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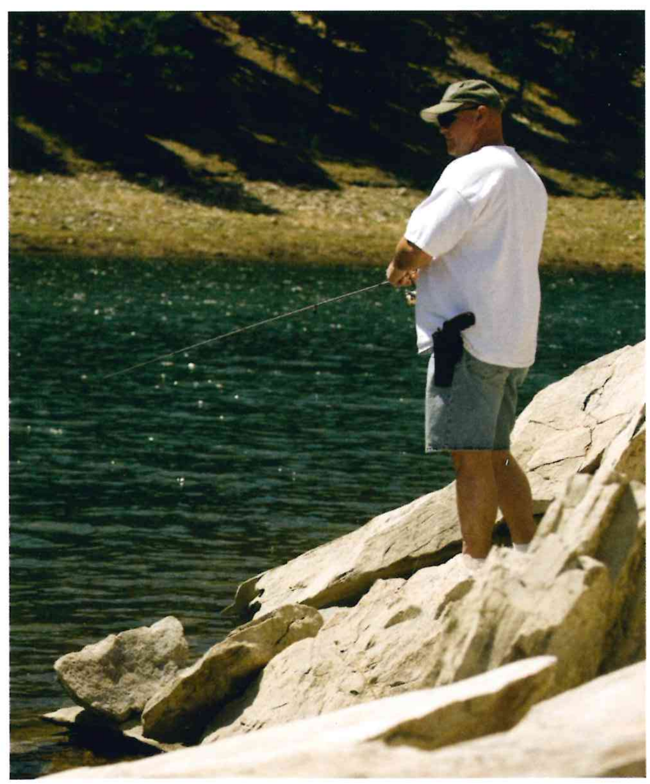

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What is Watershed Management?

South Dakota has more than 95,000 miles of streams, of which over 9,000 miles are perennial. South Dakota also has almost 200,000 acres of classified, publicly owned lakes and reservoirs. Wherever you live, you are in a watershed, and you contribute to the quality and quantity of the water that enters South Dakota's lakes, reservoirs and streams.

A watershed is a land area that contributes all of the runoff to a point of interest, such as a lake or the mouth of a stream or river. Watershed management refers to land use practices that ensure effective stewardship of water quality and quantity. A watershed management plan is a roadmap for how to manage a watershed in order to meet the water quantity and quality requirements for its intended beneficial uses.

Nationwide, watershed management plans have typically been developed in watersheds where the water quality had already degraded below a threshold level for its use or where there were limited water supplies. In such cases, implementing a watershed management plan has often been very costly and in some cases, because of lack of transparency, resulted in a lack of trust among watershed stakeholders. Therefore, rather than reacting to existing problems, taking a proactive approach to address emerging water resource problems by preemptively developing a watershed management plan with stakeholder input requires fewer resources and is less costly compared to waiting for the problems to get worse.

Successful watershed management needs local support and engagement through the involvement of citi-

