies in Montana. Geothermal sources associated with the Greater Yellowstone Ecosystem have affected the Madison, Yellowstone, and Missouri rivers. Geologic materials in the watersheds of the Milk, Powder, and Tongue rivers have contributed arsenic to the associated waterbodies.

The maximum acceptable excess lifetime risk of cancer caused by exposure to arsenic has been identified as one case per one thousand people and one per hundred thousand for all other carcinogens (MCA 75-5-301(2)(b)(i)). Studies of human population responses to ingesting a wide range of drinking water arsenic concentrations [7,8] were used as a basis for the adopted Montana human health standard of 18μg/L total recoverable arsenic. The EPA drinking water standard is 50μg/L arsenic[9].

Arsenic and heavy metals, both of which are on the priority pollutant list, are commonly associated with metals mining and processing, and have been the most commonly analyzed toxins. Water samples are analyzed for organic pollutants they these are suspected to be present. (Please refer to the Department Circular WQB-7 if more information is needed regarding toxins and carcinogen criteria).

[7] Tseng, W.P., 1977. Effects and dose-response relationships of skin cancer and Blackfoot disease with arsenic. Environ. Health Perspect. 19:109-119.
[8] Tseng, W.P., H.M. Chu, S.W. How, J.M. Fong, C.S. Lin, S. Len, 1968. Prevalence of skin cancer in an endemic area of chronic arsenicism in Taiwan. J. Natl. Cancer Inst. 40(3):453-463.
[9] U.S. EPA, 1986. National primary drinking water regulations, 40 C.F.R. Part 141, July 1, 1986 edition.

Lakes Water Quality Assessment

Summary Statistics

Total Size
Montana, including the seven Indian reservations within the state's boundaries, has 7,004 perennial lakes, reservoirs and ponds larger than 5 acres. All are assumed to have public access. Combined, they cover 833,964 acres and are considered to be "significant publicly owned lakes" for the purpose of reporting under Section 314 of the federal Clean Water Act. The term "lake" as used in this chapter means "significant public lakes" as described above.

Use Support
The ability of Montana lakes to support aquatic life, swimming, and drinking water uses is summarized in Table 13. Assessment of use support is based on a comparison of lake information with Montana Surface Water Quality Standards.

Table 13
Summary of Aquatic Life,
Swimming and Drinking Water Use Support

Use	Lake Acres			
	Supporting	Partially Supporting	Not Supporting	Support Unknown
Aquatic Life	113,964	683,226	0	36,774
Swimming	457,556	337,228	3,800	35,380
Drinking Water	463,563	18,195	315,428	36,778

Only 14 percent of Montana's lake acres fully support fish and aquatic life. That is because reservoirs, which comprise most of Montana's lake acres, have inherent problems due largely to water level fluctuations that make them less than ideal habitats for fish and aquatic life.

Well over half of Montana's lake acres support swimming. Support of swimming depends on the levels of nutrient enrichment, algal growth, and bacterial contamination.

Twenty-nine percent of Montana's lake acres do not support drinking water use. This is due largely to naturally elevated levels of arsenic in the large mainstem reservoirs of the Madison and Missouri rivers. The arsenic originates in the geysers and hot springs of Yellowstone National Park.

Support of uses is unknown for the four percent of Montana's lake acres that remain unassessed.

Lakes Assessed
A total of 183 lakes covering nearly 800,000 acres have been assessed for their support of various uses (Table 14). Assessed lakes are those for which the state has made use support decisions based on actual water quality information. Assessed lakes, including all of Montana's largest lakes and reservoirs, comprise only 3 percent of all lakes but 96 percent of all lake acres in the state.

Lakes Evaluated
A total of 148 lakes comprising 107,061 acres have been evaluated to determine their support of uses (Table 14). Evaluated lakes are those for which use support is determined on the basis of information other than current water quality data. For evaluated lakes, use support decisions may be based on land use data, reservoir operations, location of sources, and other information.

Table 14 Assessed Lakes in Montana by Assessment Category				
Unit	**Assessment Category**		**Total**	
	Evaluated	**Monitored**	**Assessed**	**Not Assessed**
Number of Lakes	148	35	183	6,821
Acres of Lakes	107,061	691,523	798,583	35,381

Total Lakes in Montana = 7,004 Lakes
Total Lake Acres in Montana = 833,964 Acres

Lakes Monitored
Thirty-five lakes, comprising of 691,523 acres, are being "monitored" (Table 14). Monitored lakes are those with current data on water quality conditions which can be used to determine if the waterbody's uses are being supported. Lake monitoring in Montana is supported by EPA grants and conducted by DEQ, the Flathead Lake Biological Station (UM), and volunteer monitors. Volunteers are trained and coordinated by DEQ, the Flathead Basin Commission, the Montana Science Institute, and DFWP.

Sources of Impairment
Agriculture is the leading source of impairment to Montana lakes (Table 15). Other sources of impairment are:

1. Natural sources (including arsenic in the Madison and Missouri River reservoirs)
2. Dam operations
3. Municipal sewage plants
4. Air pollution (The leading source of phosphorus in Flathead Lake is atmospheric deposition-i.e., dust and smoke.)

Point sources of pollution (municipal and industrial discharges) impair use support of 133,929 lake acres in Montana. Nonpoint sources of pollution (the remaining sources in Table 13), impair approximately 549,297 lake acres.

Causes of Impairment
Algae-stimulating nutrients (i.e., phosphorus and nitrogen) are the leading causes of impairment in Montana lakes (Table 16). Nitrogen and phosphorus originate from polluted runoff, municipal wastewater treatment plant effluent, septic tanks, and other sources. Excess nutrients lead to the growth of nuisance aquatic plants, reduced water clarity, and may cause dissolved oxygen deficits. Nutrients impair more than half of Montana's lake acres.

Other leading causes of lake impairment are:

1. Water level fluctuations in reservoirs due to dam operations
2. Metals (natural arsenic in Madison and Missouri River reservoirs)
3. Suspended solids (silt)
4. Nuisance aquatic plants (algae)
5. Organic enrichment.

Clean Lakes Program
In the past, States received Clean Lakes Program grants from EPA under 314 of the federal Clean Water Act. Montana's Clean Lakes Program consisted of:

- Diagnostic and feasibility studies on Swan Lake, Georgetown Lake and Flathead Lake
- Statewide lake assessments using volunteer monitors
- A survey of fish contaminants in 20 popular fishing lakes
- Development of lake biocriteria

Table 15
Acres of Lakes Not Fully Supporting Uses by Various Source Categories

Source	Acres Impacted
Municipal Point Sources	132,959
DOMESTIC WASTEWATER LAGOON	970
AGRICULTURE	370,015
Non-irrigated Crop Production	14,936
Irrigated Crop Production	299,364
Range Land	278,751
Silviculture	34,332
Highway/Road/Bridge Construction	4,520
Land Development	10,469
Resource Extraction	1,620
Subsurface Mining	1,600
Placer Mining	1,600
Petroleum Activities	9
On-site Wastewater Systems (Septic Tanks)	44,257
Dam Construction	59,649
Flow Regulation/Modification	270,779
Atmospheric Deposition	126,007
Highway Maintenance and Runoff	9
Contaminated Sediments	1,520
NATURAL SOURCES	41,934

Table 16 Acres of Lakes Not Fully Supporting Uses by Various Cause Categories	
Source	**Acres Impact**
METALS	32,739
Other inorganics	3,996
Nutrients	452,446
pH	20
Siltation	67,137
Organic enrichment / Dissolved Oxygen	259,353
SALINITY / TDS / CHLORIDES	31,347
Thermal modifications	25,918
Flow alteration	346,399
OTHER HABITAT ALTERATIONS	5,549
Pathogens	13,312
Oil and grease	9
Suspended Solids	311,265
Noxious aquatic plants	306,116

Background
The numbers and acres of lakes of various sizes in Montana are given in Table 3 (pg. 6) and Figure 4 (pg. 6.) As the figures indicate, well over half of Montana's lake acres are in a few large lakes and reservoirs, including Fort Peck, Flathead, and Canyon Ferry. Although there are more than 3,000 bodies of water in the less-than-5-acre category, together they account for only about 10,000 acres. Most of the small waterbodies are private stock ponds in eastern Montana.

The Clean Lakes Program has not been funded for the past three years. Instead, EPA has suggested that Clean Lake program "projects" should be funded under the 319 Nonpoint Sources Pollution Program (NPS). Currently (1998) state government in Montana is using funding from the Nonpoint Source Program to fund the development of lake water quality and shoreline protection educational materials for northwestern Montana. The grant is sponsored by the Flathead Conservation District and was awarded to DFWP (Region 1, Kalispell).

Trophic Status
Trophic status relates to the degree of nutrient enrichment of a lake and its ability to produce algae. Although department staff and volunteers in Montana have subjectively determined the trophic status of about 1,500 lakes [see 1994 Montana 305(b) report], DEQ has abandoned subjective assessments in favor of the objective and more reliable Carlson trophic state index [10].

[10] Carlson, R.E., 1977. A trophic state index for lakes. Limnology and Oceanography, vol.22, no.2, pp. 361-369.

Carlson's index is based on summertime measurements of Secchi depth, total phosphorus, and chlorophyll a in surface waters determined through standard collection and analytical methods. Trophic status is based on the average of the Carlson index values computed for the three variables. An average index value of 35 is used as the transition value between oligotrophic and mesotrophic lakes; an average value of 50 is considered the transition between mesotrophic and eutrophic lakes.

DEQ has determined trophic status for 177 lakes covering 797,184 acres (Table 17). These "assessed" lakes are lakes for which the state has made trophic status decisions based on actual water quality data. Trophic status determinations have yet to be made for a number of lakes for which trophic status data are available.

Most of the lakes and lake acres assessed so far have been classified as mesotrophic. Mesotrophic lakes, like Fort Peck Reservoir, have moderate levels of nutrients, produce moderate growths of algae, and have water clarity intermediate between the crystal clear waters of oligotrophic lakes and the "pea soup" often displayed by eutrophic and hypereutrophic lakes.

Oligotrophic lakes comprise the next largest group. Oligotrophic lakes, such as Flathead Lake, are nutrient poor, produce small amounts of algae, and have very clear water. Algae blooms, if they occur, are infrequent and of limited duration. However, these lakes are very sensitive to inputs of nitrogen and phosphorus from sewage, polluted runoff, air pollution, and other sources. Eutrophic and hypereutrophic lakes are in the minority in Montana. Eutrophic lakes, like Canyon Ferry Reservoir, have abundant nutrients and often produce thick blooms of algae. They may also have low levels of dissolved oxygen and produce high densities of unwanted rough fish (carp, for example). Some Mesotrophic lakes and most eutrophic lakes are capable of producing periodic blooms of bluegreen algae that are toxic to people, pets, livestock, and wildlife.

Table 17
Trophic Status of Significant
Publicly Owned Lakes in Montana

Status	Number of Lakes	Acres of Lakes
Total	7,004	833,964
Assessed	177	797,184
Oligotrophic	49	289,569
Mesotrophic	71	425,599
Eutrophic	46	81,495
Hypereutrophic	1	500
Dystrophic	10	22
Unknown	6,827	36,780

Control Methods

Since practically all pollution sources in Montana are upstream from a lake, all federal Clean Water Act and state Water Quality Act programs administered by DEQ control sources of lake pollution to one degree or another. Programs include:

- Monitoring, Assessment and Planning
- Clean Lakes
- Montana Pollution Discharge Elimination System discharge permits
- Stormwater
- Pollution Prevention
- Pretreatment
- Groundwater
- Construction Grants
- Nonpoint Source/Wetlands
- Water Pollution Control (compliance with nondegradation rules, water quality standards, and mining permits)
- TMDL

Montana Surface Water Quality Standards apply to lakes and streams (see Montana Water Classification System and Water Quality Standards). The Montana Sanitation in Subdivisions Act also provides significant protection to lakes by controlling the release of septic leachates.

Some tribal, county and city ordinances have been passed and are being enforced to protect lakes in Montana. Included are the lake-shore protection ordinances of Missoula and Flathead counties and the Confederated Salish and Kootenai Tribes. Phosphate detergent bans have been implemented by Lake and Flathead counties (primarily to protect Flathead Lake) and by several towns along the Clark Fork River (to protect the river and Lake Pend Oreille, into which the Clark Fork flows in Idaho). A nutrient TMDL has also been completed for the Clark Fork River, and one is nearly complete for Flathead Lake (jointly with Confederated Salish and Kootenai Tribes).

Flathead Lake, at 126,000 acres, is the largest natural freshwater lake in the West and among the cleanest of the world's major lakes. It is also a mainstay of the economy of northwest Montana. In 1984, the Montana Department of Health and Environmental Sciences, predecessor to DEQ, prepared a "Strategy for Limiting Phosphorus in Flathead Lake," which set in motion several initiatives to protect the lake.

Besides county lake-shore protection ordinances and phosphate detergent bans, Flathead Lake has benefited from many activities sponsored by the Flathead Basin Commission (FBC). Three of the most significant are a public information/education campaign, the Volunteer Monitoring Project, and the Forest Practices/Water Quality and Fisheries Cooperative Program. The FBC has been participating in a Flathead County planning effort and investigating whether shoreline erosion could be reduced by modifying operations of Kerr Dam at the lake's outlet to stabilize lake levels. Flathead Lake also benefited from action by the International Joint Commission (IJC) regarding a proposed coal mine in British Columbia. The IJC recommended against coal mining and for establishing a zone of cooperation between the U.S. and Canada in the North Fork of the Flathead watershed. The Flathead Basin is the only drainage in Montana where advanced treatment (nutrient removal) is required of all municipal wastewater discharges.

Restoration and Rehabilitation Efforts

Pollution control efforts employed to protect Montana lakes are outlined below. DEQ cooperates with several other jurisdictions to protect lakes. The agency is represented on the Clark Fork/Pend Oreille Tri-State Implementation Council and the Flathead Basin Commission.

A final Flathead Phase I report, completed in April 1994, includes recommended management measures. DEQ has cooperated with the Confederated Salish and Kootenai Tribes in developing a nutrient TMDL for Flathead Lake, and also shares lake information with the Blackfeet Nation, which also had its own Section 314 Clean Lakes Program. DEQ also works on lake protection with private, non-profit groups, including the Flathead Lakers and the Montana Science Center.

The Swan Lake Phase I (diagnostic and feasibility) study that was funded by the Clean Lakes Program was completed in 1994. EPA has provided further funding to develop a TMDL for Swan Lake. The funding was used for a sampling design to monitor the Swan River. The objective is to determine the sources of organic carbon and nutrients that may be contributing to a dissolved oxygen deficit in Swan Lake. This sampling was completed in 1998.

Volunteer monitoring has continued in northwestern Montana and is being coordinated by the Flathead Basin Commission and DFWP (Region 1, Kalispell). However, continued funding for the volunteer monitoring of lakes is uncertain. Biocriteria development projects for lakes are not currently funded.

Fish contamination surveys are being conducted by DFWP and the Montana Department of Public Health and Human Services. In 1994, these agencies submitted a report to EPA summarizing the findings of these surveys for PCBs and mercury in 20 of Montana's most popular fishing lakes. PCB levels up to 0.94 ug/g were found in lake trout from Flathead Lake. The source of PCBs was not identified. Mercury concentrations in large predatory fish species were moderately high (between 0.4 and 1.4 ug/g in Bighorn Lake, Flathead Lake, Fresno Reservoir, Hebgen Lake, Lake Elwell, Lake Francis, Tongue River Reservoir, and Nelson Reservoir. Elevated mercury in these fish is believed to result from natural physical and chemical conditions that occur in these impoundments, rather than from human-caused contamination.

