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Watershed Management Workshop for the James, Vermillion, and Big Sioux Rivers

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PROCEEDINGS

B 720



WATERSHED MANAGEMENT WORKSHOP

FOR THE JAMES, VERMILLION, AND BIG SIOUX RIVERS

February 7—8, 1995 • Crossroads Hotel • Huron, South Dakota

Agricultural Experiment Station • South Dakota Cooperative Fish and Wildlife Unit • South Dakota State University
South Dakota Department of Environment and Natural Resources • South Dakota Department of Game, Fish and Parks
Natural Resources and Conservation Service, USDA • National Biological Service, DOI

WATERSHED MANAGEMENT WORKSHOP
FOR THE
JAMES, VERMILLION, AND BIG SIOUX RIVERS

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B 720

Agricultural Experiment Station • South Dakota State University • U.S. Department of Agriculture

PREFACE

Rivers have become prominent subjects for natural resource personnel and the public. There are new riparian and wetland programs, controversial flooding and water quality issues, proposed water development projects, and innovative thinking about ecosystem management.

The Watershed Management Workshop for the James, Vermillion, and Big Sioux rivers was developed to bring people, projects, problems, and programs together from the watersheds to discuss current and future needs for management, research, and cooperative efforts.

The workshop opened with a discussion of basic principles of terrestrial, riparian, and aquatic components of a watershed and was followed by a case history of a watershed management program in Minnesota. This set the stage for a discussion of specific projects and programs that are underway on the James, Vermillion, and Big Sioux River watersheds.

It is our hope that this workshop was a step in cooperative management of these watersheds and in the continuing education needed by all involved in watershed and ecosystem management.

ACKNOWLEDGEMENTS

We would like to thank the speakers and poster presenters for contributing to the success of the workshop. In addition, we would like to express our appreciation to the South Dakota Department of Environment and Natural Resources, the United States Department of Agriculture Natural Resources Conservation Service, and South Dakota Cooperative Fish and Wildlife Research Unit for sponsoring the workshop. The Coop Unit is jointly sponsored by South Dakota State University, the South Dakota Department of Game, Fish and Parks, the National Biological Service, and the Wildlife Management Institute.

Steering Committee:
Sandra Wyman, USDA Natural Resources
Conservation Service
Chuck Berry, South Dakota Cooperative Fish and
Wildlife Unit
Craig Milewski, SDSU Graduate Student

... for the last 50 years, the Jim River has been a source of good fishing, good recreation for the family and for our retirement years, and good comradeship with fellow fishermen. While the Jim may be the lowest of rivers we hold it in the highest esteem. Rather be small and shine than be large and cast a shadow.

George Nikolas and Tony Gefre
Aberdeen, S.D.

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The art of land doctoring is being practiced with vigor, but the science of land health is yet to be born.

Aldo Leopold, 1949
Sand County Almanac

INTRODUCTION, WATERSHED MANAGEMENT WORKSHOP

Tim Bjork

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Good morning, ladies and gentlemen. Welcome to Huron and the Watershed Management Workshop for the James, Vermillion, and Big Sioux rivers. My name is Tim Bjork, and I am an employee of the South Dakota Department of Environment and Natural Resources.

We have quite an extensive program planned for you for the next 2 days, so I won't take much of your time with introductions. However, I would like to recognize the South Dakota Cooperative Fish and Wildlife Research Unit, the South Dakota Department of Environment and Natural Resources, and the U.S. Department of Agriculture, Natural Resources Conservation Service for sponsoring this workshop. Let's thank Sandy Wyman, NRCS; Dr. Chuck Berry, SDSU, Duane Murphey, DENR; and Craig Milewski, SDSU, for putting this workshop together.

Before we get started with the official program, there are several questions that I would like all of you to consider as you listen to the presentations. Please think these questions through and provide your answers on the back of the survey form that was passed out earlier.

First question: What is a watershed? Surprisingly, many of the questions that I get on watersheds relate to size. Does this include ground-water and air also? There is not a genuine understanding of what each of us means when using the term "watershed."

Second: What is a riparian area? Many people have never heard of the term.

Third: How do you define an ecosystem?

And finally: What is watershed management? Although we in South Dakota operate under the principle of watershed management in the Nonpoint Source Pollution Control Program, we probably shouldn't jump to the conclusion that it is a naturally occurring management philosophy. In fact, in talking with some drinking water managers last week, I found they were surprised to learn that there was a program like ours that protects the "sources" of drinking water.

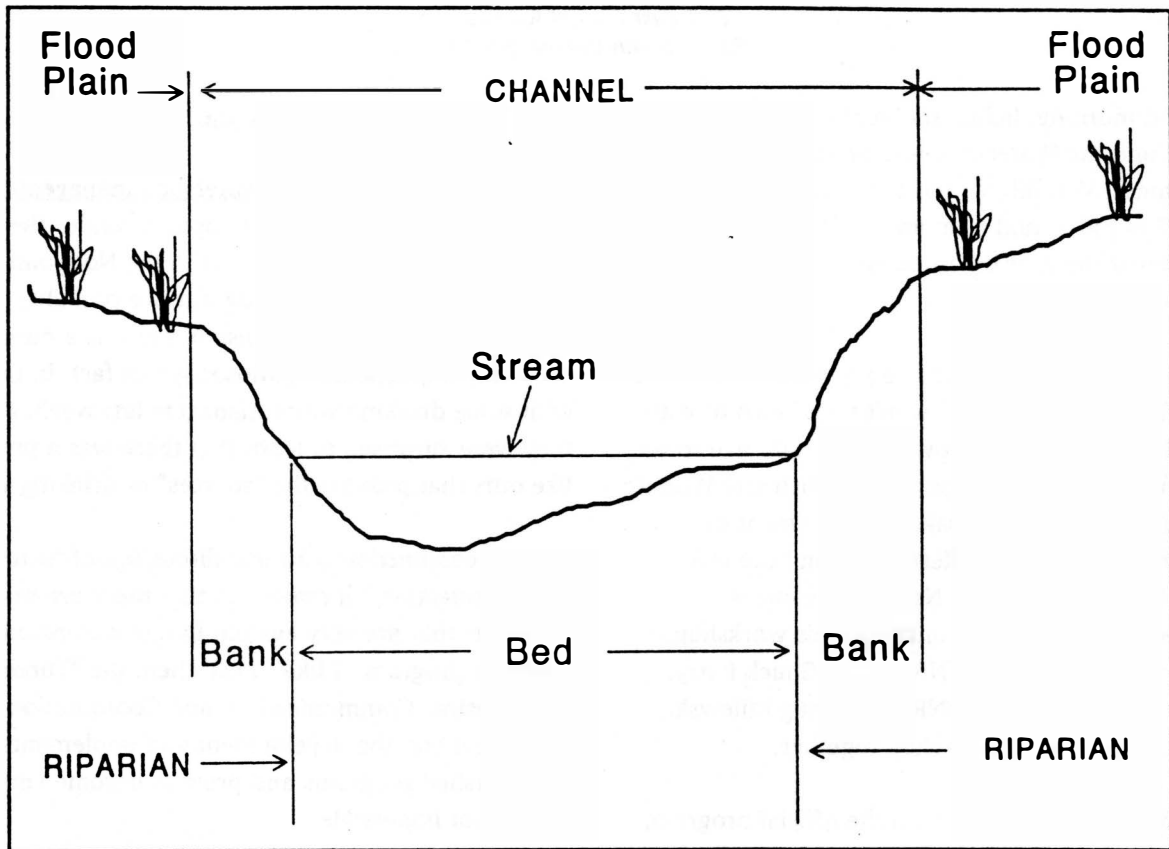
In conjunction with this discussion of "source water protection," it struck me that there are several constants that are very evident in any watershed management program. I like to call them the "Three C's—Cooperation, Communication, and Coordination." Without these, the development and implementation of watershed programs and projects become very difficult, if not impossible.

Does this sound painfully simple? Painfully obvious? Maybe it is, but count your blessings, folks, because the way we (and I mean all of us, not just DENR!) do business is not all that common. In reference to the California drinking water people again, they were just astounded that our state agencies, universities, agricultural groups, and a host of others were able to work so closely in solving problems. One individual said he "would give anything" to be able to work in such a cooperative atmosphere!

And, finally, although I don't see this element of watershed management listed specifically on the agenda, I know it's in there.

To what do I refer? People!! Let's not forget to include us humans as we work on solving resource problems. However simplistic it may sound, people and their needs are a critical element in the watershed management equation. Let's fact it, folks, watershed management is for and because of us! Whether it is

drinking water, pasture taps, wastewater treatment, or economic sustainability, watershed management deals with people and their needs. So, as we go about this business of "watershed management," let's "us" not forget to include "us" as we strive to balance the equations.



Typical stream cross section, showing the components of the channel and riparian zone.
(U.S. Forest Service)

WATERSHED CONCEPTS

The first part of the workshop established the basic principles of watershed processes and management. An overview covered the physical, chemical, and biological processes that govern the movement of energy and material resources within a watershed. Three interrelated themes were: 1) terrestrial-aquatic linkages, 2) knowledge-based management, and 3) interdisciplinary cooperation.

Several presenters emphasized terrestrial-aquatic linkages, in particular, the ties between riparian and upland areas. Many stated that managing riparian areas to intercept overland transport of energy and material before they enter the waterway is more effective if upland conservation is being practiced. Furthermore, alteration of upstream processes (movement of sediment and water) can cause downstream changes in streamside vegetation.

The second theme, knowledge-based management, means that land management over large areas and indefinite periods requires a solid knowledge

base. All the presenters stated the need for continued observations, measurements, data analyses, and interpretation to improve our management capabilities. The ability to foresee the short- and long-term social, economic, and biologic realities of our actions is positively related to our knowledge base.

The third underlying theme was interdisciplinary management based on ecosystem concepts. In other words, watersheds should be the basic ecosystem units for planning and management. One presenter stated that the use of watersheds as management boundaries is not a new concept but one that must be revisited. Two others outlined steps and rationale for ecosystem and planning approaches to watershed management that were similar in that current and future conditions are defined and agreed upon, choices are made, actions are implemented, and results are monitored or evaluated. Adjustments are made as new information becomes available. In summary, the overview on watershed concepts conveyed the idea that managing and using the resources is a shared responsibility.

Everything is related to everything else in personal and functional ways and the land, if it were to remain fruitful, must support all forms of life.

Vine Deloria, 1990
Standing Rock Sioux
lawyer and educator

DESIGN, FUNCTION, AND MANAGEMENT OF MULTI-SPECIES RIPARIAN BUFFER STRIP SYSTEMS

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The highly productive agricultural landscape of the midwestern United States yields substantial quantities of non-point source (NPS) pollutants which find their way into surface and ground waters. While upland conservation practices can reduce NPS pollution, it is the riparian zone immediately along the stream edge which may contribute the most to NPS pollution. If this zone is exploited by row crop agriculture or overgrazing, NPS pollutants can be generated immediately adjacent to the stream. If riparian zone best management practices (BMP) are employed, this source of NPS pollution is eliminated and the riparian zone becomes a living filter of NPS pollutants generated in the upland. Increased use of such buffer zones has the potential to greatly improve the environmental performance of the agricultural landscape.

The Agroecology Issue Team of the Leopold Center for Sustainable Agriculture and the Iowa State Agroforestry Research Team (ISTART) are conducting research on the design and establishment of multi-species riparian buffer strip systems (MSRBS). The plan is that the buffers will intercept eroding soil and agricultural chemicals from adjacent crop fields, slow flood waters, stabilize streambanks and reduce channel movement, and improve in-stream environments, while also providing wildlife habitat and biomass for energy and high quality timber. The MSRBS system is an integrated management system which also includes willow-post soil bioengineering features to stabilize streambanks and constructed wetlands placed at the outlet of field drainage tiles to process agrichemicals contained in tile flow before they enter the stream.

The interdisciplinary teams began the research on a private farm located along Bear Creek in a highly

developed agricultural region of central Iowa in 1990. The restored MSRBS systems have reduced sediment and chemicals moving with surface runoff by trapping over 90% of the material in the buffer zone where the plants and soil microbes can immobilize and metabolize them. NPS pollutants moving through the soil solution of the rooting zone or in the shallow ground water also are reduced by over 90% to levels well below the maximum contaminant levels allowed by the U.S. Environmental Protection Agency. Similar improvements in water quality are seen in water passing through the tile wetland, and streambanks are stabilized by living willow stems and associated grasses and forbs.

Beginning at the streambank edge, the first zone of the MSRBS is 10 m wide and contains four or five rows of rapidly growing trees, the second zone is 4 m wide and contains one or two rows of shrubs, and the third zone is 7 m wide and contains native, warm-season grasses. This zonation is important because the trees and shrubs provide perennial root systems and long-term nutrient storage close to the stream, while the shrubs add more woody stems near the ground to slow flood flows and provide a more diversified wildlife habitat. The native grasses provide the high density of stems needed to dissipate the energy of surface runoff and the deep and dense annual root systems needed to increase soil infiltration capacities and provide organic matter for large microbial populations.

Fast-growing trees are needed to develop a functioning MSRBS in the shortest possible time. It is especially important that rows 1-3 (the first row is the closest to the streambank edge) in the tree zone (zone 1) include fast-growing, riparian species such as willows (*Salix* spp) and cottonwoods (*Populus* spp). If, through-

out the year, the rooting zone along the streambank is more than 1.2 m above normal stream flow and soils are well drained, then upland deciduous and coniferous trees and shrub species can be planted in rows 4 and 5. Although these slower growing species will not begin to function as nutrient sinks as quickly as faster growing species, they will provide a higher quality product to the landowner.