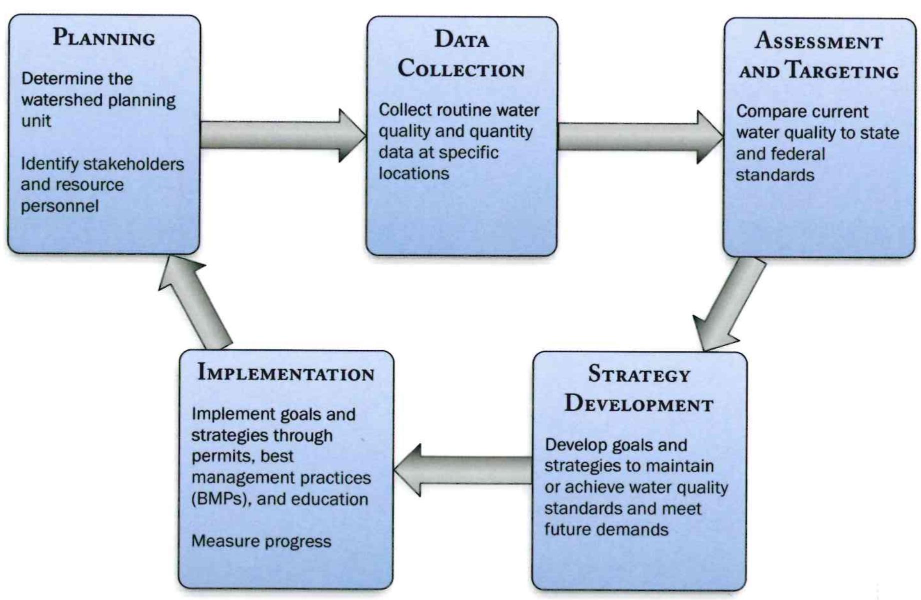

Figure 1: The watershed management cycle.

zens and stakeholders representing the watershed's population. Stakeholders throughout a watershed will benefit from becoming familiar with the steps involved in developing a watershed management plan, in order to influence the outcome of the process. The approach currently recommended by the Environmental Protection Agency (EPA) includes five steps: 1) planning; 2) collecting data; 3) assessing current water quality and targeting desired standards; 4) developing goals and strategies to reach those standards; and 5) implementing strategies and measuring their effectiveness. Figure 1 graphically outlines this process and will serve as a guide to the rest of this publication which discusses these steps from the viewpoint of watershed stakeholders and from a water quality perspective.

1. Planning

1.1 Determine the watershed planning unit

When delineating the boundaries of a watershed it is necessary to consider which scale you will be working at; for example, whether a watershed management plan is to be developed for a large river basin, for a tributary, a smaller stream, or closed basin with a lake.

The size of a watershed influences stakeholder roles in all steps of the watershed management cycle. Also, the size of a watershed determines which government unit exercises authority over a particular land area. For example, a state or federal agency may be the lead stakeholder in a large river basin (1,000 to 10,000 square miles in area), while local government agencies may play the larger role in a smaller watershed (0 to 1000 square miles in area). Watershed unit size also determines the focus of management strategies ranging from, implementations of local best management practices to planning for the entire river basin. Table 1 gives an overview of watershed characteristics along with primary planning agency.

South Dakota's Water Resources

South Dakota's surface water network consists of 14 major river basins (Figure 2). All but three of these are shared with neighboring states. These river networks supply South Dakotans with part of their water needs. The surface water quality varies within these watersheds due to both natural processes and human activities.

Hydrologic Unit Codes

Because it is necessary to be able to accurately delineate and identify watersheds, the United States Geological Survey (USGS) has developed a system of hydrological land 'units', each identified using a unique numerical code. The unit boundaries are developed so that all surface drainage within each unit converges at a single outlet point such as a lake or the mouth of a stream or river. There may be 'non-contributing areas' located within a unit that do not drain to the outlet such as potholes or smaller closed basins, which do not drain to the common outlet.

Each hydrological unit (HU) delineates the boundaries of a watershed. The hydrologic unit codes (HUC) are organized in a hierarchy where more digits are added to the code as watersheds are being divided into smaller units:

Table 1. Generalized Watershed Management Unit Characteristics (Schueler, 1995)

Watershed Management Unit	Typical Area, mi^2 (Acres)	Primary Planning Authority
Catchment	0.05-0.50 (32-320)	Property owner (local)
Subwatershed	1-10 (640-6,400)	Local government
Watershed	10-100 (6,400-64,000)	Local (or multi-local) government
Subbasin	100-1,000 (64,000-640,000)	Local, regional or state governments
Basin	1,000-10,000 (640,000-6,400,000)	State, multi-state or federal governments

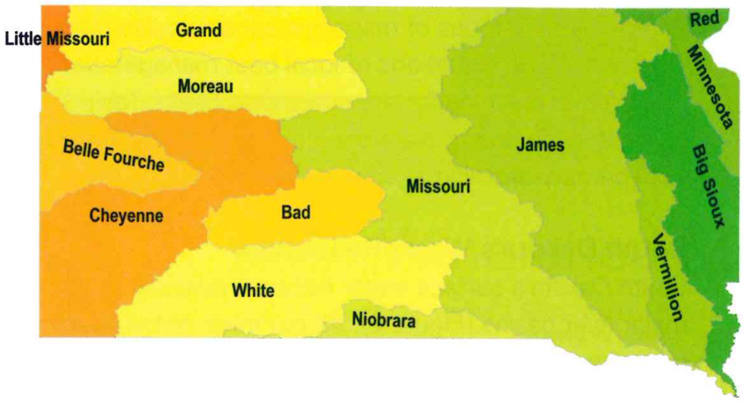

Figure 2: Major South Dakota river basins.