Acid Effects on Lakes

Since 1991, the USFS has sampled 200 high-elevation wilderness lakes in Montana to assess their sensitivity to airborne contaminants. The Wilderness Lake Survey has been conducted through the USFS Region One in Missoula under the Air Resource Management Program. The principal measure employed in this survey is acid-neutralizing capacity (ANC), although field pH and other parameters are also measured. The 200 lakes sampled to date cover about 1,000 acres.

Although a number of lakes in the Wilderness Lake Survey had pH values less than 7.0, most of those were believed to be naturally acidic and poorly buffered. Only one lake, Goose Lake on the Gallatin National Forest near Cooke City, had a pH less than 6.0. Goose Lake, which is about 75 acres, is believed to be the only lake in Montana in which an acid condition has been made worse by human activities. The source of the acidity is residual mine tailings and adit discharges. There are no plans for restoration or mitigation at this site.

Toxic Effects on Lakes

Most of the mainstem reservoirs along the Madison and Missouri rivers exceed the drinking water MCL (maximum contaminant level) or Human Health Standard for arsenic. This arsenic is released by geothermal activity in Yellowstone National Park.

Agriculture is the source of selenium and other trace elements exceeding water quality standards in several artificial impoundments. Past mining is the cause of elevated heavy metals in Lake Helena at the mouth of Prickly Pear Creek.

Trends in Lake Water Quality

Flathead Lake (126,000 acres) is the only Montana lake for which long-term trend data are available. Mean annual primary productivity at a site near the midpoint of the lake has been increasing since 1978. Although Flathead Lake remains oligotrophic, this increase represents an accelerated rate of eutrophication and a degrading trend. Other evidence of declining water quality in Flathead Lake is heavier periphyton growths along the shoreline and development of seasonal hypolimnetic oxygen deficits in the Ross Deep area of Big Arm Bay.

WETLAND ASSESSMENT

Introduction

For many years, wetlands were viewed as wastelands. With support and encouragement from the federal government, ranchers, farmers and developers converted marshes and wetlands to what were then deemed more "productive uses"-- pastures, croplands and urban areas. It is now recognized that wetlands serve highly important ecological, economic, recreational, and aesthetic functions. Wetlands benefit humans directly through functions such as flood water retention, sediment trapping, improving water quality, enhancing groundwater recharge, and providing recreational opportunities (Table 18).

Table 18. Wetland Functions and Societal Values

Wetland Function	Societal Value
Sediment retention	Water clarity for swimming and fishing
Floodwater storage	Reduced property damage from floods
Wildlife habitat	Waterfowl for hunting and nature observation
Groundwater recharge	Maintenance of drinking water supplies
Filtering pollutants	Maintenance of drinking water quality
Support for aquatic life	Maintenance of fisheries

Wetlands also provide environmental benefits and are vital to many Montana fish and wildlife species including threatened and endangered species such as whooping cranes, piping plover and bald eagles. Many freshwater fish and upland game birds rely on wetland habitats, which also provide stopover feeding and breeding grounds for migratory waterfowl. Some of the nation's most valuable waterfowl production areas are the prairie pothole region of the northern Great Plains, including wetlands of northeastern Montana. As Montana's tourism industry becomes increasingly important, so do the state's wetlands for the extensive opportunities they provide for fishing, hunting, camping and viewing wildlife.

The value of wetlands was not recognized until the effects of reduced wetland functions were noticed. For example, sportsmen gradually began to notice a decline in the numbers of fish and wildlife. Flooding along rivers and shorelines increased over historical levels. The public began to recognize that wildlife habitat; water pollution control, groundwater recharge and flood control were direct benefits of wetland preservation. With this recognition has come an expanded interest in protection, conservation, and management of Montana's remaining wetlands.

Wetlands are included as "waters of the state" and therefore are provided the protection associated with other state surface waters. However, wetland water quality standards have not been developed in Montana and wetlands differ greatly from surface water, so applying surface water quality standards to wetlands is often not appropriate. No single federal, state, local or tribal program addresses all activities that affect wetlands. Existing wetland protection and conservation programs are limited in scope, do not address all problems, are not well coordinated, and are often hindered by insufficient data and information. Montana has recently expanded its wetland program to provide better wetland protection and conservation through increased coordination and targeted action.

State government of Montana has designated DEQ as the lead state agency regarding wetlands. DEQ staffs and provides leadership to the Montana Wetlands Council, administers the EPA Wetland Protection Grant program, administers the federal Clean Water Act (CWA) Section 401 certification, is developing bioassessment protocols for wetland water quality standards, and provides wetland enforcement actions. Further, DEQ through the grants program provides contract oversight for wetlands education, hydrogeomorphic assessment (HGMA) development, wetland inventory and mapping, database development, and clearinghouse functions. Related activities include general statewide wetland planning and inter-agency coordination on wetland issues.

Extent of Resources/Wetland Trends

No one knows for sure how many acres of wetlands Montana had before European contact. Further, the number of acres converted to cropland, pasture, urban areas or other uses has never been determined. One commonly cited study (Dahl 1990) estimates that 27 percent of Montana's wetlands have been lost since colonial times (Table19). This loss is significant because wetlands comprise less than 1 percent of the total surface area of Montana. The 1982 Montana 305(b) report to EPA said: "Precious little is known about Montana wetlands except that they are disappearing." The Montana FW&P (1992) agreed, and forecast that "a continuing general decline in the wetland base in the state appears most probable."

Table 19. Wetland Losses in Montana 1780's to 1980's (Dahl 1990)

Surface Area (acres)		Wetlands				
Land	Water	1780's Est. Wetlands	% Surface Area	1980's Est. Wetlands	% Surface Area	%Wetland Loss
93,185,920	982,400					
		1,147,000	1.2%	840,300	0.9%	27%

Despite laws enacted to protect them, wetlands throughout the U.S. continue to be lost each year, though the rate of loss in recent years has slowed. Dahl, Young and Caldwell (1997) report that wetland restoration activities may be contributing as much as 78,000 acres per year to the national wetland base; however the average annual net loss of wetlands is still 117,000 acres. This rate of loss has declined by 60 percent from the period 1985-1995. A variety of activities such as filling, dredging, draining, flow and vegetation modification, flooding, nonpoint source runoff, and other contamination affect wetlands. On a national basis, 79 percent of wetland loss to upland is a result of agriculture, 6 percent to urban development and 15 percent to other upland land uses.

Montana does not yet have a baseline inventory or tracking system of wetland restoration and loss to provide statewide statistics.

Wetland Classification and Assessment

Background

Unfortunately, there is no single, universally accepted classification or assessment scheme for wetlands. Wetland classification is intended to define different types of wetlands, while wetland assessments are intended to evaluate the functions of a wetland. Functions relate to the ecological significance of wetland properties without regard to subjective human values. Methods for classifying and assessing wetlands are numerous. The National Wetlands Newsletter (March-April 1998) reports that in the last decade more than 40 rapid wetland assessment techniques have been developed for different situations and different uses.

The U.S. Army Corps of Engineers (ACOE) Regulatory Division is required to consider impacts to wetland functions and values when evaluating a CWA Section 404 permit application. Section 404 established a program to regulate the discharge of dredged and fill material into waters of the U.S. including wetlands. A jurisdictional wetland delineation is required to determine if an area is a wetland for ACOE regulatory purposes. A jurisdictional wetland delineation is different than a wetland classification or assessment. See Section 401 Certification for information on the state's role in Section 404 implementation.

The lack of a universally accepted classification or assessment scheme for wetlands has made evaluating impacts to wetlands difficult. The following classification and assessment methods are being used or developed for Montana.

Cowardin Classification and the National Wetland Inventory (NWI)
In 1974, the U.S. Fish and Wildlife Service (USFWS) was directed to design and conduct the National Wetlands Inventory (NWI). The NWI was developed to classify and map all U.S. wetlands, to establish a wetland database for the entire country, and to develop statistics that could be used to evaluate wetland status and trends. In 1979, USFWS adopted the Cowardin *et al.* (1979) classification system for wetland and deep-water habitats of the U.S. The Cowardin *et al.* classification system was developed to be used with the NWI to provide national consistency for mapping, data bases, concepts and terms. This classification describes ecological taxa. In the highest level of Cowardin's classification, wetlands are grouped into five ecological systems: palustrine, lacustrine, riverine, estuarine, and marine. The palustrine class includes only wetlands; the other four classes include wetlands and associated deep-water habitats. Deep-water habitats are defined as areas where water is greater than 6.6 feet deep. Only the palustrine, lacustrine and riverine wetland types exist in Montana.

The NWI is complete for about 89 percent of the continental U.S., but only about 20 percent of Montana has been completed. The Montana Wetlands Council (discussed in more detail later) has supported completion of the NWI and development of a wetland database for Montana. DEQ has submitted a state grant proposal to assist in the completion of the NWI and is actively seeking financial partnerships with other agencies and groups. DEQ also is working to develop a cooperative effort among state and federal agencies and others to complete and digitize national wetland inventory maps covering the state.

Hydrogeomorphic Functional Assessment (HGMA)
The HGMA method for wetland classification and functional assessment is currently under development by ACOE in conjunction with other state and federal agencies and the academic community for use in Montana. This approach uses a hydrogeomorphic classification of wetlands to assess wetland functions (Brinson 1993) and is based upon the wetland's position in the landscape, the dominant source of water and the flow and fluctuation of water in the wetlands. Brinson describes seven classes: riverine, depressional, slope, mineral soil flats, organic soil flats, estuarine fringe, and lacustrine fringe. The HGMA method is intended to satisfy technical and regulatory requirements, and a variety of other local government planning and management situations requiring assessment of wetland functions.

Federal regulations require use of the HGMA in evaluating all applications for 404 permits where HGMA methods have been developed into a guidebook. At this time, (November 1998) few regional guidebooks are complete. However, two recently completed HGMA guidebooks are applicable to Montana; one for shallow depressional montane potholes and one for riverine wetlands. Both guidebooks were developed for the Northern Rockies Intermountain West Region. Weeklong training sessions were held for Montana field personnel in the summer and fall of 1998 to familiarize them with the two HGMA guidebooks. An HGMA guidebook on prairie potholes also has been developed and is being tested for use in Montana.

Index of Biotic Integrity (IBI)
The Index of Biotic Integrity (IBI) method is another approach at evaluating wetland functions. Montana is using IBI to develop wetland biocriteria which will be used later to help determine wetland water quality standards. Montana DEQ's work on IBI is discussed in more detail in the wetland water quality section.

Proper Functioning Conditioning (PFC)
PFC is a methodology for assessing the physical functioning of a riparian-wetland area. It provides information critical to determining the 'health' of a riparian-wetland ecosystem. PFC considers both abiotic and biotic components as they relate to the physical functioning of riparian areas, but does not consider the biotic component as it relates to habitat requirement.

The BLM is required to evaluate the functional condition of all riparian and wetland areas, running water (lotic) areas and still water (lentic) areas, using the principles in Riparian Area Management, Process for Assessing Proper Functioning Condition (Barry et al. 1995, Bridges et al. 1994). This system uses a qualitative, rapid assessment checklist to provide information on whether a riparian-wetland is functioning in a manner which will allow the maintenance or recovery of desired values (i.e., fish habitat, forage etc).

Montana Department of Transportation Field Evaluation of Wetlands
In 1989 the Montana Department of Transportation (MDT) and other state agencies developed a Wetland Field Evaluation Form for reviewing proposed projects relating to transportation and other developments that might affect wetlands. The method was primarily designed to evaluate linear projects such as highways, pipelines and transmission lines, and is not to be used to delineate jurisdictional wetland boundaries. The field form was revised in 1996 and the objectives are to provide a rapid, economical and repeatable, Montana-applicable wetland evaluation method that:

1. meets the needs of local regulatory agencies in terms of quantifying jurisdictional wetland functions and values with respect to the majority of proposed wetland disturbance-related and mitigation projects in the state;
2. minimizes subjectivity and variability among evaluators;
3. provides a means of assigning overall ratings to wetlands; and
4. incorporates some of the principles of the hydrogeomorphic assessment (HGMA) method to foster use of the revised form as an interim method until HGMA is fully implemented in Montana.

Classification of Montana's Riparian and Wetland Sites
A more detailed riparian and wetland vegetation-based ecological site classification for Montana was developed by BLM and the Montana Riparian and Wetland Association for running water, still water, and large river systems (Hansen *et al.* 1995). The purpose of this classification was to assist resource managers in the identification, description, communication and management of riparian and wetland areas. Vegetative field data were collected and the communities and habitat types were determined using Classification and Management of Montana's Riparian and Wetland Sites.

Wetland Biological Criteria
Montana initiated the development of wetland biocriteria in 1992 with funding from EPA's State Wetlands Protection Program, as defined in Section 104(b)(3) of the Clean Water Act. At that time, the State of Montana Department of Health and Environmental Sciences (reorganized in 1996 as DEQ) had little information concerning the status or trends of the water quality of Montana's wetlands. Further, Montana's water quality standards were developed to protect the beneficial uses (e.g., aquatic life) of lakes, rivers and streams. Many of Montana's water quality standards are not applicable for most wetlands. For this reason, DEQ is attempting to develop bioassessment protocols and water quality standards that will more adequately evaluate and protect the aquatic life that live in wetlands.

DEQ sampled diatom and macroinvertebrate communities and associated environmental variables from 80 Montana wetlands. The study was designed to sample approximately 75 percent reference sites and 25 percent impaired sites (i.e., having notable anthropogenic impacts). Diatoms were collected as a composite grab sample, identified to the lowest taxonomic level possible and analyzed using multivariate analysis. Macroinvertebrates were collected using a 1 mm mesh D-net, identified to a standardized taxonomic level and assessed using multimetric techniques. The wetlands were classified using ecoregions and hydrogeomorphology and using water-column chemistry. DEQ found that diatoms and macroinvertebrates were most useful for evaluating the biological integrity of perennial wetlands with open water environments that had relatively stable water levels and were not excessively alkaline or saline. DEQ concluded that multivariate analysis was a useful tool for developing a wetland classification system and that hydrogeomorphology and ecoregions were practical approaches to classifying wetlands for the development of biocriteria. DEQ determined that the multimetric and multivariate techniques were effective for analyzing the biological data. In most cases, both approaches used to assess the macroinvertebrate and diatom communities identified the same wetlands as impaired.

Section 401 Certification.

CWA Section 401 gives states the authority to affect the issuance of federal permits or licenses for activities over which states do not have primacy. In Montana, these include Section 404 permits issued by ACOE for any construction in "waters of the U.S." including wetlands and for issue or renewal of hydropower licenses by the Federal Energy Regulatory Commission (FERC). Section 401 specifically requires all applicants for these federal permits to obtain from the state a certification that the project is acceptable and will not violate state water quality standards.

The state can either approve, deny or waive certification on any project and its decision is binding upon the federal permitting agency. An approved certification is a positive statement that the project is acceptable and will not violate water quality standards or any appropriate requirement of state water policy or law. Typically, certifications contain conditions under which the project is approved. Any condition imposed by a certification automatically becomes a condition on the federal permit and is enforceable by the permitting agency.

The state can effectively veto a federal permit by denying certification. Federal agencies are prohibited from issuing a permit for an activity for which certification has been denied by the state. Certification denials are rare. Most projects can be conditioned to give reasonable assurance that water quality will be protected. If DEQ waives its certification, then it forfeits its ability to affect the conditions of the federal permit. State authority is waived automatically if the state fails to act on an application within "a reasonable amount of time." This is usually within 60 days of the acceptance of a completed application but can be up to one year for complicated projects.

DEQ and ACOE have established a joint permitting procedure for the issuance of 404 permits and 401 certifications. An applicant needs only to submit a single application to ACOE, which then supplies DEQ with all the needed information to complete the certification. ACOE issues a public notice that also serves as a notice for the state certification.