Shrubs are included in the design because their permanent roots help maintain soil stability, their multiple stems help slow flood flows, and their presence adds biodiversity and wildlife habitat.

Many native shrubs can be used and are often selected because of their desirable wildlife and aesthetic values.

The three-zone MSRBS model of trees, shrubs, and prairie grasses is well suited to agroecosystems of the Midwest and eastern Great Plains. Although these species combinations provide a very effective riparian buffer strip plant community, there are other combinations that can be effective. Site conditions, major buffer strip biological and physical functions, owner objectives, and cost-share program requirements should be considered in specifying species combinations.

It costs about \$875 per ha to install the three-zone MSRBS. This includes plant purchases, site preparation, planting, labor, and maintenance costs in the first year. About \$50 per ha should be figured for annual maintenance for the first 3 to 4 years.

Streambanks that have been heavily grazed or that have had row crops planted to the edge of the bank are often very unstable and need extra protection beyond that provided by the vegetated buffer strip. In these situations soil bioengineering techniques, such as the willow post method, can be employed. On vertical or actively cutting streambanks, combinations of dormant willow 'posts' are planted along with anchored dead tree revetments to protect streambanks. These plant materials provide a frictional surface for absorb-

ing stream energy and trapping sediment and also provide shade and organic matter for instream biota.

Where there is a concern for active undercutting of the bank, bundles of eastern red cedar or small hardwoods (3-4.5-m-long silver maples, willows, etc.) can be tied together into two- to four-tree bundles. A row of these bundles is laid along the bottom-most row of willow

posts with the lower trunks pointed upstream and the bundles anchored to the willow posts or streambank.

In areas of artificial drainage, small wetlands can be constructed at the end of

field tiles to interrupt and process NPS pollutants before they enter water bodies. A 0.5-1 m deep depression is constructed at the ratio of 1:100 (1 ha of wetland for 100 ha drainage). A berm should be built along the stream, stabilized on the stream side with willow cuttings, and seeded with a mixture of prairie grasses and forbs. If a coarse textured soil is encountered, the bottom of the wetland can be sealed with clay and topped with original soil. A gated control structure for controlling water level should be installed at the outflow into the stream.

In designing the wetland it is important to remember that most of the chemical transformation and retention occurs at or near substrates (sediments or plant litter). Wetlands containing large amounts of vegetation and decaying plant litter will thus have a much greater capacity for pollutant removal. Any management technique which accelerates vegetation establishment (active regeneration) or litter buildup (addition of organic substrate) will improve chemical retention.

The above recommendations will provide a MSRBS system that effectively intercepts and treats NPS pollution from the uplands. However, a MSRBS system cannot replace upland conservation practices. In a properly functioning agricultural landscape both upland conservation practices and a MSRBS system should be in place.

The restored [buffer strips] have reduced sediment and chemicals moving with surface runoff by trapping over 90% of the material ... where the plants and soil microbes can immobilize and metabolize them.

VEGETATION AND STREAM PROCESSES

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The subject of vegetation and stream dynamics is complex because the associated biological and physical processes are so strongly interactive. For example, the cross-sectional characteristics of rivers are partly determined by the type and extent of vegetation. Likewise, the characteristics of vegetation occupying the floodplain depend on hydrology, sedimentation patterns, and riverbed soils, among others.

The product of this intense interaction is strong vegetation zonation horizontally and vertically. This strong spatial patterning of vegetation is the result of the ability of some plant species to tolerate the hydrogeomorphically active portions of the floodplain near

the channel, while others can only tolerate less disturbed areas away from the channel.

Regulation of rivers usually changes the extent and location of riparian vegetation. Numerous studies have shown that altered flow and sediment transport caused by dams and water diversions have dramatically altered vegetation. In some cases, such as in the Platte River, riparian forest has expanded. In others, such as the Missouri River, it has disappeared or changed type. Rivers respond individually to regulation, but enough research has now been conducted to predict the general response of riparian vegetation to human impacts.

PREDICTING THE BEHAVIOR OF WATERSHEDS: THE JAMES RIVER AS AN EXAMPLE

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Hydrologists are in the business of predicting the response of watersheds to various meteorological conditions, land use changes, and water management factors. However, our ability to make predictions depends upon just what hydrologic process is under examination. The historical development of the science of hydrology largely determines what it is that hydrologists are good at, and the history of water development in the James River is fairly typical of the history of hydrology in general.

The development of the science of hydrology is relatively recent. It owes its primary roots to researchers in engineering, forestry, and the physical sciences, among others. Historically, hydrologic problems have been focused in engineering, and this has had an enormous effect on what types of problems hydrologists are currently able to deal with effectively. The quality of predictions depends upon how well the underlying physical processes are understood and also on how long hydrologists have been working on them.

The societal level of concern or interest usually determines which hydrologic problems have been dealt with first. In order of historical interest, the paramount hydrological problems have been navigation in rivers, flood control, water supply, pollution, and ecological problems. Thus, our abilities to make predictions roughly follow this hierarchy.

Early in the 19th century, opening territories for settlement and trade was a priority, and rivers were important for navigation. Congress gave the Corps of Engineers responsibility for navigation, and the Corps began a systematic measurement of flows and water

levels in major rivers. The Corps also began small-scale construction to make navigation easier.

The James River, although technically navigable, was rarely used for commerce. Flood control became an early concern, however. After the floods of the early 1920s, the state of South Dakota set up the James and Big Sioux Valleys Drainage District. Flood control activities in the James have been going on since. Currently, hydrologists and engineers are fairly well adept at predicting floods and calculating flood mitigation steps. Also, hydrologists have a good understanding of descriptive hydrology, statistical analysis of flood flows, and of rainfall/runoff processes.

With the "Dust Bowl" years of the 1930s, water supply and watershed conservation practices became important. "Water development" became synonymous with dam construction. The Missouri River dams are an example, with the Garrison Diversion Project being an example of a proposal to use the James River for water supply. These problems spurred understanding of watershed processes like evapotranspiration and groundwater flow, fluvial processes such as sediment transport and meandering, and engineering design and operation of systems.

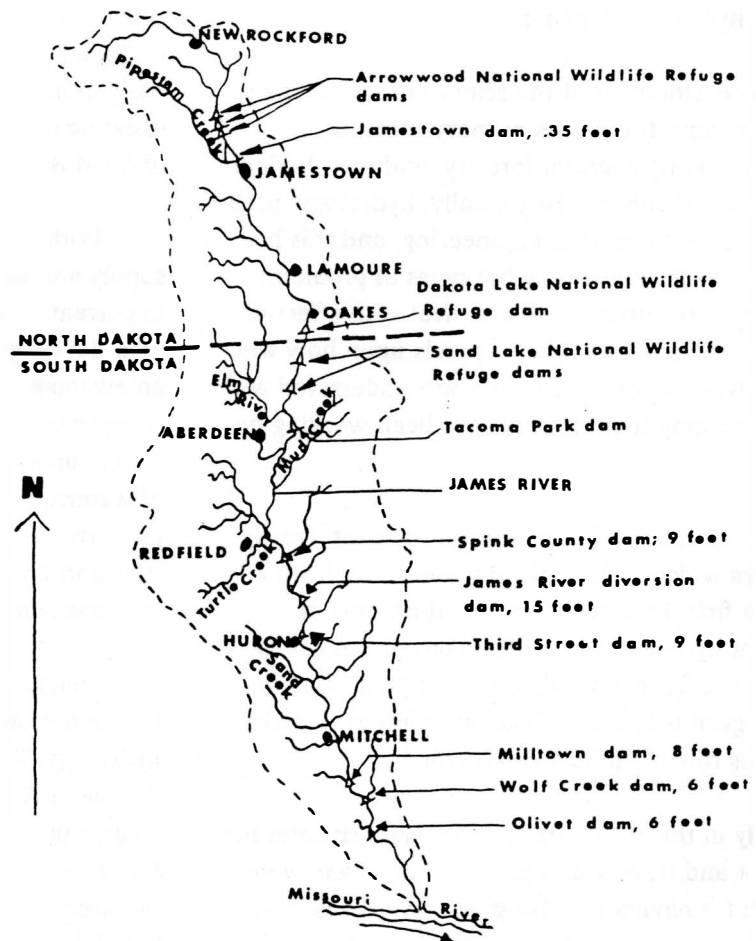
Heightened public concern over pollution of surface and ground water led to another frontier of hydrology. These problems were initially addressed by the Clean Water Act, where point sources of pollution (municipal sewage outfalls, e.g.) were treated. Along the James, cities from Aberdeen to Scotland were required to treat water before releasing it. Currently, U.S. EPA plans increased efforts against nonpoint source pollution, particularly agricultural pollution.

The study of the fate and transport of contaminants in watersheds led to a number of advances in hydrology. Today, hydrologists have a number of very sophisticated simulation models to describe watershed behavior and transport of pollutants. These efforts also led to better descriptions and to better accounting for the spatial variability found in any natural system.

Environmental problems are currently the focus of considerable public attention. This is also the topic of a great deal of hydrologic research. Past experiences have shown that small or piecemeal changes to watersheds can have profound impacts on habitats. They can also require unforeseen levels of investment in the long term. Predicting environmental consequences requires a very sophisticated hydrologic understanding, particularly in modeling how processes at difference scales interact.

This research is leading to advances in a number of other areas. Hydrologists are currently working on modeling processes with diverse scales of action. This includes research in geomorphology (predicting fluvial behaviors like meandering, etc.) and in linking hydrologic models with the biosphere to predict response of key trophic levels of an ecosystem.

In summary, the ability of watershed hydrology to make a prediction depends upon the question submitted. Hydrologists generally have great predictive capabilities in engineering for flood control and water supply, modeling watershed processes, and predicting the fate and transport of contaminants in surface and ground waters. Prediction of multiple-scale problems will require more development, as will the prediction of long-term consequences of a piecemeal approach to water resources development.



The James River Basin in North and South Dakota, with location and heights of larger dams.
(From U.S. Geological Survey)

GRAZING MANAGEMENT: A WATERSHED APPROACH

David W. Schmidt

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My task is to convince you that proper grazing by domestic livestock both on the uplands and within the riparian zones themselves should be considered as just one more management tool available for improving water quality and reducing flooding. Proper grazing by domestic livestock is not the environmental calamity that it is often portrayed. I use the term "proper grazing" to denote grazing management designed with the needs of the plant, animal, soil, and water resources in mind and not the animal-centered grazing which is very predominant throughout many of the watersheds that we are concerned about in this conference.

Grazing is a natural process. Before settlement, eastern South Dakota was home to hundreds of thousands of American bison, elk, antelope, and deer. All of these animals had to eat. Their grazing, along with the climate, developed the plant communities that the early settlers found. There can be no doubt that these sometimes large herds of herbivores did overutilize the native vegetation. Distance between reliable water sources would limit animal movement and, as with domestic livestock, areas within riparian zones often received the brunt of grazing pressure.

For the most part, early settlers in eastern South Dakota came to farm. They plowed the sod and planted wheat and corn. The land which was not plowed included the steep rocky uplands, flood plains, and wetlands. These grasslands were stocked with horses, dairy, and beef cattle, often with disregard to the environmental consequences to the grassland resource. In contrast to the western areas of the state where grass is often viewed as a crop which must be sustained for the continued success of the ranching operation, farmers in the east often view the remaining grasslands as wasteland or

a place to put livestock until crop residues are ready to graze. I call this either the presence or absence of a grassland ethic. Since the physical location of many of the remaining grasslands in eastern South Dakota is adjacent to ephemeral and perennial streams and rivers, the impacts on water quality are obvious.

Grazing patterns of the free ranging large herds of wild ungulates of eastern South Dakota prior to settlement were quite different from the confined herds of domestic livestock of today. Today the lack of use management on many grazing lands has led to continued overgrazing of forage or the continued heavy utilization of forage on a yearly basis. Wild herds more than likely overutilized forage for short periods of time, but their free ranging nature probably prevented overgrazing. The difference between overgrazing and overuse, although apparently subtle, has often drastically changing species composition, soil health, and hydrologic functions.

Research and technical assistance on grazing land management has often taken a back seat to the more visible erosion seen on croplands. However, grazing lands make up close to 60% of the lands in the state and thus are perhaps more important in terms of watershed values than any other lands. In addition, the largest sector of this state's economy comes from the sale of livestock, many of which depend on the forage from grazing lands for a large portion of their feed supply.

I applaud the organizers of this conference for dealing with a watershed approach to land management issues. Today we are bombarded with buzz words such as ecosystem based assistance, riparian area management, and managing for maximum natural genetic variation (biodiversity). All of these programs and causes are

fine and good in their own right, but most fail to address the root of the problem which is the generally poor management of much of the agricultural land in the United States. We need to view environmental concerns such as degraded riparian areas not as a problem but as a symptom of a degraded watershed or poor land management. Riparian areas are just one small part (albeit an important part) of a dynamic ecosystem. They are not a separate ecosystem but are inextricably tied to the surrounding uplands. If we think we can improve our river systems solely by treating the riparian areas while ignoring the surrounding uplands we are doomed to failure.

If you look at the best examples of riparian area management in South Dakota, you will also see good upland management or what I call "riparian management by default." In other words, through proper management of all lands including range, pasture, crop, forest, and haylands, we have managed to produce healthy riparian areas by default. Practices such as various stream and headcut engineering practices, corridor fencing of streams, or planting trees and shrubs along stream banks have no effect on the uplands of the watershed where the stream problems originate. These techniques often show rapid stream channel improvement, but they are also not self sustaining. The only long-term solution to watershed problems on grazing lands is to attempt to mimic natural systems through the development of grazing management systems.