Want to find your watershed?

See the Environmental Protection Agency (EPA) Web site "Surf Your Watershed" at:

http://www.epa.gov/surf/

Region. Under the HUC the system, the US has been divided into 21 regions based on the nation's major river watersheds. Each region has been assigned a two digit number between 01 and 21. For example, the Missouri River Basin has been assigned the code 10.

Subregion. Each region is subdivided into subregions. Each subregion is contained entirely within a region. A four-digit code is used to identify a subregion, of which the first two digits are the code for the region and the last two are the subregion identifier.

Basin. Each subregion is subdivided into basins. A six-digit code is used to identify a basin, of which the first two digits are the code for the region, the two middle digits are for the subregion and the last two are the basin identifier.

Subbasin. Each basin is subdivided into subbasins. An eight-digit code is used to identify a basin.

Watershed. Each subbasin is subdivided into watersheds. A ten-digit code is used to identify a watershed.

Subwatershed. Each watershed is subdivided into subwatersheds. A twelve-digit code is used to identify a subwatershed.

The hydrologic unit code (HUC) system levels are summarized in Table 2 with example names and codes for commonly identified regions. Figure 3 shows the HUC system's levels and their characteristics using the Big Sioux River Basin in eastern South Dakota as an example.

The USGS HUCs are widely accepted as the norm for identifying watershed boundaries and are commonly used in the watershed planning process. Maps and descriptions of the HUCs are available at no cost for download from the USGS or from the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Data Gateway. The addresses for these websites are included at the end of this publication.

Table 2. Hydrologic Unit Code (HUC) levels and characteristics

Name	Level	Digits	Number of HUs Nationally (approx.)	Example Name	Example Code (HUC)
Region	1	2	21	Missouri Region	10
Subregion	2	4	221	Missouri-Big Sioux	1017
Basin	3	6	378	Big Sioux	101702
Subbasin	4	8	2264	Lower Big Sioux	10170203
Watershed	5	10	22000	Skunk Creek	1017020311
Subwatershed	6	12	160000	Beaver Lake	101702031101
14-digit HUC	7	14	Not Completed	-	-