On routine projects, the certification process does not necessarily require the applicant to have direct contact with DEQ. For complicated projects, DEQ contacts the ACOE if the original application lacks important information or if the certification will contain complex conditions. Usually, in these situations, ACOE and DEQ jointly, in direct consultation with the applicant, attempt to arrive at a reasonable solution. Certification is withheld until the questions or issues are resolved. Joint procedures such as these have not been established with FERC for power licenses. These projects are usually more complex than projects requiring a 404 permit and there are very few FERC hydropower licenses in the state.

DEQ does not track the type of activities permitted or the number of 401 certificates issued. DEQ is actively working with ACOE to gain access to its permits data base (RAMS). With access to RAMS, the state will be able to better track and determine ACOE permit activity statistics. Usually, MDT is the largest single 404 permitting entity in Montana. In recent years, two oil and gas pipelines were permitted to cross Montana and involved issuance of many 404 permits. Most ACOE 404 permits involve aquatic resources other than wetlands. Stabilization of river banks and maintenance of stabilization-related structures are the most common.

DEQ certifies the ACOE nationwide permits once every five years. Once DEQ has certified a nationwide permit, all activities covered by that permit are approved for the 5-year term of the permit. During the most recent nationwide permit certification cycle, DEQ denied certification of several nationwide permits. The primary concern was that cumulatively the use of these nationwide permits in Montana, without appropriate mitigation, might adversely affect aquatic resources. Montana DEQ denied certification of nationwide permits #12 - utility lines, #13 - bank stabilization, and #26 - isolated wetlands/headwaters.

Additional Wetland Protection Activities

Montana Wetlands Council

The Montana Wetlands Council was formed in the fall of 1994 and meets quarterly in Helena. The Council is a forum that promotes cooperative wetland management in Montana. The Council's mission is to develop a formal strategy and coordinate efforts to protect, conserve and enhance Montana's wetlands for present and future generations. The Council supports environmentally responsible wetland stewardship through the cooperation of pubic and private interests. Membership is open to all. Individuals and organizations representing agriculture, conservation, consultants, federal government, land trusts, local government, Montana Legislature, mining, other industry, real estate development, recreation and outdoor sports, state government, tribal government, water/wetland organizations, education groups, and the wood products industry are on the Council mailing list and attend and participate in Council meetings.

Conservation Strategy for Montana's Wetlands

The Montana Wetlands Council developed a draft Conservation Strategy for Montana's Wetlands (DEQ 1997). A Situation Assessment (Consensus Associates 1998) was conducted in early 1998 to determine support for finalizing the draft Conservation Strategy and for priority actions to implement. Results from the Situation Assessment that were supported by the Wetland Council recommended that the state not spend additional time, energy or resources finalizing the draft Conservation Strategy, instead effort should go toward action and implementation. The Montana Wetlands Council is actively implementing strategy components that were supported by all interest groups.

Priority action items include public education in wetland matters, distribution of wetland information, development of a baseline wetland inventory and wetlands data base for the state, and, for private landowners, technical and financial assistance and incentive programs for wetland conservation or restoration on their land.

Wetland Grant Program

DEQ administers the EPA Wetland Development Protection Grants program to state and local governments. The grant program began in 1991. The grants are awarded competitively within EPA Region 8 that includes 6 states and 26 tribal governments. The purpose of the wetland grants program is to assist state, tribal and local government agencies in wetland protection. Montana state and local governments typically have received wetland grants between $250,000 and $400,000 per year. Twenty-two contracts are currently (November, 1998) active and administered by DEQ.

DEQ issues requests for grant proposals in the early fall each year. Proposals are submitted to DEQ typically in mid-October and are reviewed by a state review committee. Project sponsors are given an opportunity to revise their proposals if needed. Revised proposals are ranked by the review committee and submitted to EPA for funding in early December of each year. EPA awards grant funding to DEQ and contracts are written with project sponsors for successfully funded proposals for work beginning July 1.

Past funding has gone to numerous groups and agencies including:

* DEQ, to develop and implement wetland conservation strategy and priorities identified by the state-wide Wetlands Council and to develop biocriteria for wetland assessments.
* Montana Watercourse, to develop information and education programs, materials and public service announcements on wetland conservation for Montanans.
* Montana DNRC, to help fund local conservation district riparian workshops and wetland and riparian portions of range management and other outreach programs.
* The Montana Watercourse, to develop wetland leadership training for EPA Region 8 states for community wetland protection programs.
* The Montana Riparian and Wetland Association, to conduct wetland workshops on ecological classification, management and restoration.
* Flathead Lake Biological Station, to help develop and test hydrogeomorphic models for wetland functional assessment.
* The Montana State Library, for wetland inventory and assessment, development of a wetland clearing-house and wetland database.
* Montana Department of Transportation, for wetland monitoring equipment and equipment training.
* Montana State University, for riparian forestry workshops.
* Montana Wetlands Trust, for a mitigation banking workshop.
* Lewis and Clark County Water Quality Protection District, for a local wetland inventory and education program.

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Surface Water Supplies and Public Health

EPA and the Public Water Supply Section of DEQ, required public water suppliers using surface water to address new surface water treatment requirements by June 29, 1993. EPA and DEQ adopted the requirements in response to the 1986 amendments to the Safe Drinking Water Act. Unfiltered surface water sources were required to be filtered, or to meet stringent watershed protection and water quality requirements. Filtered water supplies had to meet new standards for filtration and disinfection. Table 20 lists the few sources and municipalities that meet these requirements.

Table 20 Montana public water supplies and municipalities that meet raw surface water quality standards for turbidity and coliform bacteria concentrations.

Water Supply	Municipality Served
Basin Creek Reservoir	Butte-Silver Bow
Fred Burr Lake	Philipsburg
Indian Creek	Ronan
Ashley Creek	Thompson Falls*

*Thompson Falls currently is under a compliance schedule.

A few water suppliers chose to abandon their surface water sources and rely entirely on groundwater. Some suppliers were not able to meet the June 29, 1993, deadline for compliance, but most submitted schedules for compliance in advance of the deadline. Most of the suppliers using unfiltered surface water have received administrative orders to set compliance schedules for providing filtration. Three supplies probably will be able to continue to meet the watershed protection and water quality criteria and will therefore continue to avoid the need for filtration. Polson failed to meet some of the criteria to avoid the need for filtration and has abandoned the surface water source. Thompson Falls also failed to meet criteria to avoid filtration, and will either rely on groundwater, provide filtration treatment of its source (Ashley Creek), or evaluate the Ashley Creek springs for suitability as a groundwater source and have the springs classified as groundwater.

Approximately 329,000 people in Montana get their drinking water from 68 public water supplies using surface water. Table 21 shows the public water supplies in Montana that use surface water, the source of the surface water, and the populations (including transient populations) served by the system.

Most of the suppliers that must install filtration have applied for funding assistance. Some of these water supplies are very small and the installation of filtration treatment is expensive.

The community of East Glacier Park has been on a boil order since April 1994 because of water quality and water treatment problems. East Glacier has turbidity problems because of runoff and also does not have adequate chlorine contact time. The community is moving toward compliance, but is sorting out with the Blackfeet Tribe some difficult issues regarding jurisdiction, ownership, and water rights. East Glacier has received an EPA State Revolving Fund grant toward construction of a new water treatment facility.

The following communities have installed new surface water filtration plants: Pinesdale (in the Bitterroot), Seeley Lake, Libby, Neihart, and Seville Colony, near Cut Bank. State water quality authorities lifted a boil order for Neihart after the new system came on-line in 1996.

Other public water supplies using unfiltered surface water that are in the process of planning, designing or constructing surface water treatment plants in Montana include: Hill County Water Users, Whitefish, Essex, The Lodges Resort (near Seeley Lake), Spring Creek Lodge (near Thompson Falls), South Hills (near Billings), Denny's Underpass Inn (near Essex), and the Big Sky RV Resort near Rollins.

Outbreaks of Cryptosporidium in the United States have created an increased awareness of the risks of using unfiltered, or inadequately treated surface water for a public water supply. EPA is now developing new standards for surface water treatment. It is apparent that systems serving populations of more than 10,000 with surface water in Montana will have to meet even more stringent standards in the future. Even smaller surface water systems will have to comply with the same standards, but at a later date.

TABLE 21: MONTANA SYSTEMS THAT USE SURFACE WATER FOR DRINKING WATER			
System Name	**Source**	**Location**	**Population**
BIG SKY RV RESORT	FLATHEAD LAKE	ROLLINS	90
BILLINGS	YELLOWSTONE RIVER	BILLINGS	91,195
BOZEMAN	SOURDOUGH CREEK	BOZEMAN	28,522
BRADY	BYNUM RESERVOIR	BRADY	250
BUTTE	BASIN CK RESERVOIR BIG HOLE RIVER MOULTON RESERVOIR	BUTTE	34,051
CAMP TUFFIT	LAKE MARY RONAN	PROCTOR	150
CEDAR PARK	YELLOWSTONE RIVER	BILLINGS	85
CHESTER	TIBER RESERVOIR	CHESTER	952
CHINOOK	MILK RIVER	CHINOOK	1,586
CLEARWATER SUPPLY	CLEARWATER RIVER	GREENOUGH	100
COLSTRIP	CASTLE ROCK LAKE	COLSTRIP	3,100
CONRAD	LAKE FRANCIS	CONRAD	2,873
CULBERTSON	MISSOURI RIVER	CULBERTSON	819
CUT BANK	CUT BANK CREEK	CUT BANK	3508
DENNYS UNDERPASS INN	PINNACLE CREEK	ESSEX	100
DEVON WATER USERS	TIBER RESERVOIR	DEVON	70
E GLACIER CO W&S DIST	MIDVALE CREEK	EAST GLACIER	275
ESSEX	ESSEX CREEK	ESSEX	25
FORSYTH	YELLOWSTONE RIVER	FORSYTH	2,141
FORT PECK	FORT PECK LAKE	FORT PECK	226
GLACIER PARK INC	MIDVALE CREEK	E GLACIER PARK	700
GLASGOW	FORT PECK LAKE	GLASGOW	3,656
GLENDIVE	YELLOWSTONE RIVER	GLENDIVE	4,557
GOLDEN SUNLIGHT MINE	JEFFERSON SLOUGH	WHITEHALL	150
GREAT FALLS	MISSOURI RIVER	GREAT FALLS	57,758
HARDIN	BIG HORN RIVER	HARDIN	3,225
HARLEM	MILK RIVER	HARLEM	976
HAVRE	MILK RIVER	HAVRE	10232
HELENA	MISSOURI RIVER TEN MILE CK	HELENA	27,982
HELL CREEK	FORT PECK RESERVOIR	NEAR JORDAN	25
HILL COUNTY	FRESNO LAKE	HINGHAM	1,721
HYSHAM	YELLOWSTONE RIVER	HYSHAM	360

TABLE 21 (cont.) MONTANA SYSTEMS THAT USE SURFACE WATER FOR DRINKING WATER			
System Name	**Source**	**Location**	**Population**
LAUREL	YELLOWSTONE RIVER	LAUREL	6,125
LIBBY	FLOWER CREEK	LIBBY	2,701
LOCKWOOD	YELLOWSTONE RIVER	BILLINGS	5,373
LOGAN PASS	GLACIER MELT	WEST GLACIER	1,000
LOMA	MARIAS RIVER	LOMA	400
MCGREGOR LAKE	MCGREGOR LAKE	MARION	40
MELSTONE	MUSSELSHELL RIVER	MELSTONE	190
MILES CITY	YELLOWSTONE RIVER	MILES CITY	8,882
MT AVIATION RESEARCH CO	FORT PECK LAKE	GLASGOW	100
MT DAKOTA UTILITIES CO	YELLOWSTONE RIVER	SIDNEY	30
NEIHART	O'BRIEN CREEK	NEIHART	53
NORTH HAVRE	FRESNO RESERVOIR	HAVRE	100
ORCHARD HILLS	FLATHEAD LAKE	BIGFORK	60
PHILIPSBURG	FRED BURR LAKES	PHILIPSBURG	940
PIEGAN BORDER STATION	ST. MARY RIVER	BABB	25
PINES WATER SYSTEM	FORT PECK RESERVOIR	FORT PECK	25
PINESDALE	SHEAFMAN CREEK	PINESDALE	983
POWER TETON CO	MUDDY CREEK	POWER	150
RED LODGE	ROCK CREEK	RED LODGE	2,204
RIDGEWOOD ESTATES	FLATHEAD LAKE	BIGFORK	25
ROCK CREEK MARINA	FORT PECK RESERVOIR	FORT PECK	50
RONAN	CROW CREEK	RONAN	1,877
SEELEY LAKE	SEELEY LAKE	SEELEY LAKE	900
SEVILLE COLONY	CUT BANK CREEK	CUT BANK	110
SIDE OF THE ROAD	MISSOURI RIVER	NASHUA	60
SNOWBOWL LODGE	SPRING #1	MISSOULA	500
GIANT SPRINGS INC	GIANT SPRINGS	GREAT FALLS	3300
SOUTH HILLS	YELLOWSTONE RIVER	BILLINGS	150
SPRING CREEK LODGE	SPRING CREEK	THOMPSON FALLS	120
STEVENSVILLE	NORTH SWAMP CREEK	STEVENSVILLE	1,965
THE LODGES	SEELEY LAKE	SEELEY LAKE	50
THOMPSON FALLS	ASHLEY CREEK	THOMPSON FALLS	1,540
TIBER/ COUNTY WATER DIST.	TIBER RESERVOIR	CONRAD	500
WHITE SULPHUR SPRINGS	WILLOW CREEK	W SLPHR SPRINGS	964
WHITEFISH	HASKILL CREEK	WHITEFISH	5,793
YELLOWTAIL DAM	YELLOWTAIL RES	HARDIN	25

Groundwater Assessment

Summary

More than one half of the people in Montana rely on groundwater for household use. The most accessible and highest quality water is from alluvial aquifers and glacial outwash deposits wherever these are found in the state. Alluvial aquifers occupy river valleys and are shallow unconfined or semi-confined sand and gravel deposits. Glacial outwash deposits generally consist of gravel, cobbles, and boulders and are usually unconfined or semi-confined. Both of these types of aquifers are relatively vulnerable to pollution from human activities, with population growth and human developments posing the greatest risk to the alluvial aquifers, especially in the western part of the state. The challenge for Montana is to protect, sustain, and improve groundwater quality as more people and businesses move into the river valleys and on top of their source of water.

Status of Groundwater Quality

Overview of Groundwater Resources in Montana

Groundwater in Montana generally remains free of harmful levels of human-caused contamination. The unconsolidated alluvial aquifers and glacial outwash deposits that supply most public and private wells in Montana provide high quality and plentiful drinking water. Concentrations of dissolved solids in water from the western Montana alluvial aquifers commonly are less than 300 milligrams per liter (mg/L) contrasting with water from the eastern alluvial aquifers that usually exceed 1,000 mg/L. The higher quality but vulnerable aquifers of western Montana underlie approximately 16 percent of the state.

Bedrock aquifers in limestone in west-central and southwestern Montana and some of the aquifers in semi-consolidated Tertiary age deposits in northeastern and southwestern Montana are also vulnerable to contamination from human activities. This vulnerability is due to the potential for vertical or horizontal solution channels in the limestone and to surface exposure of the Tertiary deposits. These two aquifers occupy approximately 11 percent of the state.

Bedrock aquifers in the Cretaceous and Paleocene age sandstone under the eastern two-thirds of Montana generally are much less vulnerable to contamination from human activities due to the great depth to water and the widespread presence of low permeability confining layers. These aquifers underlie approximately 70 to 75 percent of the state.