These grazing management systems must include rotational grazing strategies if we expect to maintain our current high levels of production. These systems must be designed with all resource concerns in mind. Grazing levels must be such as to insure adequate plant litter and ample residue to build plant carbohydrate reserves and thus improve plant vigor. Season of use should be controlled to alleviate overgrazing of critically important species such as woody vegetation along stream channels, insure adequate rest periods between grazing as well, and avoid soil compaction. As much as possible, livestock must be kept from urinating and defecating directly into

streams. Providing alternative water sources and developing hardened watering points will go a long way toward reducing these direct deposits by livestock. The trick to grazing management is to accomplish the above items while maintaining livestock production.

The benefits from grazing management can have major positive impacts on hydrologic functions within a watershed. Rainfall simulations conducted on three soils with differing levels of grazing management within the

Bad River watershed in central South Dakota have shown that infiltration rate can increase from 63 to 94%. The

Proper grazing by domestic livestock is not the environmental calamity that it is often portrayed.

same studies showed a 62 to 95% reduction in soil erosion and a 40 to 68% increase in grass production. Grazing level, amount of litter, or mulch and height of vegetation had the greatest effect on the above variables. This study has demonstrated the often enormous impacts that grazing management can have on hydrologic functions. On a watershed scale, poor grazing management can mean tens of thousands of acre feet of additional runoff and thousands of tons of increased sediment production, while good grazing management provides hundreds of more pounds of grass production for livestock forage. The effects that grazing management has on flood control, stream function, water quality, and the economy are tremendous.

Great strides have been made at improving producer attitudes toward voluntary grazing management programs in eastern South Dakota. Workshops on grazing management often attract 50 to 100 producers. Many innovative management ideas have surfaced from various government-sponsored programs and numerous producers. Many complex problems with no easy answers exist. Continued education on methods of improving grazing lands which are economically justifiable as well as manageable will be the key to improving producer awareness in the future. We must also continually make the public aware of the great strides that are being made in improving management of these grazing lands, as public perception will undoubtedly dictate future policy decisions.

AGRONOMIC MANAGEMENT IN WATERSHEDS

Keith L. Harner

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My interest in the James, Vermillion, and Big Sioux rivers is tied directly to the fact that conservation districts cover the entire area. The State Conservation Commission and the Division of Conservation were responsible for the process of forming those districts upon local action. We continue to have certain oversight of these districts, and provide some technical and financial assistance as well.

Conservation districts were organized under state law primarily to provide a delivery system for resource programs provided by other units of government and private organizations. The main users of this delivery system have been agencies of the U.S. Department of Agriculture on the federal level (primarily the Natural Resources Conservation Service, NRCS) and the departments of Game, Fish and Parks and Environment and Natural Resources on the state level.

In recent years, the horizons of conservation districts have broadened considerably. Cooperation with entities such as the U.S. Fish and Wildlife Service, Environmental Protection Agency, Corps of Engineers, S.D. Department of Environment and Natural Resources, and many others at federal, state, and local levels has grown considerably.

When conservation districts were first authorized in the late 30s, it was thought they would be organized along natural boundaries, essentially on watersheds. It was politically and administratively more convenient to organize them along county boundaries, which is essentially the pattern we have today. The new emphasis on holistic, or ecosystem, management encourages us to revisit the original idea of watershed management.

I can envision that we will in the future determine watershed "size," or boundaries, on the basis of common problems. We will have conservation districts, counties, and other governmental units and non-governmental entities joining forces to work on the problems. This may be by cooperative agreements or, in some cases, might actually involve legal combination of smaller into larger units.

Conservation districts were organized to address soil erosion and its attendant causes and effects. Sediment caused by erosion is still, by volume, the largest pollutant of water bodies and streams, and it carries other pollutants with it.

A review of the 1992 National Resource Inventory (NRI) shows that about 69% of the land in the area we are discussing is used for cropland. The NRI shows part of this land with a high "erodibility index" at 8 to 15, as determined by the NRCS. It is important to keep in mind that, even where soil erosion is adequately controlled to protect soil productivity, there may still be serious problems for water quality, at least in some localities.

There are a number of conservation practices which can be used in agronomic management. These include (1) structural practices, such as terraces, sod waterways, strip cropping, shelterbelts, etc., and (2) management practices, such as crop rotations and conservation tillage, including no-till. Crop rotations can be used to support reduced tillage and attendant pest control with smaller amounts of chemical pesticides. Conservation districts are uniquely adapted to working with land operators on these management approaches.

We have been working on these practices for more than 50 years, with mixed success. We have made better progress with conservation tillage in the last few years, partly because of economics and partly because of farm program requirements.

There is one agronomic management element which, in my opinion, has received only a small amount of the attention it deserves. It is main-

tenance of soil organic matter content. This concern was expressed in the USDA's 1957 Yearbook of Agriculture, *Soil*. It was also discussed in the "Soils of South Dakota," Bulletin 656, SDSU and SCS (1978).

The "Soils of South Dakota" stated that with 70 to 90 years of cropping, South Dakota had lost from 25% to 35% of the organic matter and nitrogen that was originally present in the soils. We need to know how far the deterioration has continued in the 17 years since publication of the bulletin. Two quotes from the "Soils of South Dakota" are: "... the losses are great enough to

affect the tilth and fertility of the soil and hence crop yields," and, "Although nitrogen losses can be made up by commercial products, the effect of lower organic matter levels will further aggravate an already serious moisture conservation problem."

I have been told by some farmers that they are seeing increases in organic matter under no-till cropping systems. Long-term research is

needed to verify the conditions under which this can be true and to determine how organic matter can be increased all across the state.

Soil scientists have designated "T" for each soil. This tolerable level of erosion is calculated to protect the basic productivity of the soil, while recognizing that it is impossible to eliminate all soil erosion. The protection of water quality may necessitate goals of less than "T" erosion in some circumstances. Agronomic management will probably be a major part of reaching any goals for reducing soil erosion.

The new emphasis on holistic, or ecosystem, management encourages us to revisit the original idea of watershed management.

Riparian areas a valuable asset

Riparian areas occur along watercourses or water bodies.

They are distinctly different from the surrounding lands because of unique soil and vegetation characteristics that are strongly influenced by free or unbound water in the soil.

Riparian areas are the transition zones between stream, lake or wetland and the upland areas.

Riparian areas constitute only a fraction of the total land area but are more productive in both plant and animal species diversity and biomass per unit area.

A healthy and well managed riparian area will maintain and stabilize streambanks. It will reduce sediment load from degrading banks, grazing land and adjacent cropland into streams, lakes and wetlands.

Riparian areas act as a sponge to store and hold water along streams, lakes and wetlands which is an extremely important function in flood control.

The East River Riparian Area Improvement Demonstration Project (ERRAIDP) in eastern South Dakota will assist participating land owners in developing resource plans.

Riparian improvement practices will be developed on grazing land and cropland and act as demonstration sites for the surrounding public.

Plans will be developed with participating land owners to install riparian improvement practices on grazing land and cropland.

Grazing land practices include implementing planned grazing systems to allow grazed area

rest periods, proper stocking rates, alternative water sources away from the riparian area, and managing the riparian area as a separate unit.

Cropland practices include conservation tillage, crop rotation and installing filter/buffer strips along cropland adjacent to riparian areas to improve streambank stability and filter out sediment, fertilizers, and chemicals.

The two year project will develop demonstration sites throughout eleven conservation districts in eastern South Dakota.

Moody County Conservation District is the lead sponsoring district.

Funding is being provided by the Environmental Protection Agency through the South Dakota Department of Environment and Natural Resources (DENR); the South Dakota Department of Agriculture; the Soil Conservation Service; local in-kind matching funds as well as other interested agencies and groups.

Sandy Wyman, located at the Brookings Soil Conservation Service Area office, has been appointed the East River Riparian Area Coordinator.

If you are interested in developing your riparian areas contact Karen Cameron-Howell, District Conservationist at the Soil Conservation Service or Brookings Conservation District.

District Diggings is written by Karen Cameron-Howell of the Brookings Conservation District.

District Diggings

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ECOSYSTEM MANAGEMENT

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For people living in rural landscapes, the economic well-being and quality of life could be serviced by healthy, functioning watersheds. The potential benefits of healthy watersheds to individuals and communities include sustained or increased agricultural productivity, improved water quality, reduced runoff and erosion, lessening of downstream flood peaks, improved fish and wildlife habitat, and a more aesthetically attractive landscape.

Impediments to realizing the social and economic benefits of healthy watershed function include a lack of coalescence of currently available knowledge, expertise, and experience among resource managers and users. However, watershed-related problems such as non-point source pollution, soil runoff and erosion, and flooding have caused some resource agencies to move toward whole-systems management, rather than management of a single component.

Collectively, these components are part of an ecosystem, which can be defined as a system formed by the interaction of a community of organisms (including humans) with their environments. Inherently, then, ecosystem management must use knowledge from many disciplines and background experiences to form a basis for identifying problems and managing defined landscape areas.

But what is ecosystem management? Ecosystem management can be defined as the careful and skilled use of ecological, social, and managerial principles in managing ecosystems to produce, restore, or sustain ecosystem integrity and desired conditions over the long term. Ecosystem management considers the relations of structural and functional attributes to the

geology and climate of a defined landscape area. Structural attributes are the physical features, biological communities, and energy and material resources. Functional attributes are the physical, chemical, and biological processes that govern the flow of energy and material resources through a landscape area. Ecosystem management is long-term because structural and functional attributes are naturally organized within several scales of time and space. This natural organization is coupled with an understanding of the social, economic, cultural, and political infrastructures to identify barriers, and desired future conditions. Four ecosystem management principles (GAO/RCED-94111, August 1994) that provide practical steps and actions for implementing ecosystem management are outlined in Table 1.

In an ecosystem, the many origins and fates of energy and material resources over time form the basis for structural and functional complexities that link the terrestrial with the aquatic. Perhaps concepts related to river structure and function can guide the use of watersheds as the basic ecosystem unit.

For example, rivers move sediment and water from a collection of small areas in the upper part of the watershed to a large area lower in the watershed. Accordingly, systemic controls (e.g., the self-adjusting, self-regulating mechanisms of the river) change as the amount of water and sediment increase. These systemic controls may affect the ability of local controls (e.g., bank vegetation) to moderate the flow of sediment and water.

An ecosystem approach would integrate this concept into watershed or landscape analyses and place

Table 1. Steps for implementing ecosystem management (adapted from GAO/RCED-94-111, August 1994).

-
1. Delineate Ecosystems
 - Establish consistent boundaries for management.
 - Establish boundaries at several geographic scales.
 2. Understand Ecosystem Ecology
 - Identify structures components, processes, and linkages among ecosystems.
 - Identify current ecological conditions and trends.
 - Identify minimum ecological conditions necessary to maintain/restore ecosystems.
 - Identify effects of human activities on ecological conditions.
 3. Make Management Choices
 - Identify desired future ecological conditions.
 - Identify activities to meet these conditions.
 - Identify distribution of activities among land units over time.
 4. Adapt Management to New Information
 - Continue research, monitoring, and assessing ecological conditions.
 - Modify management choices (step 3) on the basis of new information (step 2).
 - Revise ecosystems' boundaries as warranted (step 1).
-

site-specific conditions and land use options within this larger context. Because the ability to assess and relate site-specific conditions to systemic and local controls would improve, the source of problems could be separated from the symptoms, management activities could become more cost-effective and less counterproductive, and long-term benefits in human services could be realized by way of healthy ecosystem function.

Selected References

- Brinson, M.M. 1993. Changes in the functioning of wetlands along environmental gradients. *Wetlands* 13:65-74.
- LeMaster, D.C., and G.R. Parker, editors. 1991. *Ecosystem Management in a Dynamic Society*, proceedings of a conference in West Lafayette, Ind. Department of Forestry and Natural Resources, Purdue University.
- Ryan, M.R. 1990. A dynamic approach to the conservation of the prairie ecosystem in the midwest. Pp 93-106 in (J.M. Sweeney, ed) *Management of Dynamic Ecosystems*, proceedings of a symposium at 51st Midwest Fish and Wildlife Conference, Springfield, Ill.
- United States General Accounting Office. 1994. *Ecosystem management: additional actions needed to adequately test a promising approach*. GAO/RCED-94-111.

U.S. Fish and Wildlife
Service definition of
ecosystem approach

"An ecosystem approach to fish and wildlife conservation means protecting or restoring the function, structure, and species composition of an ecosystem while providing for its sustainable socioeconomic use."

LONG-TERM COMPREHENSIVE PLANNING FOR THE WHITEWATER WATERSHED, MINNESOTA: A PARTNERSHIP APPROACH

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There is widespread and increasing recognition that in order to manage for the integrity of our land and water resources, long-term comprehensive approaches to planning and management are needed (systems approaches).

Testimony and documentation supporting reauthorization of the Clean Water Act endorse a watershed (basin) approach to planning, research, and management. The U.S. Forest Service, U.S. Fish and Wildlife Service (USFWS), and National Park Service are adopting watershed management approaches to organize research needs; meet biodiversity goals; and address endangered, threatened, and special concern species, etc. The Natural Resources Conservation Service (NRCS) has recognized the need to broaden its perspective and to recognize other resource values in its programs and planning processes.

In Minnesota, two recent exercises (EQB Lakes Task Force and Freshwater Foundation Lakes Management Forum) set out to look at lake management. State and federal agencies, local units of government, representatives of groups, and special interests participated. They concluded that efforts were fragmented with little coordination and that a long-term, comprehensive approach to planning and management was needed. The Governor's Commission on Reform and Efficiency findings and recommendations were similar.