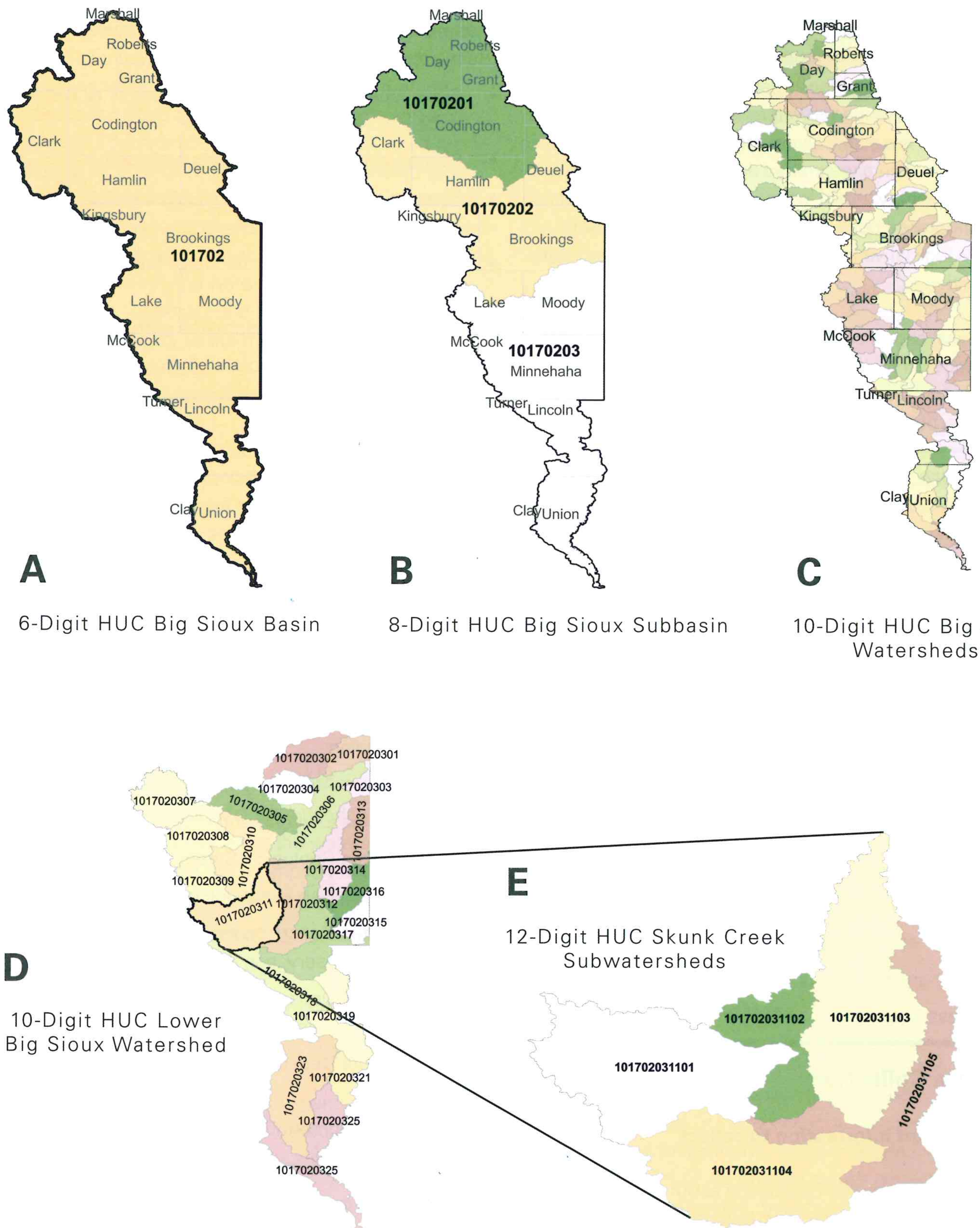

Figure 3: Hydrological Unit Codes (HUC) for the Big Sioux Watershed, SD from 6 to 12 digits (top) and an example of 10 and 12 digit HUC for the Lower Big Sioux Watershed and Skunk Creek Subwatershed (bottom).

1.2 Identify stakeholders and resource personnel

Successful watershed management needs local involvement and support. Participation from stakeholders representing a watershed's population and interests is essential. Direct stakeholders live or own property within a watershed and influence water quality and quantity, while indirect stakeholders live outside the watershed boundaries but may use its water or have a legislative mandate, such as state water quality protection.

Technical expertise may be conveyed to stakeholders and decision makers by consulting with individuals or groups with specific expertise including scientists, engineers, policy experts and attorneys.

Who are stakeholders in my watershed?

Although every watershed is unique, examples of stakeholders include:

Typical Direct Stakeholders

- Landowners (permanent and absentee)
- Homeowners
- Local businesses
- Agricultural producers
- Industries

Typical Indirect Stakeholders

- City and county officials
- State or federal officials
- Water and wastewater utilities
- Civic groups
- Mass Media

2. Data Collection

2.1 Relevant information to collect

Without background information about the watershed of sufficient substance, discussions will be based on emotions and anecdotal evidence, and the watershed management process will be impeded. The information that is relevant to collect varies between watersheds, but the following information is normally useful (Reimold, 1998).