Natural substances may affect water used for domestic or general agricultural purposes, especially in bedrock aquifers. While the national secondary drinking water standard for dissolved solids (TDS) is 500 mg/L TDS in some eastern bedrock aquifers exceeds 5,000 mg/L. Some water from eastern bedrock aquifers is suitable only as stock water. Water quality in bedrock aquifers tends to be highest near the recharge area.

Montana, the fourth largest state (147,046 square miles) in the United States, had a population of 879,000 people in 1998 and a population density of around six people per square mile. Montana has seven major urban areas, the largest of which is Billings in Yellowstone County with 126,000 people. Fifty nine percent of Montanans live in these seven metropolitan areas. The remaining population is rural and generally lives in small communities located along the alluvial valleys throughout the state. Approximately 618,800 residents or about sixty-nine-percent of the total population of Montana utilize a public system for domestic purposes (community PWS). An even larger percentage of the population uses water from public systems when considering the use of other types of PWSs such as restaurants, businesses, schools, and campgrounds. Only around 15 percent of the 645 community public water supplies are associated with incorporated towns or cities and almost half of the community public water systems serve fewer than 100 inhabitants.

Groundwater Characterization and Monitoring.
The 1991 Montana Legislature established the Montana Groundwater Assessment Program (GWAP), and directed the Montana Bureau of Mines and Geology (MBMG) to characterize Montana's hydrogeology and to monitor ambient water levels and water chemistry. Characterization studies are under way in the **Lower Yellowstone River** (Dawson, Fallon, Prairie, Richland, and Wibaux counties), **Middle Yellowstone River** (Treasure and Yellowstone counties outside of the Crow Reservation), **Flathead Lake** (Flathead and Lake counties including the Flathead Reservation) areas, **Lolo-Bitterroot** (Mineral, Missoula, and Ravalli counties), and the **Upper Clark Fork of the Columbia River** (Deer Lodge, Granite, Powell, and Silver Bow counties). MBMG also has developed a statewide network of monitoring wells in which static-water levels are measured quarterly. The network includes about 70 continuous water-level recorders to provide detailed water-level records in the monitored wells. GWAP also collects about 200 water-quality samples annually to help describe ambient water quality. Information from the characterization program and the monitoring network is stored at MBMGs Groundwater Information Center (GWIC). Data from GWIC are easily transferred to GIS for display and analysis and can be exported electronically or on paper.

Many other hydrogeologic data, including water-quality data from other projects are stored in GWIC. For example, analytical results for water samples collected by GWAP programs between July 1, 1993 and July 1, 1996 is available for 279 wells and springs. GWIC also contains results for an additional 495 samples collected during the same time period by other projects.

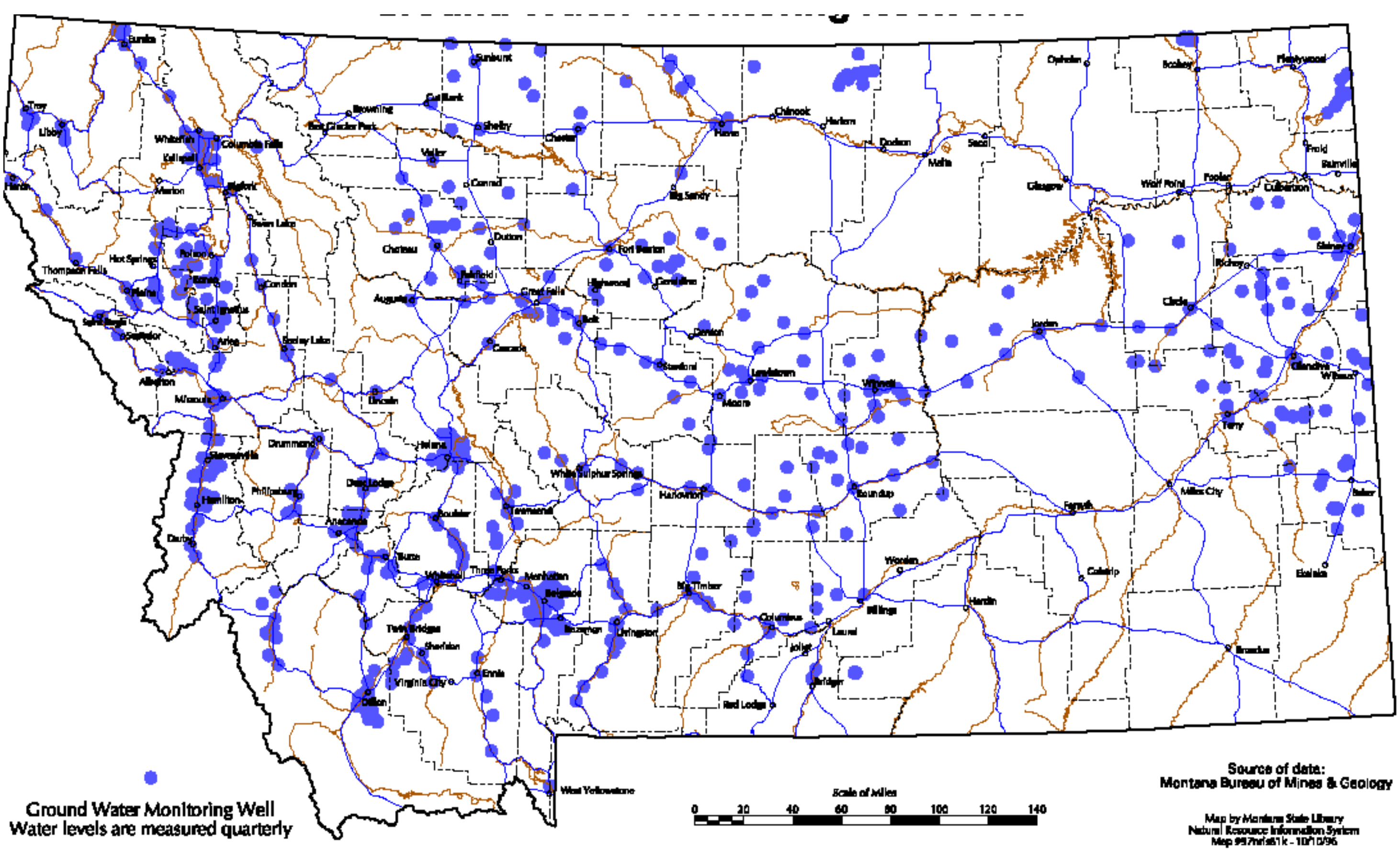
The locations of wells and springs from which the samples were collected are shown on Figure 10. The water-quality analysis data set discussed in the following paragraphs met these criteria:

- The water sample was collected between July 1, 1993, and July 1, 1996.
- The water sample had to represent ambient water quality and had an identifiable geologic source.
- The sample site was a well or spring.
- If the well or spring was sampled more than once during the time period, only the most recent sample was included in the data set.

On Figure 10, sample sites from the GWAPs Lower Yellowstone River Area characterization study are easily seen in eastern Montana just west of the Montana-North Dakota border. In the western part of the state, clusters of sample sites include those visited during DNRC's Beaverhead Groundwater study near Dillon; the USGS hydrogeologic study in Ravalli County south of Missoula; and MBMG projects in Liberty County north of Great Falls. More widely spaced sample sites in the western third of the state represent GWAP monitoring program sampling

Analytical results for total dissolved solids, nitrate, fluoride, sulfate, chloride, and radon are discussed in the text below. Analytical results for aluminum, arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc are summarized in Table 22. In about 70 percent of the samples, concentrations of these elements were below detection limits and 99 percent were less than 50 percent of their primary or secondary maximum contaminant level

Figure 10.



The following paragraphs cite specific maximum contaminant levels also known as MCLs. MCLs refer to the maximum level of a chemical allowed in public drinking water supplies as established by EPA (see **http://www/epa.gov/ogwdw.wot/appa.html**). MCLs are set at a level to ensure the contaminant does not pose significant risk to public health. Primary drinking water standards are legally enforceable standards that apply to public water systems. Secondary Drinking Water Regulations (secondary standards) are non-enforceable guidelines regulating contaminants that may cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor, or color) in drinking water. EPA recommends secondary standards to public water systems but does not require systems to comply.

Total Dissolved Solids: Sample results are for total dissolved solids concentrations in water samples collected between July 1, 1993, and July 1, 1996. About 50 percent of the samples contained more than 500 mg/L dissolved solids. Most samples from consolidated aquifers were from east of the Rocky Mountains, and most samples from unconsolidated aquifers were from the valleys of western Montana. Because most samples from unconsolidated aquifers came from western Montana, a generic difference in water quality between eastern Montana consolidated aquifers and western Montana unconsolidated aquifers is apparent (Table 22). Almost three quarters of the samples from unconsolidated aquifers contained less than 500 mg/L dissolved solids and only 5 percent of the samples contained more than 2,000 mg/L. In contrast, less than one quarter of the samples from consolidated bedrock formations contained less than 500 mg/L dissolved solids and 22 percent contained more than 2,000 mg/L.

Nitrate: The nitrate data represents 772 water samples. About 50 percent of the samples contained less than 0.25 mg/L, and 90 percent contained less than 5.0 mg/L. About 6 percent of the samples contained concentrations greater than 10 mg/L. About 37 percent of the samples from unconsolidated aquifers contained less than detectable amounts of nitrate in comparison to 65 percent of the samples from consolidated aquifers. However, about 90 percent of all the samples contained less than 5.0 mg/L nitrate, and both data sets contained approximately the same number of samples containing more than 10.0 mg/L. The median nitrate concentration in all samples was 0.3 mg/L (Nitrate as N). The median concentration in samples from unconsolidated aquifers was 0.6 mg/L and the median concentration for samples from consolidated aquifers was less than the detection limit. The nearly equal proportion in both aquifer types of samples containing more than 5.0 mg/L indicates that wells completed in consolidated aquifers are not immune to nitrate contamination. Factors such as poorly sealed annular spaces, short distances from contamination sources, and unconfined zones within consolidated aquifers make individual wells in many different geologic environments susceptible to contamination.

Wells are deeper, static water levels lower, and depths at which water enters the well are greater for wells in consolidated aquifers than for wells in unconsolidated aquifers. Table 22 summarizes these data.

Table 22: Static water level, depth water enters, and total depths for wells with nitrate analyses.

	Unconsolidated Aquifers		Consolidated Aquifers	
	Average	Median	Average	Median
Static Water Level	37	20	84	57
Depth Water Enters	93	60	216	130
Total Depth	109	76	252	154

All depths are in feet below land surface.

Median depths for static water levels in wells completed in unconsolidated aquifers were only about 35 percent of the median water level in wells finished in consolidated aquifers. Depth water enters values for wells completed in unconsolidated aquifers were about 46 percent of those in consolidated aquifers. Well depths in unconsolidated aquifers were about 50 percent of those wells completed in consolidated aquifers. About 62 percent of the samples from wells completed in unconsolidated aquifers contained more than 0.25 mg/L nitrate. In consolidated formations the percentage was about 35 percent. The differences between the sample results for unconsolidated and consolidated aquifers indicates that low-concentration nitrate contamination is more likely in the near-surface groundwater systems contained in many unconsolidated aquifers.

Fluoride: Analytical results for fluoride in 735 samples showed concentrations were between 0.1 and 2.0 mg/L in about 80 percent of the samples. However, in Montana water from consolidated aquifers generally contains more fluoride than water from unconsolidated aquifers. Almost 20 percent of the samples from unconsolidated aquifers and 8 percent from consolidated aquifers did not contain detectable amounts of fluoride. In consolidated aquifers almost 12 percent of the samples exceeded 50 percent of the fluoride MCL, whereas only about 7 percent of the water samples from unconsolidated aquifers contained concentrations greater than 50 percent of the MCL of 4 mg/L. The MCL was exceeded in 1 percent of the samples from unconsolidated aquifers and 3 percent of the samples from consolidated bedrock aquifers.

Sulfate: Sulfate is almost always present in groundwater. About 30 percent of the samples contained sulfate concentrations greater than the secondary drinking water standard of 250 mg/L. Only about 5 percent of the samples did not contain detectable concentrations. Fifty-five percent of the samples contained sulfate concentrations of less than 125 mg/L (50 percent of the secondary standard).

Water samples from unconsolidated aquifers tended to have lower sulfate concentrations than samples from consolidated aquifers. About 72 percent of the samples from unconsolidated aquifers contained sulfate concentrations of less than 125 mg/L, whereas only 49 percent of the water samples from consolidated aquifers contained sulfate concentrations of less than 125 mg/L. Only 14 percent of the samples from unconsolidated aquifers contained sulfate concentrations greater than 250 mg/L, but 52 percent of the samples from consolidated standards exceeded the standard.

Chloride: In about 92 percent of the samples, chloride concentrations were less than 63 mg/L (25 percent of the secondary standard of 250 mg/L), but only 3 percent of the samples did not contain detectable amounts of chloride. Only 1 percent of the samples from unconsolidated aquifers and 2 percent of the samples from consolidated aquifers contained greater than 250 mg/L chloride. Chloride is commonly present at low concentrations in natural water and the secondary standard is high compared to chloride concentrations in most of the samples.

About 50 percent of the samples contained detectable chloride concentrations less than 10 mg/L. About 40 percent of the samples contained more than 10 mg/L but less than 63 mg/L of chloride. Chloride concentrations vary little between water from unconsolidated or consolidated aquifers. The median concentration of chloride for all the samples was 8.7 mg/L. The median concentration in unconsolidated aquifers was 8.0 mg/L and in consolidated aquifers 9.0 mg/L.

Because chloride salts added to household waste can increase the chloride concentration in groundwater, water samples containing chloride concentrations significantly higher than the regional median could indicate water contamination from sources such as septic tanks. Another cause of elevated chloride concentrations in water samples from eastern Montana consolidated aquifers may be chloride derived from salts in formations deposited in marine environments. In the 762 samples used in this analysis, 15 percent contained concentrations greater than 26 mg/L (about 3 times the median concentration of 8.7 mg/L). In samples from unconsolidated aquifers, about 12 percent contained concentrations greater than 24 mg/L (3 times the median of 8.0 mg/L). In samples from consolidated aquifers about 19 percent contained concentrations greater than 27 mg/L (3 times the median of 9.0 mg/L).

Assessing if contamination of groundwater by household wastes is occurring based on chloride analysis can only happen through detailed analyses of specific samples and site characteristics, which is supported by additional analyses such as nitrate.

Radon: MBMG has collected groundwater samples for radon analyses since 1992. About 50 percent of the samples have been collected by projects funded for that purpose, primarily by DEQ, and about 25 percent by other agencies, programs, and projects. GWAP, through its statewide monitoring program, has collected about 25 percent of the samples. The availability of data on radon concentrations in water illustrates the benefit of having a common storage point for radon (and other water-quality data) in the GWIC database, regardless of which project or program collected the samples. The data set contains results from many geologic sources across Montana.

Radon concentrations were greater than 100 picocuries per liter (pci/L) in about 90 percent of the samples. The highest radon concentration was about 9,600 pci/L in water from the Boulder batholith of western Montana, but only 5 percent of all the samples contained radon concentrations greater than 2,000 pci/L.

About 80 percent of the samples had radon concentrations less than 1,000 pci/L. About 40 percent of the samples from unconsolidated aquifers and about 30 percent of samples from consolidated aquifers contained radon concentrations between 500 and 1,000 pci/L. Consolidated aquifers generally contain water with lower radon concentrations than do unconsolidated aquifers. Fifty-two percent of the samples from consolidated aquifers and 36 percent of the samples from consolidated aquifers contained less than 500 pci/L of radon.