The Minnesota Department of Natural Resources (MNDNR) Comprehensive Watershed Management Initiative (CWMI) evolved from an examination of the Department's river and stream management programs beginning in spring 1990.

Fifty personnel representing all disciplines and all levels from field staff to program managers to division directors were selected to be interviewed.

The results from those interviews were only surprising in their unanimity. In brief they were: 1) our approach to management is fragmented within and outside of the agency; 2) we treat symptoms, not sources; and 3) there is no comprehensive long-term approach to land and water resource management currently being employed in Minnesota.

From this, we developed the following goal and objectives and presented them to senior managers on April 1, 1991.

Goal: Improve management of Minnesota's land and water resources on a watershed basis.

Objectives: Long term - Improve land and water resource management on a watershed basis over the next decade.

Short term - Implement 3-7 prototype comprehensive watershed projects over the next 2-4 years.

The goal and objectives were endorsed by senior managers.

Criteria for project solicitation were developed and distributed to the regions. Twenty projects were received, and in September 1991, eight projects (this exceeded the 3-7 asked for) were selected to represent the prototypes.

The planning approach to comprehensive watershed management is simple and straightforward:

- Define existing conditions
- Describe where we want to go
- Investigate how to get there
- Implement the plan
- Monitor/Evaluate
- Review plan goals and objectives periodically

This process is undertaken with a steering committee that is representative of the watershed community. It typically consists of citizens, organizations, local units of government, and state and federal agencies. This process works to get groups representing diverse views and interests to share values and experiences, discover how much they have in common, and therefore, agree to strive for common goals and objectives (desired future).

What distinguishes this from other planning approaches is the time spent on the first two stages. Presentations on geology; pre-European settlement cultures; land use changes; and changes in key physical, chemical, and biotic metrics precede any discussion about issues. Following this description of past and existing conditions, we have a discussion about what the future of this area might be if we continue to manage as we have been. It is only after these presentations that we begin the discussion about where we want to go. We ask the audience to contribute to descriptions of desired future conditions for their watershed 50 to 100 years into the future. The audience is informed and thinking long-term and comprehensively (ecologically). It works and it sets up the next step. If we can agree where we want to go, we have to investigate how to get there.

The principal components of comprehensive watershed management are:

- it is Comprehensive
- it requires Citizen Participation
- and Effective Partnerships
- and it is Long Term.

The product of this planning approach is a comprehensive watershed management plan developed against an understanding of the capabilities and limi-

tations of the ecosystem (sustainable) in which we are working. Most importantly, this product has strong local ownership, the approach to planning is adaptive and flexible, and there is commitment by participating agencies to agree to its long-term implementation.

The plan is dynamic, allowing for changes to accommodate evolving socioeconomic conditions and the introduction of management (implementation) brought about by a better understanding of the systems in which we are working (research, monitoring, and evaluation).

An area and watershed where this approach to planning is being conducted is the 205,000-acre Whitewater Watershed in southeastern Minnesota. The Whitewater Watershed Project got its start in 1987. In that year, the USFWS, in cooperation with the Winona and Olmsted Soil and Water Conservation Districts, launched a pilot project in the Middle Branch of the Whitewater River watershed. The intent of this project was to determine if there was interest and a willingness by property owners (mostly farm operators) to implement land treatment practices to reduce runoff and erosion. The USFWS' primary interest and reasons for undertaking this initiative were sedimentation, habitat loss, and degradation of Weaver Bottoms, Pool 5, Mississippi River, to which the Whitewater River is a tributary.

The reception by property owners in the Middle Branch watershed was very supportive. This led to the establishment of a three-county Whitewater Watershed Joint Powers Board in 1989 for the beginning of a watershedwide assessment.

This effort has largely been assisted by a Clean Water Partnership grant from the Minnesota Pollution Control Agency, a NRCS PL-556 small watershed planning process, and participation from numerous agency partners.

The organizational structure of the project consists of the Joint Powers Board, Executive Director, Citizens Committee, Conservation Coalition, and Technical Committee. The project is currently going through the pains of examining how decisions are

made, what the project goals and objectives are, and how to better involve citizens.

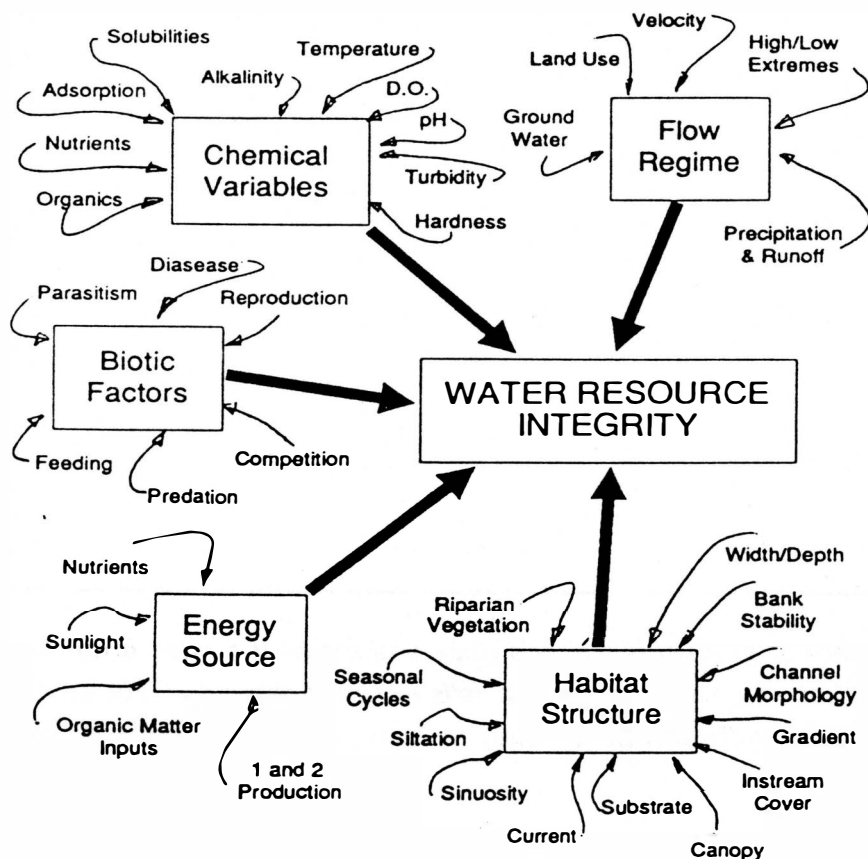
A lot of information has been collected for the project watershed. This constitutes the basis from which to understand the system, quantify objectives, design implementation, and develop monitoring and evaluation to determine if objectives are being met. Information is available upon request.

What have we learned? Representation of all views and interests in the watershed is imperative. It takes time to build relationships, develop your needs, and build the process, committee, and funding sources, etc. to satisfy the needs as you go. Do not try to force a cumbersome planning process down people's throats. Be adaptive and flexible to accommodate different levels of understanding, embrace opportunities, and demonstrate a willingness to work with others. Management by goals and objectives is imperative. Technical advice and assistance is essential and, in our case, has been forthcoming from agency partici-

pants. Do not get stuck in data gathering and analysis. Project coordination is fundamental to the success of the project.

Project coordinators (managers) set up meetings; distribute information and schedules; hold peoples' feet to the fire to meet timelines; do project administration; recognize opportunities and constraints; nurture groups and individuals; identify resources (financial, technical, and personal); communicate; and coordinate. They are the "go to" people at the beginning and growing stages of the project and they manage the process to adhere to the planning approach with the emphasis on its critical components. They help maintain a long-term planning perspective and continue to cultivate the understanding that this is not a static exercise, but one which results in a new approach to business.

Finally, remember that this takes time. The dividends come from getting everyone working together toward common goals and objectives.



The five principal factors, with some of their important chemical, physical, and biological components, that influence and determine the integrity of surface water resources. (From Ohio Environmental Protection Agency)

In the 43 years or so of this writer's observations of the river, it has become an expected occurrence that when the heavy rain falls in Champaign or Douglas County, the rich black soil from those areas will soon be passing by Coles County in the dark, muddy appearing water.

Leonard Durham, 1993,
about the Embarrass River, Illinois

PROJECTS & PROGRAMS

In the second part of the workshop, personnel from local, state, and federal levels of government shared information about available data, ongoing studies, existing river resources and values, and current projects and programs. Presenters showed that data were available and studies were underway on flood control, streamflow, groundwater, aquifers, irrigation, water quality, riparian zones, and fish and wildlife. Presenters described a host of technical and financial assistance available to landowners and managers.

Assistance was generally related to conservation programs, farm management systems, flood and disaster programs, and wetland management. Regulatory processes or permit and project reviews were discussed for wetland alterations, water allocations, and water quality standards. This segment of the workshop showed the array of knowledge from many disciplines, the diversity of programs and projects available to both resource managers and landowners, and the potential issues related to watershed management.

Eight hundred fifty-three new jobs with \$12.8 million in additional wages if rangeland/pastureland is improved ... with secondary benefits to wildlife and water quality.

Marty Beutler, 1991,
South Dakota State University
economics professor

NATURAL RESOURCES CONSERVATION SERVICE PROGRAMS AND INTEREST IN WATERSHED MANAGEMENT

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Conservation Technical Assistance

The Natural Resources Conservation Service (NRCS) is the new federal agency in the U.S. Department of Agriculture that works hand-in-hand with American people to conserve natural resources on private lands. Our name change from the Soil Conservation Service to the Natural Resources Conservation Service more accurately reflects what we do, helping people conserve all natural resources on private lands. It reflects a streamlined agency that provides quality service more efficiently. Our name has changed, but some things will not change. NRCS will build on 60 years of experience, our scientific and technical expertise, and our partnerships with conservation districts and others. NRCS will build a unique relationship between federal, state, and local government and farmers and other private land users.

NRCS will emphasize strengths in natural resource conservation: voluntary programs, technical assistance, and conservation cost sharing. Technical assistance will continue to be delivered through conservation districts, managed by locally elected officials charged by state law to develop local programs to meet local natural resource and conservation needs and priorities.

NRCS will provide Technical Assistance and services to land users and units of government through the 69 conservation districts in South Dakota.

Great Plains Conservation Program (GPCP)

Under provisions of GPCP, landowners may enter into long-term contracts with USDA whereby,

in cooperation with a local conservation district, they adopt a conservation plan for their entire unit and agree to make land use adjustments, apply conservation practices, and establish a desirable cropping and use system, all according to an agreed-upon schedule. The USDA, for its part, agrees to provide technical assistance and cost-sharing to further the adoption of these conservation plans for the whole farm or ranch.

There are 47 South Dakota counties currently designated for participation in GPCP. A \$35,000 ceiling on costshare payments per contract is in effect. The 15 counties along South Dakota's eastern border are not eligible for the program.

Watershed Protection and Flood Prevention Act (PL-566)

Applications for assistance may be submitted by conservation districts or any local organization with the authority under state law to carry out Public Law 566 projects. For approved projects, public meetings are held throughout the planning period to solicit inputs from concerned federal and state agencies and the public.

The program has had a significant reduction in funding. A redirection toward a more holistic total resource management approach is continuing with emphasis on nonstructural land treatment measures because they are generally less expensive than structural measures and for their multipurpose effects in conservation practices. Strict economic feasibility studies limit projects that are approved for planning.

River Basin Surveys and Investigations Program

This is composed of Cooperative River Basin Studies and Flood Plain Management Studies. The objectives are to work cooperatively with state and local governments to identify water and related land resource problems, evaluate alternative solutions, and assist local governments to develop implementation programs. Currently the only study in South Dakota is in the Upper Bad River drainage area.

Priority is given to identifying cost-effective solutions to agriculture and rural community flooding, agricultural pollutants contributing to water quality problems, wetland restoration, and agricultural water management in areas where sponsors are highly committed through their participation and implementation using other than federal program funds.

Resource Conservation and Development Program (RC&D)

The objectives of the RC&D program are to improve the capability of state and local units of government and other local citizens to plan, develop, and carry out programs for resource conservation and development.

RC&D area councils are made up of citizens from the local area who serve on a voluntary basis, identify area problems, set priorities, and develop and seek technical and financial assistance to implement plans. The councils coordinate their activities with state, area-wide, and local agencies.

Wetland Reserve Program (WRP)

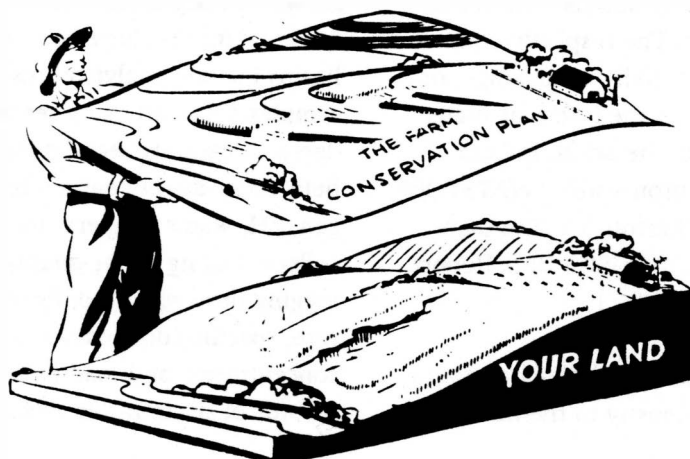
Wetlands Reserve Program is authorized by the 1990 Farm Bill. It allows individuals to enroll eligible acreages into permanent easements. Eligible areas include wetlands farmed under natural conditions, farmed wetlands that are restorable, and wetlands converted to cropland prior to December 23, 1985. Eligible land also includes: 1) a riparian area along a stream or other waterway that links or, after restoring the riparian area, will link wetlands which are protected by an easement or other agreement that achieves the same objectives as an easement; 2) land adjacent to the restored wetland, which would contribute significantly to functions and values of the restored wetlands, but not more than that which is necessary to protect these functions and values of wetlands restored. These areas are limited to buffer areas, inclusions, and noncropped natural wetlands.