- Sizes, locations, and designated uses of all water bodies of interest
- Demographic data and growth projections
- Economic conditions, such as income and employment
- Impairments rendering the water unfit for its intended uses
- Pollution sources and estimates of their loadings
- Water attributes: physical, biological, chemical
- Groundwater quality and sources affecting it
- Fish and wildlife surveys
- Maps: topographic, hydrologic, land use and cover (including wetlands and riparian areas) and changes in land use Detailed soil surveys
- Threatened and endangered species and their habitat
- List of relevant local stakeholders

A substantial amount of information about South Dakota watersheds is available from state and federal agencies, including

- United States Army Corps of Engineers
- United States Environmental Protection Agency
- United States Geological Survey
- United States Fish and Wildlife Service
- United States Department of Agriculture Natural Resources Conservation Service
- South Dakota Department of Environment and Natural Resources
- South Dakota Department of Game, Fish, and Parks
- Water Development Districts
- Municipal utilities and rural water systems
- Tribal water resource authorities

Sources of information are listed in the resources section at the end of this document.

In case pertinent information about the watershed is not available, it must be generated, for example through monitoring or surveying programs. Establishing routine monitoring that follows standard procedures for sampling and analysis is crucial to developing meaningful information to be used in watershed management. SD DENR (2005) outlines suggested procedures to follow, including pre-sampling considerations, sample collection and analysis, instrument calibration and quality assurance. Having an outside entity not directly involved in the watershed management plan development undertake the monitoring typically lends additional credibility to the monitoring data.

2.2 Estimation of pollution load

When developing a watershed management plan, it is necessary to identify the source(s) of possible pollutants and establish what the current conditions are. This may be achieved by analyzing available information and historical monitoring data, or new data may need to be collected. Pollutants may stem from natural sources or from human activities. The total pollutant load is broken down using the formula:

Total Pollutant Load = Total Point Source Load + Total Nonpoint Source Load

Point Sources of Pollution

Point source pollution is the term used to identify those contaminants that enter the watershed at an easily defined location, for example, through an outlet pipe. Examples of point sources include:

- Wastewater treatment plant discharges
- Industrial waste discharges
- Stormwater collection systems discharge
- Concentrated Animal Feeding Operations (CAFO)

State and federal environmental agencies monitor and regulate point source pollution based on established water quality and quantity water standards.

Nonpoint Source Pollution

Nonpoint source pollution comes from numerous and widely scattered sources not discharging from a clearly defined point. The pollutant load from any single location may represent a small and seemingly insignificant contribution. However, the collective impact of all these loads may have substantial impact on the water quality in the watershed. Since these pollutants sources are not coming from a defined point, they are difficult to monitor and treat effectively.

Examples of nonpoint source pollutants common to South Dakota include:

- Bacteria and nutrients from livestock, pet wastes and faulty septic systems
- Excess fertilizers and pesticides from agricultural lands and residential areas through surface and subsurface runoff
- Sediment from improperly managed construction sites, crop and forest lands, gardens and eroding stream banks
- Oil, grease, and toxic chemicals from urban, industrial, and agricultural runoff and energy production
- Acid drainage from abandoned mines
- Atmospheric deposition (the transfer of pollutants from the air to the earth's surface)

In most cases, the types of activities that can lead to nonpoint source pollution are not specifically regulated. Nonpoint source pollution may be controlled through the design, construction and maintenance of best management practices (BMPs). Putting BMPs into place is a voluntary action, but is often supported through cost-share programs.

3. Assesment and Targeting

3.1 Water quality standards

South Dakota Codified Law 34A-2-1 outlines the public policy for protecting and conserving the quality of the waters of the state. Surface water quality standards are laid out in Administrative Rules of South Dakota (ARSD). ARSD 74:51:01 defines eleven general categories for the designated, beneficial use of regulated lakes and streams in the state:

1. Domestic water supply waters;

2. Coldwater permanent fish life propagation waters;
3. Coldwater marginal fish life propagation waters;
4. Warmwater permanent fish life propagation waters;
5. Warmwater semipermanent fish life propagation waters;
6. Warmwater marginal fish life propagation waters;
7. Immersion recreation waters;
8. Limited contact recreation waters;
9. Fish and wildlife propagation, recreation, and stock watering waters;
10. Irrigation waters; and
11. Commerce and industry waters.

A stream or lake may have more than one designated use. Each designated use is associated with a set of water quality standards. The standards specify thresholds for water quality impairments that are used to identify instances where the water quality may be inadequate for its designated use. The surface water quality standards are designed to:

- Establish numerical and narrative goals for water quality; and
- Provide a basis for the South Dakota Department of Environment and Natural Resources (SD DENR) to develop reasonable methods for reaching these goals.