The differences among radon concentrations are influenced by the distribution of sampling points. More of the sampling sites in unconsolidated aquifers are from the western Montana valleys than from unconsolidated deposits east of the Rocky Mountains. The aquifers in the western valleys often contain *detrital* materials from consolidated bedrock sources such as the Boulder or Idaho batholiths, which have higher concentrations of uranium and may produce correspondingly higher radon in groundwater. In contrast, most of the water samples from consolidated bedrock aquifers were collected in eastern and central Montana, and relatively few were collected from the western Montana batholithic rocks that are known to contain water with high radon concentrations.

Metals: Most of the analytical results included trace metals. Table 23 summarizes results for some metals with primary or secondary MCLs. None of the samples contained detectable silver, but 85 percent contained zinc. No more than one percent of the samples contained concentrations greater than the MCL for any metal. The percentage of samples that contained concentrations of any metal between the detection limit and less than 50 percent of the MCL ranged from 0 percent for cadmium and silver to 84 percent for zinc. About 40 percent of the analyses for arsenic and selenium reported concentrations of less than 50 percent of their respective MCLs.

Table 23: Summary of analytical results for trace metals [in micrograms per liter(μg/L)]

Metal	MCL	Total Samples	Percent < detection Limit	Percent > detection limit and < 50% MCL	Percent > 50% MCL and <100% MCL	Percent > 100% MCL
Aluminum*	50 (s)	695	94	3	2	1
Arsenic	50(p)	740	59	39	1	1
Cadmium	5(p)	739	99	0	0	0
Chromium	100(p)	736	69	31	0	0
Copper	1,000(s)	730	45	55	0	0
Lead	10(p)	737	97	2	1	0
Mercury	2(p)	47	94	6	0	0
Nickel	100(p)	727	59	40	1	0
Selenium	50(p)	734	60	38	1	1
Silver	50(p)	724	100	0	0	0
Zinc	5,000(s)	745	15	84	0.5	0.5

* Aluminum has been associated with discoloration of drinking water following treatment therefore the MCL is sometimes given as a range from 50 to 200 μg/L to allow states to address local conditions. (p) = primary drinking water standard. (s) = secondary drinking water standard
Detection limits: Al = 30, As = 1, Cd = 2, Cr = 2, Cu = 2, Pb = 2, Hg = 0.1, Ni = 2, Se = 2, Ag = 2, Zn = 2,.

Sources of Groundwater Contamination

Overview of Groundwater Contamination Sources

Contamination generally refers to the alteration of water so that it may not be put to some intended use. Most of the contaminants of concern in Montana are related to human activities, but a few, like arsenic, appear to have significant natural sources. Contaminants can enter groundwater in different ways including direct injection, underground discharge, and ground surface discharge. In the past, potentially polluting land use activities were regulated to prevent surface water discharges with little regard for potential groundwater impacts. Now, as we gain an understanding of the dynamics of surface and groundwater flow systems, concerns about groundwater contamination share an equal footing with concerns about surface water.

Groundwater Contamination in Montana

Approximately 126,000 individual on-site septic systems are used by 252,000 people in Montana. Septic systems are believed to cause substantial, widespread nutrient and microbial contamination to groundwater. Groundwater monitoring in Montana has shown elevated nitrate levels near areas of concentrated septic systems. Nitrate levels above 10 mg/L can cause "blue baby syndrome" which may be fatal to infants. Bacteria can cause several different waterborne diseases such as typhoid and gastroenteritis while the potential health effects of viruses from septic systems are as yet unknown.

Disposal of non-domestic wastewater into open-bottomed drains or septic systems (also known as sumps, French drains, or seepage pits) threatens Montana's groundwater. Organic solvents can be flushed into unconfined alluvial aquifers in urban areas via these drains which are also termed "injection wells" and regulated by federal law (see **http://www.epa.gov/ogwdw/uic.html**). Public water supply wells in Missoula and Bozeman have been abandoned after being contaminated with solvents. It is impossible to know how many private wells may also be contaminated. The EPA estimates there are about 400 industrial injection wells and 200 automotive injection wells in Montana. Over 300 automotive injection wells have already been closed by converting the operation to a "dry shop" or connecting to a sanitary sewer. Storm water is also often directed into subsurface drains but there’s no evidence that clean stormwater runoff contaminates groundwater. Stormwater disposal structures are frequently associated with pretreatment features such as grassy swales, vegetated buffers, or oil/water separators to minimize the impact of stormwater infiltration.

Montanans have registered the location of 26,736 underground storage tank locations since tank registration began in the mid-1980s. Most of those tanks have been removed or permanently closed. In June, 1998, there were 5,872 active tanks. There have been 3,295 confirmed leaks from underground tanks in Montana. As a result of those leaks, 1,959 tank sites have undergone remediation. About half of the leaks reached groundwater. Five leaks resulted in contamination of public water supplies by benzene, a carcinogen.

Montana has eight sites listed on the federal Superfund National Priority List. These are generally either called Superfund or CERCLA (Comprehensive Environmental Response, Compensation, and Cleanup Act) sites. As of June 1998, 187 sites were prioritized for remedial action through the Montana CECRA or state superfund (Comprehensive Environmental Cleanup and Responsibility Act). Unlike the federal Superfund Act, this act also addresses sites that have asbestos or petroleum contamination. Ninety-four of the CECRA sites have documented impacts to groundwater.

In July 1996 several state resource agencies were reorganized to create DEQ. Groundwater sites that require long-term remediation but are not associated with permitting, underground storage tanks, or CECRA sites, were assigned to the Remediation Division in the Montana DEQ. In mid-1998 there were 84 groundwater remediation program sites. These sites include petroleum pipeline ruptures, spills associated with tanker truck wrecks, abandoned dumps, former dry cleaning facilities, transformer oil spills, and leaks from sewer lines. Approximately 79 of these sites are handled by the Groundwater Remediation Program of Hazardous Waste Site Cleanup Bureau. Five sites are being handled by the bureaus' Petroleum Release Section.
DEQ has reported that one third of the existing and abandoned mines that have used cyanide to process ore in Montana have had documented cyanide spills. Montana has had about 38 ore processors that use or have used cyanide, 34 of which are now inactive. Of the spills, 9 affected groundwater quality beyond the

boundaries of the mine property. Three resulted in the contamination of a water supply.

An average of 300 accidental spills are reported each year to the Montana Hazardous Materials Emergency Response System. About 5 percent require extensive cleanup and monitoring. In 1995, a derailment in the Helena rail yard spilled of 17,400 gallons of fuel oil. Prompt removal of the contaminated soil prevented the contaminants from reaching groundwater, as confirmed by groundwater monitoring.

Several pesticides have been detected in Montana groundwater: aldicarb sulfoxide and aldicarb sulfone, assert and its metabolite-imazamethabenz methyl, atrazine, bromacil, clopyralid, dicamba, dinoseb, diuron, imazapyr, MCPA, picloram, pentachlorophenol, prometon, simazine, and 2,4-D. Of those detected in public water system wells, all were below established health guidance levels except for pentachlorophenol and dinoseb. In three cases, pesticides have been detected in wells that supply water to rural schools. The Montana Agricultural Chemical Groundwater Protection Act directs the Montana MDA to develop a general management plan and specific management plans implementing BMPs where pesticides are detected in the groundwater. The statewide general pesticide management plan was completed in 1994. A specific management plan is currently being developed by MDA for assert and its metabolite.

Twenty-five years ago the state had about 500 landfills and waste dumps most of which are closed. Some have been converted to container sites, which are regulated by local government. In June, 1998, there were 60 licensed Class II solid waste management facilities in Montana: 36 municipal/county landfills, 9 transfer stations, 10 soil treatment facilities, 1 incinerator, 1 infectious waste treatment facility, and 2 compost facilities. Thirty-one active and 10 inactive Class II waste management facilities currently monitor groundwater quality. There are also 62 Class III solid waste management systems.

The Montana Salinity Control Association estimates that saline seep has lowered the productivity of over 300,000 acres of agricultural land in Montana. The impacts of saline seep affect not only soil but also shallow groundwater and surface water. Saline seep occurs when water percolates beneath the root zone and becomes trapped by clay or shale layers. The water dissolves sodium, calcium, magnesium, sulfate, nitrate and occasionally selenium as it flows through the soils. If the clay or shale layers intersect the surface of the ground down-gradient, a seep forms and leaves white salts as the water evaporates. The conditions that can produce saline seep exist on over 17,000 square miles in Montana.

The Montana Agricultural Statistics Service estimates there were 2,700,000 cattle in Montana in June, 1998. Currently, 61 concentrated animal feeding operations have discharge permits that allow a wastewater discharge only in the event of a unusually large precipitation event.

Table 24 summarizes the major sources of groundwater contamination in Montana.

Table 24
Major Sources of Groundwater Contamination in Montana

Contaminant Source	Ten Highest Priority Sources	Factors Considered in Selecting Source	Contaminants
Agricultural Activities			
Agricultural chemical facilities			
Animal feedlots	X	ACEF	jkel
Drainage wells			
Fertilizer applications	X	ACEF	e
Cropping & Irrigation practices	X		beg
Pesticide applications			
Storage and Treatment Activities			
Land application			
Material stockpiles			
Storage tanks (above ground)			
Storage tanks (underground)	X	ABCDEF	cdh
Waste piles			
Waste tailings			
Disposal Activities			
Deep injection wells			
Landfills			
Septic systems	X	ABCDEF	dejkl
Shallow injection wells			
Other			
Hazardous waste generators			
Hazardous waste sites			
Industrial facilities	X	ABC	cdh
Material transfer operations			
Mining and mine drainage	X	A	him
Pipelines and sewer lines			
Salt storage and road salting			
Salt water intrusion			
Spills	X	ABCDEF	abcdg
Transportation of materials			
Urban runoff			
Saline seeps	X	AD	g

Factors Considered Assigning Priority
(A) Human health and/or environmental risk (toxicity)
(B) Size of the population at risk
(C) Location of sources relative to drinking water sources
(D) Number and/or size of contaminant sources
(E) Hydrogeologic sensitivity
(F) State findings, other findings

Contaminants
a. Inorganic pesticides
b. Organic pesticides
c Halogenated solvents
d. Petroleum compounds
e. Nitrate
f. Fluoride
g. Salinity/brine
h. Metals
i. Radionuclides
j. Bacteria
k. Protozoa
l. Viruses
m. Arsenic

State Groundwater Protection Programs

Groundwater Management Strategy

Planning efforts to protect, sustain, and improve groundwater quality and quantity through a statewide groundwater plan began in 1992. A draft plan was initially completed in 1994 by a group representing diverse interests in water quality and quantity. The planning process was temporarily slowed down due to state government reorganization and staffing changes, but is now almost complete. The planning process was led by the DNRC with considerable input from DEQ. Public meetings were held in 1998 for final comments on the plan. The Groundwater Plan has been endorsed by the Environmental Quality Council of the Montana Legislature. It is expected to adopted in January of 1999 by the Director of DNRC and will be presented to the 1999 Legislature. Because of the length of time for the planning process, many of the recommendations in the plan have already been accepted and implementation has begun. The Groundwater Plan has three major components:

Protection Strategy

1. The MGWP seeks to improve public, corporate, and individual decision-making that affects Montana's groundwater. In most cases, the groundwater is clean and plentiful. Yet where groundwater is contaminated, the public is becoming aware that the cost of cleanup is often beyond the financial ability of most communities, and sometimes even the state of Montana. Therefore, citizens need the means to prevent contamination and protect this vital resource. Between 1982 and 1998, the state took great strides in establishing programs protecting Montana's groundwater quality and quantity. The objective is to coordinate the implementation of these programs, discover gaps, and eliminate duplication.

2. Education Strategy. The MGWP identifies educational assistance and information necessary to effectively implement the components of the plan. Education is critical for protecting groundwater. Groundwater protection requires pollution prevention. This can only be accomplished by people who are aware of the effects their actions have on the groundwater. Groundwater laws, characteristics, and processes are essential prerequisites to successful groundwater policy implementation.

Remediation Strategy

3. The MGWP strives to coordinate governmental activities to address adequate, cost-effective, clean-up of groundwater contamination. State legislation passed in the past 10 years established or enhanced a variety of regulatory programs for solid waste landfills, underground fuel storage tanks, mines, agricultural chemicals, and several other sources of pollution. Due to pollution liability concerns, property assessments to document the degree of contamination that may be present at a site are standard for commercial property sales. As a result, numerous sites with groundwater contamination have been discovered in Montana. The objective is to ensure that appropriate and coordinated action is taken at those and other sites where groundwater contamination is present.

Source Water Protection (formerly Wellhead Protection)

The Montana Wellhead Protection Program was approved by the EPA in 1994 and is unique in that participation in the program by Public Water Supplies (PWS) is voluntary. Program implementation includes extensive effort on education and outreach in order to increase the publics' general knowledge about groundwater resources and protection. The 1996 amendments to the federal Safe Drinking Water Act require states to develop a Source Water Delineation and Assessment Program. This effort is currently underway in Montana and will lead to the identification of the source of water used by PWS, identification of the origins of regulated contaminants within the source water area, an assessment of the susceptibility of the PWS to identified contaminants, and the development of a mechanism to make the delineation and assessment information available to the public. The concepts of source water protection apply to both surface- and groundwater-based systems, so wellhead protection and source water delineation and assessment are now referred to as the Montana Source Water Protection Program.

Montana will develop a GIS-based approach to implementing this program that will result in a technical report being provided to each of Montana's 1,900 PWSs. The technical report will utilize a base map upon which the source water protection area delineation will be overlain. The origins of regulated contaminants that pose an acute health risk or those that have been detected through PWS monitoring will be the focus the potential contaminant source inventory. These sources or land uses will also be shown on the base map. Other potential contaminant sources with regional or local significance may also be identified at the discretion of DEQ. Susceptibility will be assessed based on intake characteristics, depth to groundwater, soil characteristics, slope, aspect, separation distances, contaminant characteristics, and on-site use of BMPs. The delineation and assessments will be made available to the public using Montana's DEQ Internet site, PWS consumer confidence reports, and through local governments and libraries.

The Pollution Prevention Bureau at DEQ will be responsible for implementing the source water protection program, and will: conduct delineation and assessments internally and will negotiate and administer contracts to complete assessments by external entities where appropriate; coordinate statewide source water protection efforts; make information available on potential contaminant sources; and will provide technical assistance to local communities on source water protection plan development.

The federal SDWA requires delineation and assessments generally be completed for all PWS by May 2003. In late 1998, approximately seventy-five community public water supplies out of a possible 610 were in the early stages of the source water protection planning process and another 10 PWSs had certified source water protection plans in place.

Local Water Quality Districts.
In 1991, the Local Water Quality District law was enacted, allowing counties to form local water quality districts with the purpose of protecting, maintaining, and improving water quality. The enabling legislation allows county commissioners to assess fees on property owners who benefit from a water quality program approved by the Montana Board of Environmental Review.

Lewis and Clark County set up the first local water quality district for the Helena Valley watershed in 1992. A year later, Missoula County set up a district covering the Missoula Valley Sole Source Aquifer. In 1995, Butte/Silver Bow County established Montana's largest district covering the entire county. Shortly after, Gallatin County formed the newest district to protect water quality in the Gallatin Valley.

The district programs usually monitor for water quality and quantity, compile data into Geographic Information Systems, inventory potential pollution sources, educate citizens on water resource issues, and engage in water resource projects specific to the needs of the community. For example, Lewis and Clark County Water Quality Protection District is working with the Helena National Forest on a watershed management plan for the Tenmile Creek drainage, a significant source of water to the community. The Missoula Valley Water Quality District administers the Missoula Valley Aquifer Protection Ordinance. The water quality program of the Butte/Silver Bow Water Quality District covers the largest Super Fund site in the United States. Managers of the program and the community established a controlled groundwater area to regulate the use of contaminated water that is a threat to human health. The Gallatin Water Quality District is in the early stages of characterizing the water in the district.