Water Bank Program (WBP)

In the 40 South Dakota designated counties, agreements are for 10 years with eligible landowners to help preserve important nesting, breeding, and feeding areas of migratory waterfowl. The participants agree, in return for annual payments, not to drain, burn, fill, or otherwise destroy the wetland character of such areas and not use them for agricultural purposes.

The NRCS provides technical assistance to protect, improve, or restore eligible wetlands, identifying eligible wetlands, helping wetland owners develop the conservation plan required for participation, and helping participants apply contracted conservation treatment.

The name has changed but the message hasn't. Old clip art from the former SCS shows the holistic approach the NRCS continues to advocate.



U.S. GEOLOGICAL SURVEY DATA COLLECTION AND INTERPRETIVE STUDIES IN THE JAMES, VERMILLION, AND BIG SIOUX RIVER BASINS IN SOUTH DAKOTA

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The USGS provides the hydrologic information that is needed to manage the nation's water resources. The 1994 district program in South Dakota was almost \$4 million; 51% was from the USGS federal and federal-state cooperative programs, 17% was from other federal agencies, and 32% was from state and local agencies. In 1994, the South Dakota District cooperated with 5 federal, 6 state, and 19 local agencies. The District program generally can be divided into two parts—data collection and interpretive studies.

Systematic collection of surface-water data in the James, Vermillion, and Big Sioux basins (the 3 Basins) dates back to the 1920s, when the gages at Huron and near Scotland on the James River and at Akron on the Big Sioux River were established. Discharge, stage, or flood-crest information either has been or currently is being collected at 12 mainstem sites in the James Basin, at 7 mainstem sites (including the East Fork, West Fork, and the Little Vermillion River) in the Vermillion Basin, and at 12 mainstem sites in the Big Sioux Basin. On tributaries or lakes within the 3 Basins, discharge or stage or flood-crest information has been or currently is being collected at 47 sites in the James Basin, 7 sites in the Vermillion Basin, and 29 sites in the Big Sioux Basin. The respective data are stored as daily mean discharge, daily mean stage, or instantaneous peak discharge on the National Water Information System (NWIS) on the South Dakota District PRIME computer in Huron and/or WATSTORE on the AMDAHL computer in Reston, Va. The data also are published annually in the USGS Data Report for South Dakota.

The systematic collection of groundwater data in the 3 Basins has been limited mostly to the SD-5 pro-

gram, which was a program to collect water-level data from bedrock aquifers throughout the state during 1959-89. A total 62 wells were monitored in the 3 Basins—43 in the James, 8 in the Vermillion, and 11 in the Big Sioux. Water levels for four additional wells in the 3 Basins are being collected and published annually in the USGS Data Report for South Dakota. In addition, South Dakota Department of Environment and Natural Resources (DENR) water-level data are archived on NWIS: Data for 832 DENR wells within the 3 Basins are stored on NWIS.

The collection of water-quality data by USGS in the 3-Basin area began in the early 1950s, when the U.S. Bureau of Reclamation provided funding to collect baseline water-quality data in the James Basin to assess potential impacts of the proposed Garrison Diversion Unit (GDU). Due to GDU-related monitoring activities, more water-quality data generally are available for the James Basin than for the Vermillion or Big Sioux Basins (Table 1).

The USGS NASQAN program also has resulted in a substantial amount of water-quality data in the James and Big Sioux basins. General types of water-quality data that have been collected by USGS in the 3 Basins include analytical results for discrete water samples collected using representative width- and depth-integrating techniques; continuous records of field water-quality parameters such as dissolved oxygen, pH, water temperature, and specific conductance collected using water-quality monitors and electronic logging devices; and daily records of water temperature, specific conductance, and/or suspended-sediment concentration and load determined from observer records or using rating techniques. Water-quality data

collected by USGS are stored in NWIS and published annually in the Data Report for South Dakota.

County studies, completed in cooperation with the South Dakota Geological Survey (SDGS), represent the most comprehensive areal water-resource studies that USGS has accomplished within the 3 Basins. The multiyear studies involved an extensive test drilling program by SDGS to determine the thickness and areal extent of aquifers. Surface-water resources and water quality of both groundwater and surface water also were evaluated. The studies usually resulted in four reports—a Water-Resources Report written and published by USGS, a Lay-Reader Report written by USGS and published by SDGS, and Geology and Sand & Gravel Reports written and published by SDGS. Studies are essentially complete for all counties within the 3 Basins, except for McCook County which is not scheduled.

The USGS has completed drainage-area studies in all 3 Basins. Drainage areas for all named tributaries and for all unnamed tributaries with drainage areas exceeding 5 square miles were delineated on 7.5-minute quadrangle maps and digitized to determine drainage area. The studies were published as map reports.

Other significant studies that have been completed by USGS include seven groundwater models in the Big Sioux Basin that were accomplished as a part of the Big Sioux Hydrology Study or at the request of the City of Sioux Falls and four groundwater models in the James Basin, three of which were done in cooperation with DENR to evaluate the effects of increased irrigation demand on groundwater resources. Four general hydrology studies have been completed, two in the James Basin and two in the Big Sioux Basin. Two studies have been completed in the James Basin to develop naturalized (unregulated) streamflow data for the Bureau of Reclamation. Three water-quality reports, three groundwater-level reports, and three sediment reports also have been completed in the James and Big Sioux basins.

Several studies currently are ongoing in the 3 Basins. In the James Basin, USGS is assisting South

Table 1. Number of sites and samples, by category, for USGS surface-water-quality data-collection activities in the James, Vermillion, and Big Sioux river basins.

| | <i>James</i> | <i>Vermillion</i> | <i>Big Sioux</i> |
|--|--------------|-------------------|----------------------|
| Total sampling sites | 36 | 12 | 73 |
| Active sampling sites (1995) | 1 | 0 | 1 |
| Inactive sites with continuous or daily water-quality data | 8 | 0 | 2 |
| Inactive sites with daily suspended-sediment data | 6 | 0 | 2 |
| Major ion analyses stored in USGS NWIS | 1536 | 187 | 770 |
| Nutrient analyses stored in USGS NWIS | 954 | 141 | 834 |
| Trace-element analyses stored in USGS NWIS | 758 | 58 | 432 |
| Suspended-sediment analyses stored in USGS NWIS | 758 | 58 | 432 |
| Pesticide analyses stored in USGS NWIS | 170 | 4 | 60 |

Dakota State University with the Huron Project of the High Plains Demonstration Program, where treated James River water is being injected into the Warren Aquifer to study the potential for artificial recharge of glacial aquifers. Precipitation (acid rain) data are being collected at a site near Huron as part of the National Atmospheric Deposition Program. In the Big Sioux Basin, two lake sediment studies (Lake Pelican and Lake Kampeska) are being done using continuous seismic reflection to determine sediment thickness and using global positioning to determine horizontal position. Two groundwater model studies and an urban runoff study (for NPDES permitting) are being accomplished in cooperation with the City of Sioux Falls.

Groundwater model studies in Codington and Grant counties and in Lincoln and Union counties are nearing completion.

Currently, USGS is working on three statewide and one multi-state activity that encompass the 3 Basins. Data for as many as 13 categories of water use are compiled by county and by basin; every 5 years, USGS places special emphasis on the program to collect and compile data nationwide. A statewide bridge-scour study is being accomplished in cooperation with the South Dakota Department of Transportation (DOT) to evaluate scour potential at 31 sites—12 of the sites are in the 3 Basins. Also in cooperation with DOT, two flood-flow frequency studies are being done. A study to update flood-flow frequency estimates through 1993 for all

sites on gaged streams in the state is nearing completion. Another study to update equations used to estimate flood-flow frequencies at ungaged sites in the

state is in progress. Thirteen sites in the 3 Basins have been sampled as part of the USGS Mid-Continent Pesticide Reconnaissance Study that is nearing completion.

Systematic collection of surface-water data in the James, Vermillion, and Big Sioux basins ... dates back to the 1920s, when the gages at Huron and near Scotland on the James River and at Akron on the Big Sioux River were established.

The Water Resources Division of the USGS has collected and continues to collect a vast amount of surface-water, groundwater, and water-quality data in the 3 Basins. Numerous interpretive studies also have been completed, and several are ongoing. Inquiries concerning the availability of information in the 3 Basins, as well as anywhere in South Dakota, can be directed to the Subdistrict Office in Huron (353-7176) or the District Office in Rapid City (394-1780).

WATER DISTRICTS: PROJECTS, PROBLEMS, AND POLITICS

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I have lived along the Vermillion River all of my life. I have watched the flooding for most of my 62 years. The floods in the 1940s were nothing compared to current flood events.

Since 1940 an enormous change has taken place mostly because of man-made drainage. This drainage continues despite our efforts to stop it. If you have a prairie pothole that is a liability and you drain it, you then pass that liability on to someone else. Currently, much of this draining is tiling instead of open ditching. Some counties refuse to enact drainage ordinances.

The Vermillion Basin is 2,185 square miles and is 120 miles long. It includes all or part of 10 counties. The Vermillion Basin Water Development District currently consists of all of Turner and Clay counties. The Turner, Lincoln, Clay (TLC) Water Project District includes the floodable land between Davis and Vermillion. The two districts currently share office space in Centerville, S.D. The Vermillion Basin Watershed Management Advisory Board (consisting of county commissioners from all counties involved) is trying to form a regional organization.

Lake Thompson is located in the upper end of the East Fork of the Vermillion River. In the last 10 years, the lake has experienced very high water. It appears the solution may be to have some controlled drainage of the lake or wait for nature to correct the problem.

Lake Vermillion is a South Dakota Game, Fish & Parks dam located in the southern portion of McCook County. It does not provide flood control, and at times of severe flooding it contributes to the flood peaks.

The TLC Water Project District has a flood control plan for most of the south half of the Vermillion Valley. It involves a large dam on the East Fork 5 miles north of Parker. This structure would catch 34,000 acre feet of water and release most of it slowly. There are also plans for four or five tributary dams that would work the same way. This would be followed by 50 or 60 stock dams along the tributaries. We feel these projects would also enhance wildlife.

A Corps of Engineers Reconnaissance Study showed less than a 1:1 cost:benefit ratio. This hurt funding opportunities. However, the Corps did not include wildlife and recreation benefits as well as erosion control benefits. Other things not taken into account include economic benefits to surrounding towns, tax base, and cost shares from federal, state, and local governments to repair damage. We feel these added items would enable a favorable cost/benefit ratio.

The federal government buyout program is not going to work at this time in the Vermillion Valley. The damage to property, roads, and wildlife from flood to flood is serious. This is some of the best land in the state, but we need relief from floods.

GAME, FISH AND PARKS STREAMS PROGRAM

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The Department of Game, Fish and Parks (GFP) fisheries program is organized into four subprograms. These are 1) streams, 2) large lakes and reservoirs, 3) small lakes and ponds, and 4) Missouri River reservoirs. The entire fisheries program is funded through a user-pay mechanism. State license fees are matched with a 10% manufacturers excise tax collected at the federal level and redistributed to the states by the Fish and Wildlife Service through the Sport Fish Restoration Program. The match ratio for this program is 25% state money matched with 75% federal monies.

In 1994 South Dakota fisheries management cost the user \$3.8 million (state and federal monies) and generated 3,000,000 angling days of recreation and \$358 million of economic activity when direct angler expenditures are magnified by the 2.5 multiplier used by the South Dakota Department of Tourism.

Streams in South Dakota contribute 402,000 angling days of recreation to total angling recreation. Approximately 10,000 miles of stream are available for angler use. According to the Department of Natural Resources (DENR), 48% of this stream mileage meets water quality criteria. In addition to angler use, streams support the bulk of the approximately 1,900 appropriative surface water rights in South Dakota. Nearly 400 National Pollutant Discharge permits also are dependent on streams. In addition to these readily measurable uses, there are others such as cattle watering, sub-grade irrigation, riparian zone cover and forage, and esthetics attributed to streams of the state.

Stream management by GFP has historically focused on the 700 inventoried miles of coldwater stream habitat found in the Black Hills.

Stream habitat restoration and enhancement has taken place in the Black Hills since 1973. Nearly 30 miles of stream reaches have been worked on during the last 22 years at a cost of approximately \$1.9 million. Projects have been completed with a variety of cooperators and have been justified by the high value placed on trout fishing opportunities and the uniqueness of coldwater stream habitat in a prairie state. Most efforts have been directed towards recovery of stream meanders, bank erosion control, and fish habitat enhancement. Stream habitat work in the Black Hills has, in part, led to less dependence on stocking of trout, as natural reproduction has supplied the majority of angler needs.

The future of stream management in GFP is being directed through the strategic planning process known as SAM, the Strategic Approach to Management, the results of the Statewide Angler Use and Preference Survey completed in 1993, and the ongoing Black Hills Angler Use and Preference Survey (results to be available January 1996). All of these efforts rely heavily on public input combined with GFP technical expertise to determine directions for stream management in the future.

The Streams Program strategic goal is as follows: "To conserve and enhance the natural resources of streams in South Dakota and to increase public knowledge of them." Nine strategic objectives are identified:

- 1) In cooperation with DENR, upgrade the beneficial use designation on 2% of statewide stream mileage by 2000 A.D., while maintaining beneficial uses on all remaining stream reaches.
- 2) Establish an instream flow reservation on a selected stream reach by 2000 A.D.