3.2 Identifying Impaired Waters

Federal and state agencies conduct and oversee water quality monitoring and normally make the results publically available. Every two years (in even numbered years) the SD DENR conducts a statewide surface water quality assessment. The outcome of the assessment is published in the report "Integrated Report for Surface Water Quality Assessment" (SD DENR, 2012) which is available for download from the SD DENR website at no cost. The report lists the impaired water bodies where the water quality does not meet the standards for its designated uses (known as the 303(d) list) and identifies Total Maximum Daily Load (TMDL) programs for streams and lakes not meeting state standards for particular impairments (see box).

What are the Surface Water Quality Assessment and the 303(d) list?

The Surface Water Quality Assessment addresses the quality of South Dakota's waters and is conducted by the SD DENR. The 303(d) list identifies water bodies not meeting designated use standards. These reports satisfy federal Clean Water Act requirements for Sections 305(b) (water quality reports) and 303(d) (lists). The US Environmental Protection Agency (EPA) must approve the list before it is considered final.

What is a TMDL?

A Total Maximum Daily Load (TMDL) estimates the maximum amount of a pollutant that a water body can receive and still meet water quality standards. A "budget for pollution," the TMDL uses a scientific model to:

- determine the maximum amount of a pollutant at which a stream or lake can attain and maintain its designated use standards; and
- assign this load amount to point and nonpoint sources in the watershed.

An implementation plan puts the TMDL into action by outlining voluntary and regulatory steps necessary to reduce pollutant loads.

Is my watershed part of a TMDL?

To determine whether you are in a watershed that has a TMDL established, 1) find your watershed using SD DENR (2012) or one of the websites provided at the end of this document, 2) review the information on whether the current 303(d) list includes your watershed and its associated water quality parameter.

Do I contribute to a TMDL in my area?

All activities, whether agricultural, industrial, municipal or recreational, contribute to the water quality of your watershed. For example, applying excess fertilizer in an untimely manner to a lawn or garden may contribute to the TMDL. However, depending on the nature of the pollutants involved, some activities may contribute more than others.

How is a TMDL designation removed?

A plan to manage your watershed's TMDL must be developed and effectively implemented before your watershed can be removed from the 303(d) list of impaired water bodies.

4. Strategy Development

By providing input and helping to set goals and to assign priorities to them, direct and indirect stakeholders play a key role in identifying strategies and in designing watershed management plans. Plan development should also involve interest groups, experts (such as private- or public-sector engineers and scientists) and policy makers (such as local, regional, state and federal planning personnel). Seeking input from a wide range of individuals increases the likelihood of producing a feasible and successful management plan.

Management plans that outline specific goals produce the best results for stakeholders. For example, instead of specifying a goal to "improve water quality," it is better to specify "reduce watershed phosphorus loading by 25 percent". Also, it is useful to model (see box on Water Quality Models) the effects of BMP implementation. If set up properly, water quality models will help predict impacts of different scenarios relating to increases or decreases in loadings for a particular stream or lake to determine whether or not implementation of a corrective water quality measure has the desired impact on water quality.

What are Water Quality Models?

Water quality models use mathematics to simulate natural watershed processes. As input, such models need information about topography, land use, climate, soils and current and historical management of the watershed. Water quality models allow managers, engineers and planners to develop and evaluate "what-if" scenarios. They can assist stakeholders in evaluating the effect on the watershed of management strategies and land use changes. But a model's usefulness can be limited by the size of the watershed (scale) and by the amount and quality of data available (such as stream flow and water quality parameters). Successful outcomes of a modeling effort rely on combining the modeling results with considerations for the social acceptability of suggested water quality solutions. Also, models only predict changes based on available data and assumptions. Actual water quality monitoring is necessary to determine the impact of implementation of best management practices and other changes in management practices in the watershed.

5. Implementation

5.1 Implement goals and strategies

Stakeholders and decision makers commonly customize the 'tools' that exist for implementing watershed management plans. These tools include 1) permits, 2) best management practices (BMPs) and 3) educational programs.