Table 25 Montana Local Water Quality Districts in 1998				
District Name	**Cities and towns included**	**Area covered by program (square miles)**	**Annual budget (fee assessment)**	**Number of full time employees (FTE)**
Lewis & Clark County Water Quality Protection District	Helena, East Helena	360	$94,474 ($5-6.00)	1.5
Missoula Valley Water Quality District	Missoula	210	$459,816 ($9-26.00)	3.5
Butte/Silver Bow Water Quality District	Butte, Walkerville	720	$125,020 (Arco MOU)	2.2
Gallatin Water Quality District	Bozeman, Belgrade, Manhattan	356	$96,999 ($6.00)	1.75
Total- 4 districts	8 cities and towns	1,656 square miles	$776,289	8.95 FTE

Preventing Agricultural Chemical Pollution

The Montana Agricultural Chemical Groundwater Protection Act (MACGWPA) assigns responsibility for protecting groundwater from agricultural chemical impairment and contamination to the MDA and DEQ. DEQ is specifically responsible for the establishment and enforcement of agricultural chemical groundwater standards and interim numerical standards, groundwater monitoring, for providing comment to the MDA during development of agricultural chemical groundwater management plans, and promoting research. The MDA is responsible for preparation, implementation, and enforcement of agricultural chemical groundwater management plans, public education, and groundwater monitoring.

To meet one of the mandates of the MACGWPA, the MDA developed the General State Agricultural Chemical Groundwater Management Plan (Montana GMP) in 1994. The Montana GMP includes the program elements as required by the MACGWPA. The document also serves as a guide for the preparation of Montana specific management plans as well as serving as a groundwater and pesticide primer for the general public and as a resource document to state agencies.

The Montana GMP satisfies some, but not all, of the EPA specifications for federally mandated groundwater pesticide management plans. For example, both documents must address roles and responsibilities of state and federal agencies in groundwater protection. The Montana GMP is very general in nature and provides a sweeping overview of who does what with water in Montana. In contrast, the federally mandated groundwater pesticide management plan must be very specific in describing who has responsibilities in groundwater. Another example of differences can be seen in the discussion of groundwater and pesticide laws and regulations. The Montana GMP simply describes the laws and regulations related to groundwater, pesticides, or both. The federally mandated groundwater pesticide management plan will only address those laws and regulations specific to the development, implementation and enforcement of federal pesticide management plans. Generally, the Montana GMP is more general in nature and provides basic information on groundwater and pesticides in Montana as well as an explanation of state pesticide detection response. The federally mandated groundwater pesticide management plan must be highly specific and will be much more narrowly focused.

The compiled and developed a federally mandated groundwater management plan that is called EPA GMP. It was subject to review and has the concurrence of the Montana Departments of Environmental Quality and Natural Resources and Conservation, Montana State University and Montana State University Extension Service, United States Geological Survey, United States Natural Resource Conservation Service, and Montana Bureau of Mines and Geology. The EPA GMP was approved by Region VIII, EPA in March of

1998 and it is anticipated that dissemination of the document will be completed by December 1998. The EPA GMP will be used to prepare EPA- required pesticide-specific management plans. The projected date for publication of the final rule for EPA required pesticide-specific management plans are January 1999. When the rule is published, the MDA will begin development of the management plan for the EPA designated pesticides. It is currently anticipated that those pesticides will include Atrazine, Simazine, Alachlor and Metolachlor

Groundwater quality is monitored for pesticides by MDA under the MACGWPA. MDA assesses pesticide concentrations in groundwater to determine if they represent a risk to human health or the environment based on established DEQ standards pursuant to WQB-7. Monitoring is accomplished through a variety of means. The MDA has a permanent monitoring network of wells installed in areas of representative agriculture and pesticide use which are sampled twice yearly. MDA also conducts monitoring under special projects and often in cooperation with other state and federal agencies.

Groundwater in which a pesticide is detected is re-sampled to verify the presence and concentration of the pesticide(s). All verified detentions in groundwater result in additional monitoring (usually a modified quarterly basis) and are reported to DEQ. Monitoring results are available from MDA, DEQ or MBMG. A number of pesticides have been detected in groundwater in Montana. Pesticides found in Montana groundwater as result of nonpoint source type pollution activities include 2,4-D, MCPA, Dicamba (Banvel) Atrazine, Simazine, Clopyralid (Curtail, Stinger), Picloram (Tordon), Prometon (Pramitol), Imazamethabenz methyl (Assert) and it's metabolite, bromacil, aldicarb and its metabolites, and Pentachlorophenol (PCP).

Under the MACGWPA, the state is directed to develop a specific management plan (SMP) when any of the following conditions occur: (1) detection of agricultural chemical exceeds 50 percent of a standard (DEQ adopted MCL, HAL, Interim standard), (2) agricultural chemical migrates from the point of initial detection, (3) detection levels increase, or (4) a pesticide exhibits the potential to leach and is being used in an environmentally sensitive area. The first SMP in Montana is currently being developed due to the low but increasing levels of the herbicide known as "Assert" found in the shallow aquifer on the Fairfield bench northwest of Great Falls.

Monitoring of Public Water Supplies.
Nearly all of Montana's public water supplies using groundwater are free of the health-threatening contamination that has been reported in more populous states. To ensure the continued protection of consumers, state and federal regulations require water systems to have their water periodically analyzed for the presence of bacteria and various organic and inorganic chemicals and Radionuclides. Water quality at PWS must meet the standards (called Maximum Contaminant Level or MCL) established by federal regulations for public drinking water supplies. The number of samples and sample frequency varies with the size the population and type of consumer served. Community public water supplies and non-transient non-community supplies routinely monitor for the presence of contaminants, which can pose either acute or chronic health risks to consumers. Transient non-community public water supplies routinely monitor for contaminants that pose acute health risks. Between 1994 and 1998, 16 community public water supplies reported nitrate violations, of which the highest concentration was 64 mg/L.

Summary of Groundwater-Surface Water Interactions

The connection between groundwater and surface water is widely recognized as occurring, but it is very dependent on local conditions. The discharge of groundwater to surface water can often be seen in the flow of streams in the late winter when the contribution of precipitation is minimal yet streams continue to flow. The groundwater-surface water connection is a significant issue for PWSs since surface water is assumed to contain certain microbial contaminants and therefore generally must be treated before use. The Public Water Supply Section at DEQ has contracted with MBMG to evaluate public water system groundwater sources that may be influenced by surface water. Public water supplies were prioritized for study with the Missoula Valley Sole Source Aquifer to be studied first. Because this aquifer serves the largest population using groundwater, it is vulnerable to a wide variety of sources of pollution and is most likely to be under the influence of surface water. Other priority public water supply groundwater sources include all springs and infiltration galleries in the state. As of the fall of 1998, those PWSs deemed to have the highest priority have been assessed for surface water influence and the results of those assessments are being compiled.

It is becoming increasingly important to begin to consider the interaction of groundwater and surface water due to the widespread dependence on groundwater as a drinking water source and the development of TMDLs for surface waters. Groundwater contamination is attributed to surface water at two sites in Montana. (1) Near Three Forks, concentrations of arsenic increased in the alluvial aquifer after spray irrigation systems were installed to replace flood irrigation. Spray irrigation allowed greater evaporation that concentrated naturally occurring arsenic in the water, which then percolated down to the aquifer. The data were collected from 1984 to 1989 and are reported in the Montana Bureau of Mines and Geology Open File Report 210. (2) At Milltown near Missoula, arsenic and heavy metal concentrations in the alluvial aquifer have increased as a result of river water being pushed by hydraulic pressure though the mill tailing sediments behind Milltown Dam. The Milltown Groundwater Injury Assessment Report by William Woessner et al. (1993) describes the arsenic concentrations. Table 26 summarizes the data collected at the above sites.

Table 26
Groundwater-Surface Water Interactions

Surface water source	Aquifer	Concentration of arsenic in surface water		Concentration of arsenic in groundwater	
		Average	Range	Average	Range
Irrigation water from Madison River	Alluvial in Three Forks Valley	0.069 mg/L	0.058 to 0.086 mg/L	0.068 mg/L	0.001 to 0.159 mg/L
Clark Fork of the Columbia River Sediments (Milltown Reservoir)	Alluvial at Milltown	2.2 mg/L*	0.4 to 7.0 mg/L*	0.74 mg/L	0.003 to 9.3 mg/L

* Concentration in water passing through river sediments

Total Maximum Daily Loads (TMDLs)

Introduction
The federal Clean Water Act (CWA) 303(d) and the EPA Water Quality Planning and Management Regulations (40 CFR, Part 130) require each state to:

1. identify waterbodies that are water quality limited
2. prioritize and target those waterbodies
3. determine the TMDL allowable to meet water quality standards.

The process of determining the TMDL for a water body provides the basis for systematically ensuring that water quality standards are met. It is an approach that accounts for nonpoint and point sources of pollution and background levels in a watershed.

Background
A water quality-limited water body does not meet water quality standards (numeric or narrative) after application of required technology-based controls for point sources, regardless of whether BMPs have been applied for nonpoint sources.

Technology-based controls refers to the control processes and methodologies normally applied to point sources of pollution such as discharges from industrial plants or municipal wastewater treatment plants. An example of a technology-based control is the primary and secondary treatment of domestic sewage.

Nonpoint source (NPS) pollution can also cause a water body to be water quality limited even though all sources have BMPs applied to them. BMPs are standard practices designed to limit nonpoint source pollution when applied to specific land use practices. Because they are standardized practices, BMPs do not assure that cumulative effects from other sources or background conditions are adequately controlled.

A water body may be water quality limited by one or more parameters (e.g., nutrients and dissolved oxygen). An example of a water quality limited water body might be described as follows:

A stream that has received excessive nutrient loading (nitrogen and phosphorus) from several nonpoint sources and also receives the discharge from a municipal wastewater treatment plant, and experiences nuisance algae growth and dissolved oxygen (DO) sags below the standards established for the stream. The treatment plant is meeting the effluent limits in its current MPDES permit and several BMPs are in place along the stream corridor. In spite of the fact, that pollution controls are in place, water quality does not meet standards. Such a stream should be on the 303(d) list because it is not meeting water quality standards for recreation and swimming (nuisance algae growth) and the numeric criteria for dissolved oxygen.

Listing and Prioritization Process
The 303(d) listing process begins with identifying waterbodies (i.e., streams or lakes) that do not fully meet water quality standards and support the appropriate beneficial uses or are fully supporting their uses as stipulated in the standards but are threatened. Such streams or lakes are referred to as "water quality limited" and are in need of TMDL development.

The primary database used to compile the list of such waterbodies is the Water Body System (WBS). The WBS was used to compile use support information for the Montana Water Quality Report 305(b).

Information sources used to make support decisions include the following:

Clean Water Act 208 monitoring (Montana Statewide Water Quality Management Planning project)
Clean Water Act 319 monitoring and assessments (Nonpoint Source Pollution Control Program)
Clean Water Act 314 monitoring (Clean Lakes Program)
Water body assessments
Fixed station monitoring
Intensive surveys
Special projects
Data from other agencies
Tribal monitoring data
Volunteer monitoring
Data from STORET (an EPA-supported national water quality database)

After waterbodies are identified as water-quality limited and placed on the 303 (d) list, they are prioritized and targeted for TMDL development. The prioritization and targeting process is specifically designed to promote involvement from local organizations (e.g., CDs or environmental organizations) and industry, via public presentations and meetings to receive new data and comments on the proposed list.

The criteria used to place a water body in one of three TMDL development priority categories (high, moderate or low) are:

1. Magnitude of non-compliance with standards or whether the waterbody is an important high-quality resource at an early stage of degradation;
2. Resource value;
3. Size of the water body not attaining standards;
4. Whether technology and resources are available to correct the problem;
5. Recommendations obtained through the public review process, and,
6. Potential for establishing a TMDL within two years.

The high-priority waterbodies may be severely out of compliance with standards, may be a human health risk, may have technology and resources available to address the water quality problem with a reasonable certainty in a two-year time frame, may have been nominated though public comments, or strong public support may exist for the establishment and implementation of the control measures required by a TMDL.

Moderate-priority waterbodies may be less severely degraded, may have nonpoint source demonstration projects in the watershed, or the process of implementing water quality controls will require more than two years. Moderate priority includes waterbodies where significant development is planned and controls in addition to established technology-based controls may be necessary to meet water quality standards.

Low-priority includes the remaining identified waterbodies. As TMDL projects are completed and other factors change, such as recommendations from local watershed groups, selected waterbodies in this category may be upgraded to moderate or high priority or targeted for TMDL development.

After the draft ϶303(d) list has been developed, a 30-day public notice period follows. Announcement of the list to solicit comments and the location of public meetings to discuss the content of the draft list will be published in the state's major newspapers. EPA must give final approval of the 303(d) list. The guidelines outlined above were used to compile the 1998 list of water quality limited waterbodies and to prioritize those waterbodies for TMDL development.

Modifications to the 1996 Priority Listing

The waterbodies listed as moderate, high or targeted for TMDL development on the 1996 list were carried over to the 1998 list (Tables 27 and 28). Daisy Creek and Fisher Creek, which were listed as moderate-priority, are listed as high-priority at the recommendation of the Greater Yellowstone Coalition.

Flathead Lake and the Upper and Middle Clark Fork of the Columbia River were targeted as high priority waterbodies on the 1996 list and carried over into 1998. TMDLs for these waters are being actively pursued. The Clark Fork TMDL for nitrogen and phosphorus was approved in October 1998. The Flathead Lake TMDL is expected to be completed in 1999.

Many of the moderate priority waterbodies are carried over from the earlier lists. These water bodies were listed as medium priority because they were targeted by the state and local group as NPS projects that received funding for BMP implementation. The monitoring on these projects will be used to test the effectiveness of BMPs in meeting water quality standards. If standards have not been met, DEQ will continue to work with these project sponsors to develop more effective BMPs and ultimately meet TMDL water quality targets.

The low-priority waterbodies are mostly ones carried over from the last ȝ303 (d) list in 1996.

DEQ is developing a new prioritization and ranking method in conjunction with the Statewide TMDL Advisory Group. Thirteen ranking criteria were put into the Water Quality Act in 1997.

TABLE 27
Waterbodies Designated as High Priority for TMDL Development During the 1998-2000 Biennium

Waterbody Name	Montana Waterbody
Clark Fork of the Columbia River *#	MT76G001-1, 2, 3, 4 and
(Warm Springs Creek to the Flathead River)	MT76M001-1, 2, 3
Sliver Bow Creek* (above Warm Springs Ponds)	MT76G003-2
Sliver Bow Creek* (below Warm Springs Ponds)	MT76G003-1
Mill-Willow Bypass*	MT76G004-12
Warm Springs Creek*	MT76G004-23
Flathead Lake*#	MT76LJ006-1
Swan Lake*#	MT76K002-1
Tenmile Creek#	MT41I006-14
Daisy Creek*	MT43C001-14
Fisher Creek*	MT43D002-11
Soda Butte Creek*	MT43B002-3

* the waterbody is carried over from the 1996 TMDL list
\# the waterbody is targeted for TMDL development during the 1998-2000 biennium

TABLE 28 Waterbodies Designated as Moderate Priority for TMDL Development During the 1998-2000 Biennium	
Waterbody Name	**Montana Waterbody Number**
Godfrey Creek*	MT41H002-2
Big Otter Creek*	MT41Q004-5
Butcher Creek*	MT43C001-8
Otter Creek*	MT43B004-1
Big Spring Creek*	MT41S004-1, 2
East Spring Creek*	MT76LJ010-2
Musselshell River*	MT40A001-1
Ninemile Creek*	MT76M002-25
Threemile Creek*	MT76H002-29
Elkhorn Creek*	MT41D004-5
Blackfoot River*	MT76F001-1, 2, 3
Nevada Lake*	MT76F003-2
Nevada Creek*	MT76F002-8
Rock Creek*	MT76N003-19
Libby Creek*	MT76D002-6
Stillwater River*	MT43C001-11, 12
East Boulder River*	MT43BJ001-2
Whitefish Lake*	MT76LJ011-1

* the waterbody has been carried over from the 1996 list.