- 3) Provide an annual minimum of 500,000 angling days of sustainable fishing on South Dakota streams by 1996.
- 4) Propose watershed-based stream management by 1996.
- 5) Conduct stream preservation, enhancement, or restoration projects at the rate of at least 1 mile of stream annually through 1996.
- 6) Develop and maintain a centralized fisheries and habitat database by 1996.
- 7) Increase public knowledge and involvement with streams of South Dakota.
- 8) Develop and initiate a plan for departmental response to fish health problems, fish kills, and public health problems in conjunction with other regulatory agencies by 1996.
- 9) Develop a standard policy for the statewide fisheries management manual that outlines how all special status species will be managed by 1996.

In 1994 ... South Dakota fisheries management ... generated 3,000,000 angling days of recreation and \$358 million of economic activity ...

anglers felt that continued provision for stream habitat restoration and improvement is critical, very important, or important. Seventy percent of resident and non-resident anglers felt water quality was critical.

Using the stream program strategic objectives

and information collected from anglers, GFP feels that, by pursuing more active management on warmwater streams, several of the long-term needs identified can be

addressed. GFP plans to involve local users and resource managers in an effort to develop and prioritize projects on a regional basis that will address as many objectives and needs as possible. Warmwater streams offer a great deal of fisheries potential, as active management has taken place on few reaches. Cooperative projects with groups working upslope in the watershed as well as collaborative efforts with private landowners are viewed as potential mechanisms to accomplish GFP objectives and work with groups on locally identified needs.

The Statewide Angler Use and Preference Survey contains 10 summary recommendations, four of which can be applied to streams:

- 1) Develop a more diversified fishery.
- 2) Develop and manage a more localized fishery.
- 3) Develop shore fishing areas.
- 4) Get more information to the average angler about potential fishing areas.

In addition to these summary recommendations, 74% of resident anglers polled (n=760) felt that prairie stream management is critical, very important, or important. Ninety-six percent of this same group of

Selected References

- South Dakota Game, Fish and Parks. 1994. South Dakota angler use and preference survey, SDGFP, Wildlife Division. Completion Report 94-14.
- South Dakota Game, Fish and Parks. 1994. Systematic approach to management (fisheries), SDGFP, Wildlife Division. Special Publication.



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BIG SIOUX AQUIFER WATER QUALITY DEMONSTRATION PROJECT AREA

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(Sponsored by: Cooperative Extension Service, South Dakota State University; Natural Resources Conservation Service [formerly SCS]; Consolidated Farm Service Agency [formerly ASCS]; East Dakota Water Development District, U.S. Department of Agriculture.)

The Big Sioux Aquifer (BSA) is a shallow groundwater system that underlies approximately 1,000 square miles of land between Sisseton, S.D., and Sioux City, Iowa. It follows the Big Sioux River and is interconnected to the river and its many tributaries. The BSA is the principal source of water for people who live in the 13 border counties of eastern South Dakota. The importance of this aquifer is emphasized by the following facts:

- more than 200,000 residents in the state depend on the Big Sioux Aquifer for drinking water;
- 90% of the municipalities in the Big Sioux Basin use Big Sioux Aquifer water. This includes Sioux Falls, Brookings, Watertown, and 15 other South Dakota towns;
- five rural community water systems serving more than 6,000 individual farmsteads draw water from the Big Sioux Aquifer;
- 16,000 wells tap into the Big Sioux Aquifer;
- nearly 40,000 acres of cropland are irrigated from the Big Sioux Aquifer;
- more than 53 million gallons of water are pumped from the Big Sioux Aquifer every day.

Although the natural water quality of the Big Sioux Aquifer is very good, the aquifer is vulnerable to contamination. Because the aquifer is close to the surface and is connected directly to surface water, rapid recharge makes the aquifer highly susceptible to cont-

amination. Preventing contamination is preferable to, and much more economical than, cleaning up the environment afterward.

Water Quality Demonstration Project Area

The Big Sioux Aquifer lies under the fertile soil of eastern South Dakota, and the land above it is devoted to intensive agriculture. Preventing groundwater contamination from fertilizers, pesticides, and animal waste is a major objective of the Big Sioux Aquifer Water Quality Demonstration Project. This project covers 99,480 acres on 400 farms in Brookings, Moody, and Minnehaha counties. Nearly 85% is cropland, with over 10,000 acres under irrigation.

The BSA project is one of 16 demonstration projects in the United States developed as a part of a 5-year comprehensive program funded by USDA.

The purpose of the BSA Demonstration Project is to protect groundwater quality in shallow aquifers by identifying farm management practices which are environmentally sound and economically feasible. The goal is to promote voluntary adoption of innovative production practices, management systems, and land treatment to reduce or eliminate contamination of the aquifer by agricultural operations.

Environmentally Sound Management Practices

- Integrated Crop Management (ICM) programs will increase utilization efficiency of fertilizer and pesticides and reduce leaching to the aquifer.

- Irrigation water management practices will improve water use efficiency and decrease the movement of nutrients and pesticide contaminants to the aquifer.
- Reduced tillage, terracing, grass waterways, filter strips, and other conservation measures will reduce soil erosion and losses of fertilizers and pesticides to water.
- Abandoned well plugging, approved storage of agricultural chemicals, animal waste management systems, and other management practices will eliminate sources of aquifer pollution.
- Conversion of land use to less intensive agricultural practices in critical areas will reduce pollution potential to the aquifer.

- FARM*A*SYST
- Wellhead protection
- Land use conversion

Conclusion

All agricultural producers and land owners in the project area can participate in the BSA Demonstration Project by applying at the offices of the Natural Resources Conservation Service (NRCS) or Consolidated Farm Service Agency (CFSA) in Brookings, Moody, or Minnehaha counties.

Participating producers will receive help assessing their total farming operation to determine which management practices will benefit them most.

Available Practices and Management Systems

NRCS, CFSA, and Extension Service staff will help producers determine the Best Management Practices (BMPs) that provide the most protection for the aquifer:

- Integrated crop management
- Fertilizer management
- Pesticide management
- Irrigation water management
- Animal waste management
- Conservation tillage
- Plugging abandoned wells
- Filter strips

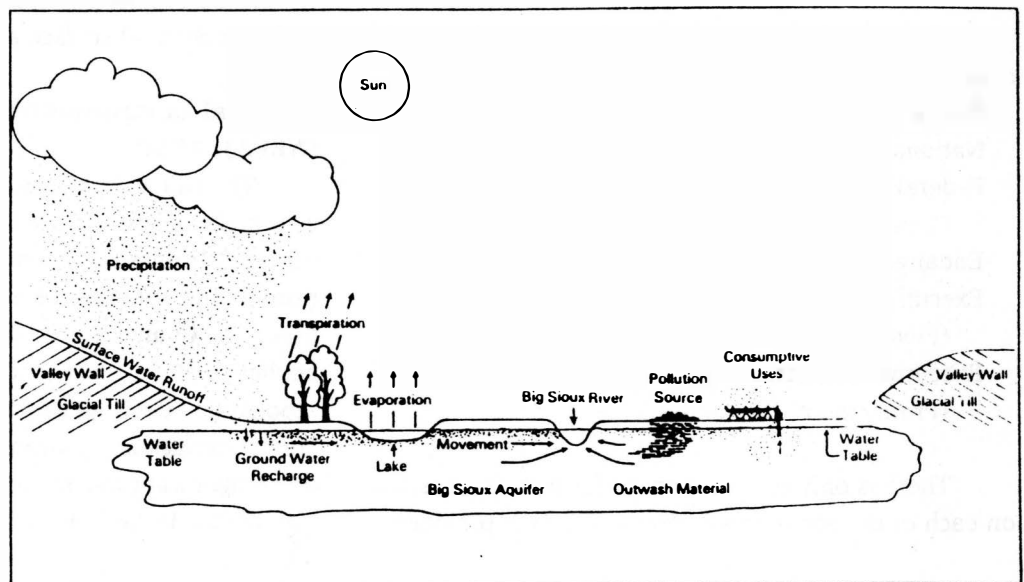
Assistance...

Cooperative Extension Service—information and programs on total farm management; technical assistance for irrigation water management; and FARM•A•SYST, a diagnostic tool to determine pollution risks on your farmstead.

Natural Resources Conservation Service — technical assistance to adopt improved conservation practices needed to protect water quality.

Consolidated Farm Service Agency — cost-share funding for implementing new practices and management approaches.

Water movement in the Big Sioux Basin. (From East Dakota Conservancy Sub-District)



PERMIT AND PROJECT REVIEW

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It is noteworthy that eight of the 10 largest cities in South Dakota occur in the Big Sioux, James, and Vermillion watersheds. According to 1990 census data, approximately 56% of South Dakota's population resides in the three watersheds which comprise about 30% of the land base of the state. Many of the cities and larger towns are experiencing growth, while rural areas and towns tend to have declining population levels. The census data is 5 years old, but the expansion of the larger cities appears to be continuing into the 1990s.

The majority of the permits and projects reviewed by the Ecological Services office in Pierre involve expansion of cities and towns, infrastructure development, and highway projects or maintenance thereof. Most of this review work is related to federal legislation passed in the late 1950s, 1960s, and early 1970s. Executive orders signed by the President of the United States in 1977 are also relevant to the presentation.

The following statutes and executive orders with enactment or amended dates will be discussed:

- Fish and Wildlife Coordination Act (SWCA), 1958
- National Environmental Policy Act (NEPA), 1969
- Federal Water Pollution Control Act (CWA), 1972
(Clean Water Act)
- Endangered Species Act (ESA), 1973
- Executive Order 11988, 1977
(Floodplains Management)
- Executive Order 11990, 1977
(Protection of Wetlands)

There is only time and space for brief discussions on each of the above topics. However, each provides

specific language or relevant authorities that are used by the Fish and Wildlife Service to review projects with a view towards conservation of natural resources. In most cases, the Fish and Wildlife Service comments are recommendations only. The permitting or funding agency may or may not use them. Fish and Wildlife Service comments are usually directed at eliminating or reducing adverse impacts to fish and wildlife or their habitats.

Fish and Wildlife Coordination Act, 1958

The purpose of this Act is to provide that wildlife conservation shall receive equal consideration and be coordinated with other features of water resource development programs, including whenever any water body is proposed to be impounded, controlled, or modified by a federal agency or federally permitted action. It requires mandatory consultation with the Fish and Wildlife Service and the State Game and Fish Department. Specific exemptions include the Small Watershed Project law (PL 566) and impoundments with less than 40 surface acres.

National Environmental Policy Act (NEPA), 1969

The NEPA process is intended to help public officials make decisions based on understanding of environmental consequences and take actions that protect, restore, and enhance the environment. The Act established the Council on Environmental Quality and applies to all federal agencies. It requires detailed reports, i.e., decision documents that may include categorical exclusions, environmental assessments, findings of no significant impact, and environmental impact statements. It involves public and agency review.

Clean Water Act, 1972

Objective of this Act is to restore and maintain the chemical, physical, and biological integrity of the nation's waters. Specific sections of this Act are intended to control discharge of pollutants into waters of the U.S. Section 404 is administered by the Army Corps of Engineers and regulates discharge of dredge and fill materials (solids) to waters of the U.S. while the National Pollutant Discharge Elimination System, section 402, regulates liquid discharges.

resources areas. Many agency regulations now have rules regarding activities that can occur in floodplains or wetlands. In some instances, certain activities are forbidden altogether.

The Fish and Wildlife Service developed a mitigation policy to assist in the review of permits and projects. It involves sequential steps that are intended first to avoid, then minimize, and finally compensate adverse resource impacts. This mitigation policy or the sequential steps are widely used in project reviews.

The Fish and Wildlife Service developed a mitigation policy ... sequential steps that are intended first to avoid, then minimize, and finally compensate adverse resource impacts.

Endangered Species Act, 1973

This authorizes the listing of species as endangered and threatened. It prohibits unauthorized taking, possession, sale, and transport of listed species. It authorizes civil and criminal penalties for violating the Act or regulations. Section 7 of the Act requires federal agencies to ensure that any action authorized, funded, or carried out by them does not jeopardize the continued existence of listed species.

The various types of permits and projects that are reviewed in the watershed include section 10/404 permits, highway and road projects, federal water projects, landfill and solid waste facilities, and numerous federal grant programs administered by numerous agencies.

Executive Orders - 11988, Floodplains Management, and 11990, Protection of Wetlands

These orders indicated to executive branch agencies how business will be done. The orders were made to reduce impacts of federal programs on these

This totaled 297 projects reviewed in three watersheds in 1994. Most of these reviews are completed in the office from information provided by applicants and available wetland maps. Other sources of information are limited; therefore, detail on cover types such as trees, native prairies, spawning sites, mussel beds, rookeries, and threatened and endangered species habitat would be valuable additions to our information database.

§ 4321. Congressional declaration of purpose.

The purposes of this chapter are: To declare a national policy which will encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the Nation; and to establish a Council on Environmental Quality.

SHORT TITLE

'National Environmental Policy Act of 1969.'

THE BIG SIOUX RIVER IN IOWA

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The Big Sioux River forms the northwestern Iowa border with South Dakota and has become a popular place to enjoy the outdoors by a variety of recreational users. The "Survey of Iowa Anglers" (Anonymous 1986) indicated streams and rivers are becoming more popular to fish and attracted the most fishing pressure statewide when compared to other bodies of water.