Permits

Regulatory permits are used most often to control point sources of pollution. Such permits are issued by government agencies and specify discharge levels for pollutants. Point sources may not exceed these permitted levels. Point source contributors might address water quality issues by modifying permits to change certain pollutants' allowed discharge quantities. However, putting such permit changes into practice may require plant expansion and/or new processes that will increase treatment costs for a facility's users or consumers. A watershed management strategy that uses permits as its sole tool will be effective only if point sources are the dominant contributors to water quality problems.

What is the major permitting program in place?

As authorized by the Clean Water Act, the permit program of the National Pollutant Discharge Elimination System (NPDES) controls water quality by regulating point source pollution, including discharges into United States waters by concentrated animal feeding operations (CAFOs), combined sewer overflows (CSOs), pretreatment (wastewater treatment) plants, sanitary sewer overflows (SSOs) and stormwater (construction activities, industrial activities, and municipal stormwater sewers). In South Dakota, these permit programs are administered and enforced by the SD DENR.

Best Management Practices (BMPs)

BMPs are the preferred approach to managing non-point source pollution. Although BMPs are often voluntary, some regulatory agencies require their inclusion in watershed management plans. A watershed management strategy that uses BMPs as its sole tool will be effective only if nonpoint sources are the dominant contributors to water quality problems and if a sufficient number of landowners are willing to participate in voluntary programs. Water quality improvements cannot be expected from projects that rely solely on voluntary efforts if landowners do not participate.

Examples of Best Management Practices

Changes in land use or management such as

- Vegetated buffer strips along lakes and streams
- Grassed waterways
- Nutrient management
- Conservation tillage
- Use of wetlands
- Sedimentation basins
- Septic system maintenance
- Stream bank stabilization

Educational Programs

Education is a key component to a successful watershed management plan. Education programs help alert stakeholders regarding watershed problems and help involve them in decision making. Educational programs also draw the attention of both agency employees and stakeholders to the need for a proper strategic balance between permits and BMPs. Such balance leads to management plans that address pollution from both point and nonpoint sources. Outreach programs can also raise the level of awareness about the importance of watershed water quality issues among those who may not consider themselves to be direct, or even indirect, stakeholders.

What types of Educational Programs can be useful?

- Publications
- Field days
- Demonstration projects
- Tours
- Focus groups
- Media coverage
- Newsletters
- Surveys

5. 2 Measure plan progress

The progress of a watershed management plan needs to be measured to assess whether it is successful. For example, if a plan's goal is to reduce lake phosphorus concentrations by 25 percent, ongoing monitoring should assess concentration trends over time compared to the base or beginning condition. Such monitoring will help determine whether plan strategies (permits, BMPs, education) are achieving desired outcomes.

REPEATING THE CYCLE

The watershed management approach can be used to decide when and what actions are needed either to correct water quality or quantity problems (reactive mode) or to prevent such problems (proactive) from occurring. Measuring and assessing the success of a watershed management plan is an ongoing process. Because watersheds and watershed management tools are dynamic, the steps outlined in Figure 1 must be repeated continually to ensure that the goals set up in the plan are reached. Also, ongoing monitoring may show that a given action may not have had the anticipated effect and adjustments to the plan are needed to attain the goals. It is important to continue to have stakeholder participation throughout the process and to make sound decisions to meet the plan goals

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South Dakota Department of Environment and Natural Resources [http://denr.sd.gov/]

South Dakota Water Resources Institute, South Dakota State University, [http://www.sdstate.edu/abe/wri/index.cfm]

US Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS)

Geospatial Data Gateway [http://datagateway.nrcs.usda.gov/]

US Environmental Protection Agency Resources

Clean Water Act [http://www.epa.gov/lawsregs/laws/cwa.html]

National Pollutant Discharge Elimination System (NPDES) [http://cfpub2.epa.gov/npdes/]

Water Quality Assessment and TMDL Information [http://www.epa.gov/waters/ir/]

Conservation Technology Information Center, Purdue University

Know Your Watershed [http://www.ctic.purdue.edu]

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