TMDL Project Update - New Strategy in Response to Legislation in 1997

With new legislation, Montana's approach to developing and implementing water quality plans underwent some needed changes. The changes included more funding for technical staff, formalization of the TMDL program, and a renewed recognition of the role for local watershed groups in setting the course for water quality protection in their own communities. This new strategy will take advantage of existing watershed protection efforts of local watershed groups and local government (e.g. CDs) and the progress they have already made and build on these partnerships as we deal with other impaired water bodies.

Montana has begun implementing a new TMDL program to assess the quality of its water bodies and systematically implement water quality plans to restore and protect them. The job will take 10 years and the state legislature has provided a new framework and new staff positions to carry it out. The plan calls for developing TMDLs for each of the 800 impaired water bodies on the 303 (d) list. Unique to the legislation was the role of local watershed groups which are asked to take responsibility for their own watersheds and work directly with DEQ to develop TMDLs. These local watershed groups are also to participate in the ranking and priority setting process.

This new water quality planning framework was a state response to long standing federal regulations requiring water quality-based limits on point and nonpoint sources of water pollution. Setting these limits was first proposed in the 1972 Clean Water Act in Section 303(d). Technically, these limits are the maximum amounts of each pollutant that a water body can assimilate and still maintain water quality standards.

The state has been implementing federal Clean Water Act programs for point and nonpoint source discharges along with its own Water Quality Act for at least two decades. The nonpoint source program alone has funded more than 42 watershed protection projects since 1990. For the past eight years, the DEQ (formerly the Montana Department of Health and Environmental Sciences) has been assisting watershed groups with monitoring and assessment programs to identify sources of key pollutants for TMDL development. As a result, one major TMDL project was recently completed in the Clark Fork of the Columbia River basin. It was started in 1994. Another, begun in the Flathead River basin in 1992, has completed the development of instream water quality targets and is developing its implementation plan. These two river systems are affected by a unique combination of point and nonpoint sources, and their size creates a technical challenge in determining pollutant causes and effects.

The following four examples of TMDL efforts in Montana show the diversity and varying levels of complexity that local watershed groups have used in setting water quality goals.

<u>Flathead River TMDL</u> - The Flathead Basin Commission is the lead group for the development of a TMDL for Flathead Lake. This commission was appointed by the governor and is made up of numerous state, local, and federal agency representatives, citizens, and business interests. The Confederated Salish and Kootenai Tribes are also represented on the commission and bring their own water quality standards into the planning process. This adds a unique level of cooperation to the planning process. Scientific data from Flathead Lake, and contributing tributaries, were analyzed by the commission's TMDL Technical Team. From these data, the team identified excessive algal growth along the shoreline, increased algal production, and algal blooms which cloud the water and contribute to dissolved oxygen depletion in deeper waters.

Many of the data were collected by the Yellow Bay Biological Field Station of the University of Montana at Flathead Lake. People from the university and others on the technical team developed TMDL targets over the past couple of years and refined and presented them during January 1998 to the full commission. The TMDL water quality targets are listed below:

Flathead Lake TMDL Targets

Parameter	TMDL Target
Primary production - (carbon produced by photosynthesis)	80.0 mg C/m2/yr
Chlorophyll *a* - (Indicator of algal growth)	1.0 mg/l
SRP	<0.5 :g/l (BDL)
Total Phosphorous	5.0 :g/l
Total Nitrogen	95 :g/l
Ammonia (NH3)	<1.0 :g/l
Nitrate/ Nitrite (NO2/3)	30 :g/l
Algal blooms	"no measurable blooms of Anabaena (or other pollution algae)"
Dissolved oxygen	"no oxygen depletion in hypolimnion"

Algal bio-mass measured as Chl a (e.g. on near-shore rocks on lake bottom) remains stable or exhibits a declining trend.

* All targets are annual averages. Integrated samples for primary production, Chl *a*, SRP, Total Phosphorous, Total Nitrogen, ammonia, and nitrate/ nitrite must be collected within the mid-lake deep site photic zone. For an annual average target to be considered valid, a sample must be collected monthly during Spring, Summer, and Fall. At least one sample must be collected during the winter. A sample must be collected during the raising limb and the falling limb of the hydrograph of the Flathead River. And, a minimum of twelve samples obtained. Anabaena (or other pollution algae) blooms are measured at the surface. The interim TMDL targets will be achieved within 5 years.

The Flathead Basin Commission is now beginning the difficult TMDL task of assigning responsibility for reducing pollutant loads to various sources. It also has begun an education effort to inform the growing number of residential landowners of their pollution prevention and land stewardship responsibilities.

Clark Fork of the Columbia River Voluntary Nutrient Reduction Plan (VNRP) - The Clark Fork VNRP is a coordinated response to excess nutrients and resulting nuisance algae on the stream bottom of the upper and middle reaches of the Clark Fork. An extensive data collection effort from 1988 through 1991 identified key problem areas and nutrient sources. In February 1994, a Nutrient Target Subcommittee was formed under the auspices of the Tri-State Implementation Council to set water quality restoration goals. The Tri-State Council, located in Sandpoint Idaho, is a regional nonprofit organization. Its purpose is to restore water quality in the Clark Fork and Lake Pend Oreille, Idaho. The council decided to take a voluntary approach to the process, using the targets as their waste treatment plant design parameters and gaining an agreement from DEQ that they would have a ten year period to achieve them.

The monitoring data from the Clark Fork showed that during the summer months, the critical period for algal problems, four point source dischargers were causing the bulk of the water quality degradation. For this reason, these discharges were the focus of the plan. The primary dischargers are Butte/Silver Bow municipal wastewater treatment plant, Deer Lodge wastewater treatment plant, Missoula wastewater treatment plant, and Stone Container paper mill treatment plant.

The VNRP was finalized in August 1998 and approved by EPA in October 1998.

The TMDL water quality limits are instream concentration values that could be achieved by meeting specific point source loadings. The instream goals are the following:

The VNRP instream targets for the Clark Fork mainstem

300 :g/l total nitrogen

39 :g/l total phosphorus downstream of the Reserve Street bridge at Missoula

20 :g/l total phosphorus upstream of the Reserve Street bridge at Missoula, where Cladophora is a problem and the 15:1 N:P ratio should be maintained

100 mg/m2 (summer mean) or 150mg/m2 (peak) chlorophyll a, at any site, for the entire Clark Fork area of the VNRP.

DEQ is working with the Missoula City and County on sprawl development issues and has agreed to add specific language to the Voluntary Nutrient Reduction Plan on targeting nonpoint source nutrients upstream of Missoula. Finally, the VNRP agreement will allow for an adaptive approach over the 10-year period so that both goals and treatment schemes can be modified as new information becomes available. The four affected municipalities with point source discharges, local jurisdictions, Stone Container Company, and DEQ signed the VNRP agreement in August 1998.

Deep Creek Nonpoint Source TMDL
This project was approved by EPA in March 1996. It is unique in the way it prescribes measurable water quality restoration goals for streams polluted by nonpoint sources. The TMDL water quality goals were developed from data collected by DEQ, the U.S. Forest Service, Montana State University, and consultants. The goals are aimed at achieving water quality standards for healthy trout fisheries. The parameters of concern are temperature, sediment, and fish reproductive success. The monitoring data showed that most sediment was coming from bank erosion caused primarily by stream-side grazing, high flows, and straightened channels. Examples of TMDL restoration goals included the following:

Deep Creek Water Quality Targets	
Eroding banks	Reduce by 50 percent over 10 years
Suspended sediment	Significant reduction in flow /total suspended sediment regression line rating curve
Trout reproduction	Double the number of returning adult female trout (to 3000) within 10 years
Temperature	Not to exceed 73 degrees F, for more than a total of 10 days in 4 of 5 years
Flow	3 cfs minimum in reaches #5-9 and 9 cfs in all other reaches

The project team made up of the Broadwater Conservation District, Natural Resources Conservation Service, a local consultant, Montana Fish, Wildlife and Parks, DEQ, landowners, and others removed a major fish blockage, achieved an agreement with an irrigation company to maintain critical instream flow, and restored much of the eroding banks using natural materials *(rootwads, rocks, willow plantings and juniper shrubs)*. Vegetation is doubly important because it will both stabilize the banks and shade the stream to provide cooler temperatures for the trout. The remaining construction and grazing management work (e.g. fencing and pasture rotation) is to be completed in March 1999.

Muddy Creek TMDL
DEQ has identified Muddy Creek (a tributary to the Sun River) as partially supporting or not supporting many of its designated beneficial uses. Muddy Creek is a 42-mile stream northwest of Great Falls, listed by DEQ and its predecessor agencies during the past 20 years as one of the top five water quality problems in Montana. Irrigation runoff from approximately 314 square miles of agricultural land causes Muddy Creek to exceed its normal annual flow rate by ten fold. Streambank erosion from this excess flow causes an average annual discharge of 200,000 tons of sediment into the Missouri River via the Sun River. These sediments increase flood potential on both the Sun and Missouri rivers and affect the usability of receiving waters for irrigation, fishing, boating recreation, public water supplies, aquatic life, and power generation. The Muddy Creek Task Force is developing a TMDL to help manage this major source of nonpoint water pollution.

The Muddy Creek Task Force is made up of local landowners, environmentalists, the irrigation district, and local state and federal government agencies. The Task Force has established goals, objectives and tasks to resolve the major pollution issues. The results were a short-term goal to control surface gradient and lateral migration of Muddy Creek by installing low level grade control structures and bank barbs in the stream. A long-term goal is to reduce return flows from the Greenfields Irrigation District (GID) and other irrigators. This would reduce both the severe erosion of the Muddy Creek channel and water quality degradation in the Sun and Missouri rivers. The purpose is to improve the quality of water available for use by agriculture, recreationists, tourists, cities, power companies, and homeowners.

Muddy Creek Goals

Reduce erosion by 75% by 2005 on Muddy Creek to reduce the sediment load in the Sun and Missouri rivers to the point where they could support a cold water fishery, and to meet the state water quality standards. Accomplished by installing a series of water control structures and application of grazing management practices on Muddy Creek to reduce suspended sediment contribution to the Sun and Missouri rivers.

Enhance irrigation practices on the 51,000 acres on Greenfields Irrigation District to reduce return flows 50% by 2000.
Enhance fisheries by 50% in ten years on Muddy Creek, lower Sun River and Missouri River near Great Falls by accomplishing goals 1 and 2.

Land use activities and water quality will be monitored throughout the watershed to document impacts of pollution and effects of control measures. Monitoring facilities includes two USGS flow gauging stations and photo points along the stream. Monitoring results will be used to further refine actions currently taking place in the watershed.

The Cascade and Teton County CDs in conjunction with the Muddy Creek Task Force have taken the lead on the Muddy Creek problem. An EPA 319 grant, DNRC grant, and other financial and in-kind assistance were used in an effort to reduce the erosion on Muddy Creek. The teamwork of the various partners has been critical to the project's recent success in reducing return flows by 50 percent and stabilizing the worst of the eroding banks with stone barbs which slow the force of the high waters.

New Program Elements and Phases

House Bill 546 enacted by the 1997 Montana Legislature included nine major components that have been woven into a new state strategy. The strategy will take a more systematic approach to identifying water quality problems, prioritizing problems, and developing water quality management plans:

1. Legal authority - clarifies DEQ's authority under the Montana Water Quality Act to monitor water quality and coordinate TMDL development.
2. Public participation - ensures expanded public and stakeholder participation in all phases of the process.
3. Listing ensures that data must be sufficient and credible for a water body to be included on the 303(d) list of impaired waters.
4. Priority setting - establishes criteria for ranking and prioritizing waters for TMDL development including creating a Statewide TMDL Advisory Group to assist in the process.
5. Schedules - DEQ is required to set up a schedule for TMDL development in one year (by May 1998) and begin implementing all TMDLs within 10 years.
6. Interim protection - activities can continue to occur in watersheds with TMDLs pending, provided interim measures to protect water quality are applied.
7. Voluntary approaches - promotes a voluntary approach to nonpoint source TMDLs.
8. Monitoring - DEQ must monitor or assist with monitoring so that an evaluation of the effectiveness of the TMDL can be completed within 5 years after approval of each TMDL.
9. Water rights - The bill states that TMDLs will not interfere with water rights.

The framework that DEQ is building evolved around this legislation and the knowledge gained by assisting successful local projects such as those described above. The strategy relies on a regional approach, built on watersheds. DEQ has assigned personnel to four regions that cover the state to assist with TMDL development and to provide technical assistance on watershed planning and monitoring. The goal is to have regional contacts who are familiar the area and its residents so that local groups can coordinate better with DEQ and other agency watershed programs. For example, a conservation district will have a principal contact at DEQ who can assist the district apply for ϶319 nonpoint source grants, source water protection (drinking water) program funding, abandoned mine cleanups and water quality monitoring design.

The following TMDL strategy was presented as part of a formal schedule to the legislature's Environmental Quality Council (EQC). The strategy will be implemented in three phases.

Phase I will continue DEQ's existing policies of issuing ϶319 grants to local projects dealing with impaired or threatened waters, refinement of existing project implementation plans for 319 projects and submitting them to EPA for approval as TMDLs, refining beneficial use assessment and sufficient credible data criteria and TMDL education. To this end, DEQ completed 12 public meetings in February and March 1998 throughout the state to discuss TMDLs, the 1998 ϶303(d) list and the new strategy for ranking and prioritizing the ϶303(d) list. The meetings were coordinated with the state's CDs and drew participation from many rural areas that have not usually participated in the list development.

Phase II of the strategy will begin in October 1999 with the completion of a database management system, a new waterbody ranking system, and a revised list of impaired waters based on more specific, publicly reviewed criteria. The ranking system will be cooperatively developed by DEQ, the Statewide TMDL Advisory Group, and local watershed groups. Watershed planning actions will be targeted toward local watershed groups and interested landowners.

Phase III will begin ***in June 2003*** with the development of a more effective coordination framework for state, federal and local groups. DEQ started this coordination process in Phase I by including water resource agencies at all levels of government in its planning processes (i.e., TMDL, nonpoint source management plan revision, and a new federal initiative called the Clean Water Action Plan). The purpose of Phase III is to expand the water quality planning process for TMDL development to new watershed groups and to foster interest by landowners on impaired water bodies that have not begun the TMDL planning process. Interagency coordination should help identify landowners and other stakeholders with interest in forming watershed groups.

Phase III will also be carried out by local and regional watershed groups and local governments (e.g. CDs and water quality districts). The Upper Clark Fork Steering Committee is an example of a regional group. This steering committee is working with watershed work groups that are interested in implementing water quality plans on impaired waters. The Ruby River Watershed Council is an example of a local watershed group. This council has expressed an interest in working with landowners, including the U.S. Forest Service, to begin implementing water quality plans that serve as TMDLs. DEQ's experience with existing watershed groups demonstrates that local governments, watershed groups, and individuals often have the best knowledge of local water quality problems, their causes, and cost effective solutions. DEQ will continue to support the leadership role of these groups in water quality protection and watershed planning.