The Big Sioux in Iowa is fed by a watershed of approximately 1,440 mi² of which 85 to 95% is in agricultural use. The river valley south of Sioux Falls, S.D., deepens and becomes narrower than the upper river and then again broadens south of Hawarden, Iowa, to its confluence with the Missouri River near Sioux City. The channel in this river reach exhibits the well defined meanders of age with elevation changes of 0.50 ft/mi near the mouth to about 1.5 ft/mi in the northern reaches. This gradual descent creates a fairly sluggish stream, especially in the lower portion of the river.

Tributaries in this section of the Big Sioux have relatively steep slopes, and runoff is more rapid with peak flows generally occurring within a few hours after a runoff-producing rainfall. The largest tributary of the river is the Rock River which contributes approximately 30% of the river's annual flow.

Historians have recorded that early settlers described the Big Sioux as a clean, clear stream. However, like many Iowa streams, it has undergone rapid changes as a result of man's influences. Stream habitat and water quality have taken the brunt of civilization's blow. But in recent years and through the continuing efforts of concerned citizens and governmental agencies, the problems of point source pollution have been greatly reduced.

The fisheries resource of the Big Sioux has undergone some changes evident through its sampling history (Table 1).

Species, such as the walleye, channel catfish, and goldeye have been present for sometime in the River system and species like the sauger and flathead catfish were probably present throughout the time of these

Table 1. A partial species list of fish sampled by Meek (1892), Bailey and Allum (1962), Sinning (1968) and Christianson and Jindrich (1983).

| Species | Bailey and | | Christianson and | |
|--------------------------|-------------|--------------|------------------|--------|
| | Meek (1892) | Allum (1962) | Sinning (1968) | (1983) |
| Walleye | X | X | X | X |
| Channel Catfish | X | X | X | X |
| Goldeye | X | X | X | X |
| Sauger | X | X | | X |
| Flathead Catfish | | X | | X |
| Northern Pike | | X | X | X |
| Common Carp | | X | X | X |
| Golden Shiner | X | X | | |
| Topeka Shiner | X | X | | |
| Total species identified | 32 | 60 | 25 | 31 |

surveys but not consistently sampled. The northern pike and common carp absent in the 1892 survey indicate these species were probably introduced sometime after this collection. The golden shiner and Topeka shiner, not collected in 1968 and 1983, may indeed be

a reflection of the Big Sioux's changing habitat and water quality, especially when considering the Topeka shiner is not tolerant of siltation and high turbidity.

The two most recent fish surveys of the Big Sioux River definitely indicate sampling similarities (Table 2).

Table 2. Fish sampling similarities from Sinning (1968) and Christianson and Jindrich (1983).

| <i>Species</i> | <i>Upper</i> | <i>Lower</i> |
|------------------------|--------------|--------------|
| Sand shiner | X | X |
| Bluntnose minnow | X | |
| Fathead minnow | X | X |
| Red shiner | X | X |
| Creek chub | X | |
| Orange spotted sunfish | X | |

Upper=above Klondike Dam on the Big Sioux River.
Lower=below Klondike Dam on the Big Sioux River.

Sinning (1968) stated that water quality was the most important factor affecting fish diversity and distribution. In the Big Sioux River fish diversity and distribution are caused by:

- river habitat characteristics (physical features)
- pollution/water quality
- river barriers (e.g., rock cascade at Sioux Falls and seasonally at lowhead dams)

Some of the immediate and future needs dealing with the Big Sioux River are:

- continued effort toward nonpoint source and point source pollution
- update and increase information on:
 1. fisheries surveys
 2. creel surveys
 3. habitat protection
 4. habitat improvements
- increase access

The future of the Big Sioux River can be looked at with optimism because of past accomplishments in point source pollution and with some pessimism because of the long road ahead when dealing with nonpoint source pollution.

Literature Cited

- Anonymous. 1986. Fishing in Iowa, a survey of Iowa anglers. Iowa.
- Bailey, P.M., and M.U. Allum. 1962. Fishes of South Dakota. Misc Pub 119. Museum of Zoology, University of Michigan.
- Christianson, J., and L. Jindrich. 1983. Big Sioux Fisheries Investigation. File Report.
- Meek, S.U. 1892. A report upon the fishes of Iowa, based upon observations and collections made during 1889, 1890, and 1891. Bulletin of the U.S. Fish Commission.
- Sinning, James A. 1968. Fishes of the Big Sioux River. M.S. thesis, South Dakota State University. 74 pp.

In the early 1900s, the water was clear enough that people could see the bottom. Residents referred to the river as "The Silvery Sioux."

Don Pottratz
Canton Historical Society

RIVER FISHERY ECOLOGY AND STATUS OF FISHES IN SOUTH DAKOTA'S EASTERN RIVERS

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More historical data have been collected on the James (Jim) River fishery because of proposals related to the Garrison Diversion project than on the fisheries of the Vermillion and Big Sioux (BS) rivers. We have new information from fish surveys from 1991 through 1995. Fish communities of these rivers have about 40 to 60 species, depending on river, and have remained relatively stable since the 1950s.

Primary gamefish are warmwater species such as channel catfish, freshwater drum, and bullheads. Coolwater species (e.g., walleye) are present in lower numbers than the warmwater fishes, probably because of temperature and spawning habitat limitations. Nongame species include shortnose gar, gizzard shad, common carp, goldeye, bigmouth buffalo, suckers, and several kinds of minnows. Twelve fish (e.g., blue sucker, Topeka shiner, plains topminnow, paddlefish) are listed as either threatened or of special concern (Table 1). Several species have been stocked (e.g., common carp, smallmouth bass, crappie), and some are still periodically stocked. The average biomass of all fish species in the Jim ranged from 666 to 1,190 pounds/acre depending on habitat. The figures are typical for similar rivers.

Statewide, South Dakota's rivers yearly support about 402,000 angling days for some 65,600 anglers. The main eastern rivers are classed as having substantial fishery value based on the fish populations; however, anglers rank rivers last as preferred fishing areas. The Jim supports some 31 other recreational uses (primarily camping, 160,000 hours annually; fishing, 140,000 hours annually), according to a late 1970s study.

Channel catfish and northern pike are probably the most important recreational fish in the Jim, whereas walleye are also important in the BS. Channel catfish populations in the Jim are similar to those in other midwestern rivers, and the population may be underexploited. The state record channel catfish (55 pounds) was taken from the Jim in 1949. The walleye population in the BS is small but individuals grow fast.

Tributaries are important to the ecology of the main river fishes because tributaries are spawning and nursery areas, especially for forage fish. The Jim, Vermillion, and Big Sioux are important to the Missouri River fishery. Larvae from at least 15 species drift into the Missouri from the Jim. The Vermillion River fish community is dominated by small fish (< 3 inches) at higher densities (about 8 fish/sq. yard) than nearby rivers.

About 60 species of midges were found on snags and rocks in the Jim in densities of more than 30,000 individuals per square foot. Worms dominated mud

Table 1. Classification of fish species in eastern South Dakota rivers.

| <i>Classification</i> | <i>James River</i> | <i>Vermillion River</i> | <i>Big Sioux River</i> |
|-----------------------|--------------------|-------------------------|------------------------|
| Native | 46 | 35 | 45 |
| Introduced | 4 | 2 | 3 |
| Endangered | 0 | 0 | 0 |
| Threatened | 1 | 0 | 1 |
| Special concern | 8 | 4 | 5 |

bottoms at about 11,000 per square foot. Growth rate of fish which feed on aquatic invertebrates is average to above average.

The fish communities are probably affected by biological factors such as competition, predation, and food abundance as they are in all rivers. Physical factors that affect the fisheries include flow, water quality, and physical habitat. Winterkills have been occasionally recorded on the Jim and Vermillion rivers. Complex habitat (woody debris, rock dams) is more important to fish than simple habitat ("reference area" in Fig 1). In the Vermillion River density of small fish was higher in riffles and woody debris habitats than in pools and runs. However, adult walleye in the Big Sioux did not associate with any particular instream habitat, thus showing that habitat use depends on species. Some dams block migration, but many rock dams do not because they are submerged during spring floods. Sediment accumulation is high in some areas, and reduces spawning sites and invertebrate habitat. Droughts reduce fish spawning and growth.

The influences of six factors (Table 2) on the fishery need further study. Also needed are 1) increased biomonitoring by using fish, 2) information on the influence of low-head dams, and 3) reduction in non-point source pollution (i.e. siltation) through protection and rehabilitation of riparian and upland areas.

Table 2. Factors potentially affecting the fisheries of eastern South Dakota rivers. Importance is v = very; m = moderate; l = little.

| Factor | James | Vermillion | Big Sioux |
|--------------------|-------|------------|-----------|
| Hydrology | v | v | v |
| Habitat | v | m | v |
| Water quality | v | m | m |
| Migration barriers | m | l | m |
| Missouri river | m | m | m |
| Fish management | l | l | l |

Important Literature

Berry, C. *et al.* 1994. The James River of the Dakotas. Pages 70-86 in Biological Report 19, National Biological Survey.

Dieterman, D. and C. Berry. 1995. Distribution and relative abundance of fishes in the Big Sioux River, South Dakota. Prog Rept 95-9, South Dakota Department of Game, Fish and Parks, Pierre.

Schmulbach, J. and P. Braaten. 1994. The Vermillion River: neither red nor dead. Pages 57-69 in Biological Report 19, National Biological Survey.

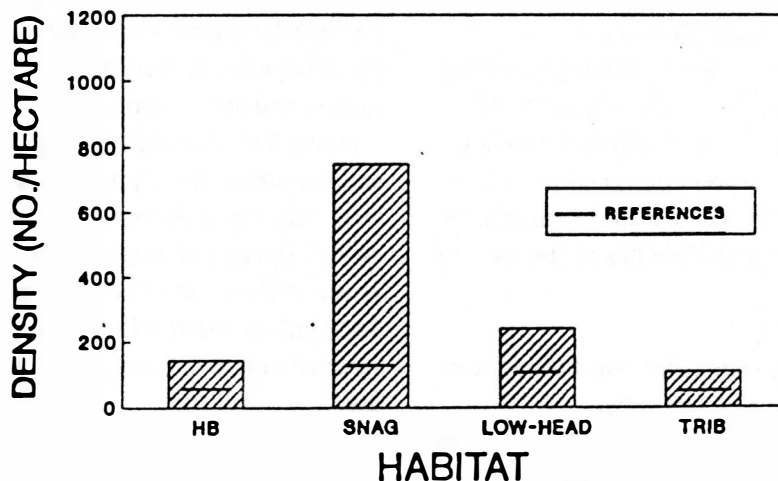


Fig 1. Mean densities of adult primary game fish in various habitats compared to simple habitats. HB = rocky bottom; SNAG = areas with woody debris; LOW-HEAD = rock crossing dam; TRIB = tributary confluence; REFERENCES = simple habitat area such as a run or chute. (From SDSU M.S. thesis by R. Walsh)

AN OVERVIEW OF WATER MANAGEMENT ACTIVITIES IN THE UPPER JAMES RIVER BASIN IN NORTH DAKOTA

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One cannot discuss water management in the upper James River Basin without starting with the 50-year-old Garrison Diversion Unit (GDU) project. As originally authorized in the Flood Control Act of 1944, over one million acres of farmland in north-central and eastern North Dakota were to be irrigated with water diverted from the Missouri River. Municipal and industrial water was to be supplied to larger cities particularly in the Red River Valley. Over time, this highly controversial project has been reduced in scale to a fraction of what was originally envisioned. Most recently, the Clinton Administration has even questioned some of the features reauthorized by the GDU Reformulation Act of 1986.

In response to the challenge, on November 12, 1993, the Governor and the Congressional delegation jointly signed a letter to Secretary of Interior Bruce Babbitt, asking for his cooperation in re-visioning the Garrison Diversion project. Commissioner of Reclamation Dan Beard responded by calling a meeting of the major stakeholders on December 17, 1993. At that meeting, he set in motion the North Dakota Water Management Collaborative Process designed to deal with the barriers to completion of a water management program that would meet North Dakota's contemporary water needs.

An executive steering committee was formed, consisting of the Governor, the three-member Congressional delegation, the three major Indian tribes, the National Wildlife Federation, and the Bureau of Reclamation. The committee has been reviewing study options, demonstrated needs, and alternative solutions while developing a program to meet legitimate water requests on a consensual basis. Progress continues to be

made, and many of the contentious issues of the past are now being addressed in a manner which should result in broad-based support.

Technical groups are currently looking at municipal, rural, and industrial (MR&I) water requirements of the more densely populated Red River Valley, statewide MR&I necessities, total water needs on three major Indian Reservations, and a study to address both flood control and water level stabilization of Devils Lake.

The outcome is likely to be a scaled-down and dramatically altered water project which reflects current technologies for water use but also respects the long history of disappointment that North Dakota has experienced in its relations with the Department of Interior and the federal government on the Pick-Sloan Missouri Basin. The executive steering committee is hopeful that the results will be a program which finally meets North Dakota's long-term water needs, preserves and enhances natural ecosystems of the prairie pothole region, and saves money over the previously authorized versions. The responsibility for development of the plan and execution of the program is shifting to state and local authorities. A continuation of financial support is needed to carry through and further develop the consensus-building process and to maintain the nearly \$400 million worth of facilities that have been constructed but, as yet, not put to any significant beneficial use.

There are no Garrison Diversion project features being constructed at this time. Completion of the bypass canal through Arrowwood National Wildlife Refuge has been delayed while the Bureau of Reclamation (BOR) prepares a new Environmental

Impact Statement (EIS). Unlike the piecemeal environmental assessments associated with Garrison Diversion in the past, the new EIS will evaluate cumulative impacts to the refuge and river ecosystems.