WATERSHED AND NONPOINT SOURCE MANAGEMENT

Introduction

Watershed planning and management are probably the most comprehensive and cost-effective means to improve or protect a water resource. Using a "watershed" approach for water resource management means that resource problems, land use impacts, and management activities are evaluated for an entire drainage basin. Watershed management may apply to any size watershed, from a major river basin with numerous private and public land holdings to a small tributary watershed with only a few landowners.

The watershed management approach is unique in that it identifies resources, problems, and management options by hydrologic areas rather than political boundaries. Watershed planners and managers typically consider many types of resources rather than focusing on just one resource or use. Several political entities such as counties may have territory included in the watershed of an individual creek. This approach also acknowledges that activities anywhere in the watershed can affect water quality and that the cumulative effect of numerous small impacts may impair a water body even though individual activities may not. Managing watersheds takes a great deal of coordination. In the past, coordination efforts in Montana have focussed at the local level, by responding to requests for assistance from local groups, local government, and research institutions. In the past couple of years, government agencies have recognized a need to improve coordination among staff members, programs, and funding sources in order to meet state and federal water ***quality and resource*** protection priorities.

Montana Watershed Coordination Council (MWCC)

The Montana Watershed Coordination Council describes itself in its web page as an information and support network. This page also describes its purpose as, "to advance voluntary local watershed work and building the capacity to get it done." Members include state and federal agencies, water user organizations, university representatives, conservation and environmental organizations, and industry representatives.

MWCC Objectives

- Serves as a forum that establishes a strong link with local watershed groups needing assistance to help enhance, conserve, and protect natural resources and sustain the high quality of life in Montana for present and future generations.
- Serves as a statewide coordination network for Montana's natural resource agencies and private organizations to share resources (financial and staff), identify and capitalize on opportunities for collaboration, and avoid duplication of efforts. The Council will foster coordination, communication, and cooperation rather than set policy or usurp any organizations' authority or responsibility.
- Encourages people who live in or near the basin to get involved early in a collaborative approach (e.g. Coordinated Resource Management planning) that will address natural resource issues and concerns. Assistance to local planning groups will be provided upon request ***by DEQ*** to help them achieve their goals.

MWCC Active Committees and Working Groups

- Agenda Committee
- Information and Education Work Group
- Grazing Practices Work Group
- Groundwater Work Group
- Water Activities Work Group
- Watershed Linking Work Group
- Wetland Council

Clean Water Action Plan - Unified Watershed Assessments

Montana resource management and environmental agencies participated in the development of a Unified Watershed Assessment during July through September of 1998, as part of the implementation of a federal initiative called the Clean Water Action Plan. The unified assessment involved most of the state and federal environmental management agencies that conduct watershed management activities in Montana. The assessment was a statewide analysis of where government priorities and local watershed restoration projects coincided. Although the Clean Water Action Plan is a framework for federal environmental management agencies, it provides an opportunity to improve interagency coordination at the state and local level. For example, as a part of the unified watershed assessment, the agencies and local watershed management groups plan to coordinate yearly in identifying local funding needs and ways to assist local projects with state and federal assistance programs.

Tribal governments conducted a similar prioritization process to help coordinate their watershed management programs. Their unified watershed assessments resulted in designated priority watersheds on individual reservations.

NONPOINT SOURCE MANAGEMENT

The state's Nonpoint Source Management Plan was initially approved by EPA in early 1988. It was updated in 1991. The state has concentrated its nonpoint source (NPS) program on three major source categories: agriculture, mining and forestry. Those are among the most prevalent sources of NPS impacts to state waters.

Over the past eight years, the state implemented a non-regulatory NPS program with emphasis on watershed demonstration projects and educational activities. Although a number of groundwater assessment projects have been initiated, the program has emphasized surface water pollution control and protection. BMPs have been adopted for each of the three primary source categories, and the state continues to refine those as well as to evaluate all other BMPs to ensure their effectiveness in protecting water quality in Montana.

The state NPS program is operated through the DEQ and is coordinated by the Planning, Prevention and Assistance Division. The program involves water quality managers and specialists working in four DEQ divisions. Watershed projects, education activities, and monitoring of agriculture, urban sources, wetlands, and forestry are handled by staff in the Planning, Prevention and Assistance Division. Stream channel work, temporary pollution authorizations (3As), mining-related BMPs, and Clean Water Act section 401 certifications of wetlands permits are handled by the Permitting and Compliance Division. The Enforcement Division investigates complaints of nonpoint source pollution and takes appropriate action when necessary. The Remediation Division works on NPS pollution from abandoned mines and industrial sites. Recently, DEQ organized a Watershed Management Core Team to coordinate watershed related activities within the agency. The team has met several times. One of its activities will be developing a new nonpoint source management plan.

Agriculture

Pollution from agricultural activities is one of the largest NPS challenges in Montana. Sediment from grazing lands and irrigation return flows is a major source of pollution to surface waters. The state nonpoint source program is aimed at controlling these sources and improving animal waste management systems and dry-land salinity control. The federal Natural Resources Conservation Service (NRCS) develops and approves agricultural conservation standards and specifications that also serve as the state's agriculture BMPs. The Montana Watershed Coordination Council's Prescribed Grazing Standards Work Group, in conjunction with NRCS developed BMPs for grazing in Montana in February 1996 and the nationwide guidelines were revised for animal waste management in the Fall of 1998. An animal waste BMP handbook was distributed in 1997 and a grazing BMP guidebook is now under development at the Montana DNRC.

Timber Industry
NPS pollution in the state from forest practices is less widespread than from agriculture, but can be a serious site-specific problem. Concentrated primarily in the western mountainous region of the state, pollution from forestry has been largely attributed to roads and activities within riparian areas. The private timber industry, working closely with both state and federal land management and regulatory agencies, has led the development and implementation of an education program to inform loggers, landowners and others of forest BMPs. This education program has been acclaimed as an example of "self-regulation." Interdisciplinary BMP audits, funded by Montana's NPS program, have been conducted every two years since 1990 and have helped pinpoint NPS problems, provided education opportunities, and suggested alternative ways to improve site specific application of BMPs. The Streamside Management Act, that stipulates a zone of special management on both sides of a stream, lake or other water body, also has assisted in the protection of water quality during commercial logging activities.

Mining
NPS pollution from mining is commonly associated with inactive mine sites. New mines are most often regulated by state and federal permits, and although the regulations have continued to evolve over the past four years, runoff from old tailings and acid mine discharges from abandoned mine adits (openings) continues to pollute surface water in many parts of the state. Mining NPS sources are addressed primarily through wastewater discharge permits, mining and reclamation permits, abandoned mine clean up programs, and Super Fund-related activities at DEQ. The identification of water quality problems relating to mining or other sources and coordination of these cleanups with other resource management activities usually is carried out by DEQ's Remediation Division, but they may also occur as part of a watershed restoration project funded by nonpoint source program grant funds and carried out by local authorities. Near Lewistown, the Big Spring Creek watershed project, which is now dealing with PCB contamination, is one example.

Other
Other nonpoint pollution sources being addressed in the state include hydromodification (stream flow or channel modification) and wetland habitat loss. These problems are regulated by DEQ through permits and the water quality certification process (CWA ϶401). For example, stream modifications require permits from the local conservation district, DEQ, the U.S. Army Corps of Engineers, and often from the county floodplain administrator. The state NPS program also promotes the use of various BMPs for these and other pollution sources through a variety of educational activities including workshops, special work groups (e.g., Cluster Development work group and Subdivision Law work group), and print media such as brochures and guides.

During the past eight years, the state has implemented 42 watershed projects, 16 groundwater projects, and 61 educational projects. The typical watershed project is sponsored by a local conservation district and involves using BMPs for nonpoint pollution sources, such as grazing management and stream bank restoration. These projects are typically in a medium-sized watersheds (8-30 miles long) and include 80-90 percent of the landowners as active participants within the watershed and has provided up to 75 percent cost-share as a financial incentive for cooperating with BMPs implementation. Monitoring occurs before, during and after implementation of the BMPs and is an integral part of the project, both to determine the effectiveness of the BMPs and the overall reduction of pollution within the watershed. Additionally, each water quality clean up demonstration project includes an educational element so that the "lessons learned" and the technology employed can be effectively transferred to other areas within the state.

NPS education projects have been carried out by DEQ, other state agencies, CDs, industry groups, and conservation groups. DEQ has helped to produce a stream management guide, animal waste guide, grazing video and workshop curriculum, and a lake water quality protection guidebook. The state NPS program personnel have also worked closely with the forest industry to produce forestry BMP education products such as BMP booklets, and with the mining industry on development of BMPs for placer mining.

In several watersheds in the state, watershed groups have formed or are forming to address natural resource problems, including water quality impairments listed on the 303(d) list of waters needing TMDLs. DEQ supports watershed management as the most appropriate method to address both NPS problems and the cumulative impact of point sources. Watershed management activities which are led by local groups and local agencies, including CDs, and supported by state, federal, and private technical experts offer the best practical, economic, and comprehensive solutions to water resource and water quality problems.

The following figures show the location of most of the watershed and groundwater projects funded by DEQ using U.S. EPA NPS (section 319) Grant funds and 1997 RDGP grants (State Reclamation and Development Grant Program). The projects are shown by category. Figure 11 shows 319 projects funded in 1995-98.

Nonpoint Source Management Projects in Montana

Watershed Projects funded with FFY 1995-1998, Clean Water Act, section 319 and state RDGP grants.

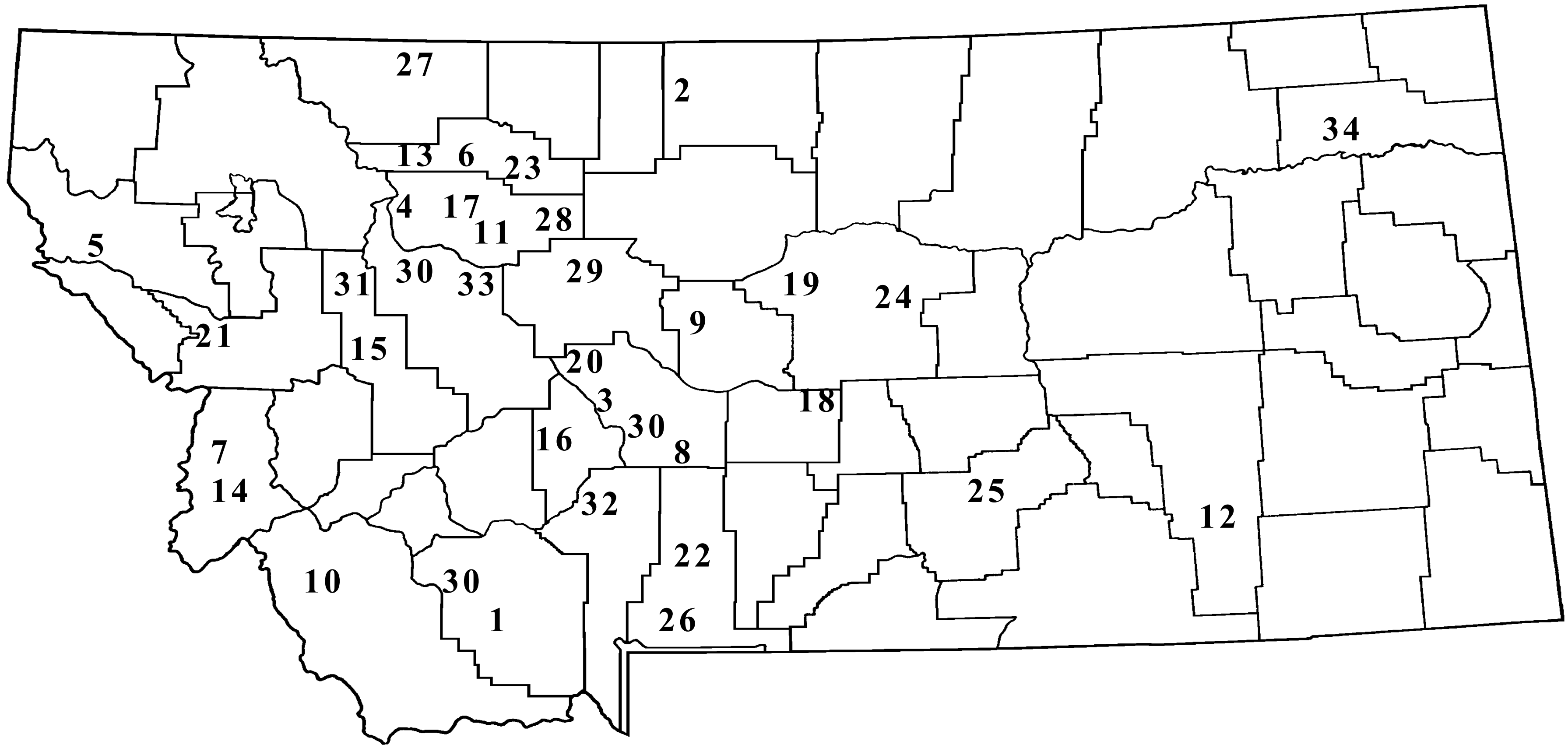


Figure 11. NPS Projects in Montana funded by NPS program 1995-98
See Table 29 for a complete list of the NPS Projects as numbered above.

Table 29

Nonpoint Source Management Projects in Montana

Watershed Projects funded with FFY199-98 Clean Water Act, section 319 and state RDGP grants

Watershed Management Projects	Sponsor
1. Ruby River Watershed Project (97)	Ruby Valley CD
2. Sage Creek Watershed Project (97)	Hill and Liberty CDs
3. Deep Creek Watershed Restoration (97)	Broadwater CD
4. Sun River Watershed Projects (97)	Cascade CD
5. Elk Creek Watershed Project (97 RDGP)	Green Mountain CD
6. Teton River (97 RDGP)	Teton CD
7. Bitterroot Watershed (97 RDGP)	Bitterroot CD
8. Agrimet Irrigation (97 RDGP)	Broadwater CD
9. Big Otter Creek (97 RDGP)	Judith Basin CD
10. Big Hole Watershed (97 RDGP)	Beaverhead CD
11. Ag. Chemicals in Sun River/Lake Ck. (98)	Teton CD
12. Rosebud / Armell Creek	Rosebud CD
13. Teton River Watershed (98)	Teton CD
14. Bitterroot Forum & Watershed Project (96)	Bitterroot CD
15. Nevada Creek Watershed Project (95)	North Powell CD
16. Deep Creek Watershed Restoration (96)	Broadwater CD
17. Sun River Watershed Projects (96)	Cascade CD
18. Careless Creek Watershed Project (95)	Lower Musselshell CD
19. Big Spring Creek Restoration (95)	Fergus CD
20. Ten Mile Creek TMDL (95)	Lewis and Clark CD
21. Tri State Implementation Council (95)	Bitterroot CD

Groundwater Protection Projects	Sponsor
22. Septic System Technical Assistance (97)	Gallatin CD
23. Pesticide in Ground Water Greenfield (97)	Cascade CD
24. Central MT/ Big Spring Aquifers (98)	Fergus CD
25. Canyon Creek NPS Assessment (98)	Yellowstone CD
26. Septics in Gallatin Subdivisions (98)	Gallatin CD
27. Red River Watershed Evaluation (95)	Glacier CD
28. Lake Creek / Benton Refuge Project (95)	Cascade CD
29. Lower Missouri GW Project (96)	Cascade Health Dept
30. Agrimet Tolson, Dillon, Ft Shaw (96)	Broadwater CD
31. Grazing Practices Demonstration (95)	North Powell CD
32. Vegetative filter strips Gallatin Co (96)	MSU/Plant Soil & Env Sciences. Dept.
33. Ft Shaw Irrigation Mgmt/Sun River	Cascade CD
34. Abandon Wells Project	Roosevelt CD