The Oakes Irrigation Test Area (OTA) was a vital component of the 1986 GDU compromise. It was authorized and constructed to study the impact of irrigation return flows on aquatic resources, particularly the James River above Sand Lake National Wildlife Refuge. Congress recently directed the BOR to shut down the OTA in 1995. While not directly involved in the collaborative process per se, it is certainly relevant to the future of Garrison. Consequently, a task force was formed to prepare an environmental assessment. It is currently reviewing options for the best use of the facilities ranging from abandonment to transfer of ownership to the state; no decisions have been made.

A substantial amount of water quality research has been conducted at Oakes. Preliminary results are encouraging, especially with regard to removal of nitrates from waste water as it passes through a marsh complex during the summer months. There is an extensive water chemistry database that has not been analyzed and, regrettably, probably won't be if the project is zero-funded.

The North Dakota Department of Health and Consolidated Laboratories (NDDH&CL) intends to initiate a James River basinwide water quality monitoring project within the next 5 years. In addition to nutrients, pesticides, and heavy metals, it plans to use Index of Biotic Integrity (IBI) methodology to assess fish and macroinvertebrate status. The NDDH&CL recently initiated a nonpoint reconnaissance effort on Cottonwood Creek near LaMoure with hopes of implementing a 319 Project there in a year or so.

North Dakota officials have been lobbying hard for continuation of the Conservation Reserve Program (CRP). There is enormous potential for water quality

benefits associated with CRP acreage. For example, of the 5 million acres of land within the James River basin in North Dakota, 2.7 million are cultivated.

Approximately 460,000 acres are enrolled in the CRP, hence 17% of the basin's cultivated land is currently being protected by permanent, vegetative cover. It is interesting to note that within the 2.7 million acres of cropland there are approximately 200,000 acres of wet-

lands. Thirteen percent (13%) or 26,000 acres are currently buffered by CRP vegetation. Moreover, another 7,000 acres are clas-

sified as farmed and/or previously converted. If the latter two acreages could be targeted in the next farm bill, then 31,000 acres (22%) of the wetlands in the upper James River Basin could be protected.

An issue that merits careful attention of resource managers is the proliferation of "value added" processing plants for locally grown agricultural products. While they are generally promoted as a panacea for local growers and economic development for small communities, subtle, negative environmental consequences are likely being overlooked as developers race to secure funding and complete construction on schedule. A buffalo meat processing plant at New Rockford, a pasta plant at Carrington, and a proposal for a large multi-million dollar potato processing plant at Jamestown are examples of "cooperatives" that require vast amounts of water, the effluent from which has to go somewhere. It is instructive to note that the James River is the designated receiving water for municipal lagoon discharges from all three cities.

On the positive side, abatement of nonpoint pollution associated with livestock feeding and wintering operations near drainage systems has been elevated to a higher priority. Proactive regulatory agencies are advising producers that if a complaint is registered and enforcement action is initiated, federal sources cannot provide financial assistance for livestock waste systems; thus, it behooves producers to help themselves while they can. This type of activity should be encouraged and supported by aquatic resource managers.

There is enormous potential for water quality benefits associated with CRP acreage.

WILDLIFE VALUES OF THE JAMES, BIG SIOUX, AND VERMILLION RIVERS

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Since the beginning of time, rivers have always been important to wildlife, and the James, Big Sioux, and Vermillion are no exceptions. For a better understanding of their value to wildlife, all one has to do is review the literature and simply spend some time on the rivers. The James, Big Sioux, and Vermillion flow through thousands of acres and through half of the 44 counties that comprise eastern South Dakota. The rivers provide an almost perfect mix of habitat diversity which most wildlife species need to grow and prosper. This unique mix of habitat diversity contains the three primary components all wildlife need: food, water, and shelter. Together they create an ideal environment for many species of wildlife from whitetail deer to cottontail rabbits to bald eagles, and the list goes on and on.

In addition to being a home for many species of wildlife, the rivers offer us as professional wildlife managers some unique opportunities to study and learn more about our valuable wildlife resources. An example of this is the introduction of eastern turkeys along the James River, beginning in 1993 when 15 hens and 5 toms were released along the James River just southeast of Forestburg, S.D. To date, the project has expanded to five other release sites up and down the river. We are hopeful that this project will give us more insight into the seasonal movements and home ranges of eastern turkeys along the river and offer some limited hunting a few years down the road. Other studies and projects currently underway involve whitetail deer movements and habitat use on Sand Lake Refuge and artificial nesting structure use by wood ducks on the James, Big Sioux and Vermillion rivers. It is projects like this that will give us a better understanding of the importance and use of these rivers by wildlife.

Besides offering many research opportunities, the rivers also provide vital winter habitat, travel corridors, and staging areas for many species of wildlife. A classic example is Sand Lake National Wildlife Refuge in northeastern South Dakota. Sand Lake Refuge is situated on the upper end of the James River and was established in 1935 as a nesting and staging area for migrating waterfowl. It contains approximately 21,500 acres, of which 11,400 acres are open water and marsh habitat, the type of habitat critical for waterfowl and many other species of over-water nesting birds.

When the Conservation Reserve Program is in full swing and most wildlife populations are doing well, it would be easy to just sit back and do little or nothing. This must not happen! Stretches of these rivers have been canalized, more intensive farming practices are occurring, and urban and suburban developments are underway. All of these activities should be monitored and carried out in such a way that the essential habitat these rivers provide will be protected and enhanced. For it is this unique habitat that ensures healthy wildlife populations and also provides thousands of hours of recreation for the people of South Dakota.

Because these rivers serve such a vital role in the future of wildlife populations and management, it is imperative that we as professional wildlife managers do all we can to properly manage this resource. It is not only our responsibility, but the responsibility of all people in resource management to work together to ensure that rivers like the James, Big Sioux, and Vermillion will be properly managed for generations to come and continue to provide the quality of life that we all know and have grown to expect.

THE U.S. FISH AND WILDLIFE SERVICE “PARTNERS FOR WILDLIFE PROGRAM” IN SOUTH DAKOTA

Carl R. Madsen

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Since 1988, throughout South Dakota, the U.S. Fish and Wildlife Service (USFWS) has been working in voluntary partnerships with private landowners interested in restoring and enhancing a variety of wildlife habitats. Under the “Partners For Wildlife” program the USFWS provides financial and technical assistance to private landowners through cooperative agreements. With these cooperative agreements participating landowners agree to maintain or implement a conservation practice but otherwise retain full control over their property. Partners For Wildlife operates strictly on a voluntary basis, and most cooperative agreements are written for a 10-year period.

The most popular project implemented in South Dakota by the program includes wetland restorations, wetland creations, grass seedings, grazing systems, and provision of waterfowl nesting structures.

Wetland restorations consist of plugging a man-made drainage ditch to restore the original hydrology to altered wetland basins. Wetland creations are usually designed to impound water within a natural draw and often serve as both waterfowl habitat and livestock water. Grass seeding projects covered by the program usually involve establishing a mix of native grasses on previously cultivated land. Rotational grazing systems are often implemented in conjunction with a native grass seeding or wetland creation. Woodduck boxes, mallard structures and goose tubs are all provided to interested landowners, who in return agree to maintain the nesting structure for 10 years.

Additional information on any of these projects may be obtained by contacting the U.S. Fish and Wildlife Service at the above address.

These days, the landowner is only a phone call away from people who know about the business of managing, restoring, and creating wetlands and who are also concerned about the economic realities of managing a farm or ranch.

C. Berry and D. Buechler
*Wetlands in the Northern Great Plains:
A Guide to Values and Management*

SOUTH DAKOTA RIPARIAN AREA CLASSIFICATION SYSTEM

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The environmental considerations and economic values of riparian areas are becoming increasingly important to our society. The South Dakota Department of Environment and Natural Resources Nonpoint Source Management Program Plan states in the introduction that "nonpoint source pollution has long been recognized as affecting the uses of more bodies of water than point sources." Riparian areas directly influence nonpoint source pollution since all surface water and to a lesser extent groundwater leaving a watershed must travel in, on, over, and through riparian corridors as it moves downstream.

Today resource managers and environmental groups are rapidly accepting the value of the riparian resource. They are just as rapidly developing methods for evaluating riparian areas which relate to their concerns. Several of these riparian inventory procedures are excellent and gather the necessary field data. These inventories are usually completed to determine a habitat factor or a vegetative rating or to examine a specific riparian site problem. However, the data have not been compared and evaluated in a manner that would set up riparian ecosystems that can be identified in their seral stages.

A system needs to be established for evaluating riparian area ecosystems based on the physical and biological factors of the region that identify each ecosystem's seral stages. This information could and would be used and transferred between agencies and other resource management groups.

The principal physical and biological factors used in this system would include geographic location, geology (soils), temperature and rainfall (climate), vegeta-

tive cover and health, location and aspect in the watershed, hydric factors, and stream type and gradient. From these and similar riparian area data, a general description for this riparian area can be developed. Trained resource people can review these similar sites and develop a condition classification based on the factors obtained from the field observations.

To gather riparian area data that would document any patterns that exist in the landscape requires a labor force. Thus far two opportunities have come up that allowed a working group to collect data. One was the Upper Bad River Basin Study where the channel is being stream typed in six subwatersheds using the Rosgen Stream Typing Method. Vegetation data have been gathered at each cross-section site in the six subwatersheds. The other was the Americorps project on the east side of the state.

Two teams of Americorps people have been gathering riparian data in the East River Riparian Project Area. This includes the Sioux, Vermillion, and James river basins plus the northeast corner of South Dakota. The data from the Brookings team are entered and have been examined to a limited extent. The Mitchell team data are just being entered, and the Upper Bad River data await further action.

For now, there are more questions than answers. Here are a few of the observations thus far.

The predominant land use is no use or continuous grazing; both favor cool-season vegetation. Also this has been a very wet period for eastern South Dakota; some vegetative patterns may be showing this overly wet influence.

On the wet/marshy sites the vegetation is dominated by *Spartina pectinata*, *Carex atherodes*, *Scripus fluviatilis*, *Typha latifolia*, and *Salix amygdaloides*. Other grasses, small forbs, and older aged trees were also present. There were very few new seedlings apparent. In the upland springy/fen sites a few varieties of *Juncus* spp were present.

In the drier/upland sites the common vegetation was dominated by *Agropyron repens*, *Bromus inermis*, *Carex atherodes*, *Spartina pectinata*, and *Calamagrostis canadensis*. Several other grasses, forbs, and trees were also present.

In the wet/nonuse sites vegetation was dominated by *Phlaris arundinacea*, *Spartina pectinata*, and *Carex atherodes*. Many of the nonuse sites have been heavily flooded during some period of the year. On sites where there had been no use for 2-5 years, vegetation was very dense, so dense that it may be preventing new seedlings from establishing.

Almost all sites were silt loam soils, so no soil/vegetation patterns have been observed. Sites

have been evaluated using the Bureau of Land Management System of functioning, functioning at risk, and nonfunctioning. Shumm's Channel Evolution Model is also noted, along with soils, land resource area, channel width, riparian area width, legal description, land use, stream order, depth to water table, and drainage classification.

The data are being reviewed at the present time. It appears that more attention needs to be given to watershed relationships and patterns and less effort to

Riparian areas directly influence nonpoint source pollution since all surface water and to a lesser extent groundwater leaving a watershed must travel in, on, over, and through riparian corridors as it moves downstream.

identifying sites that are available for access and evaluation. There appear to be some items to examine more closely, especially to see if certain types or species of vegeta-

tion are good indicators of riparian site health. It also appears that channel and valley slope, steepness of topography, higher stream orders, and intensity and history of land use need more observation.

If any individual or any agency has any ideas or suggestions to move this riparian classification effort forward, feel free to discuss them with Sandy Wyman, 605-692-8754, or Pat Kuck, 605-773-4216.

RECENT CORPS OF ENGINEERS EFFORTS IN EASTERN SOUTH DAKOTA

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The Corps of Engineers has conducted studies on the James, Vermillion, and Big Sioux rivers in recent years. A summary of the analysis for each basin follows:

Aberdeen Area. Flood control studies were conducted in the James River Basin in 1988 and 1989. The only feasible plan for flood control identified in that effort is in the Aberdeen area. The proposed project is a 2.7-mile levee on the northeast side of Aberdeen which will provide 100-year protection and prevent approximately one half of expected average annual damages to structures and contents. The levee will essentially block existing drainage to Moccasin Creek with a combination of culverts with gates and detention ponds incorporated into the design to mitigate interior drainage problems. The project has a cost of approximately \$2.8 million and will provide protection for 1,273 residences and 20 businesses. The proposed project would affect about 22 acres of wetlands in three locations. Mitigation activities will include replacing the wetlands and using indigenous grasses as ground cover on the levee which will reduce mowing requirements and allow the levee to function as a travel corridor for animals. Point of contact for this project is Mr. Mike Barnes, and he can be reached at (402) 221-4605.

James River. An environmental planning study was undertaken in 1991 and 1992 to explore opportunities to provide minimum flow to the upper James River (the Lake Plain) especially in the fall and winter periods. On average, the river at Columbia has 130 days per year of no flow. Of those, 93 days are in the fall and winter seasons. The minimum flow considered acceptable (20 cubic feet per second) is not met an average of 214 days per year with 136 of those

occurring in the fall and winter. The river feeds many wetlands that are directly or indirectly adjoined to the river. Some of these wetlands could be modified to improve their productivity. Though no plan can provide a fully reliable water supply to meet desired minimum flows in the Lake Plain, small strategically located storage sites could significantly reduce the periods of "no flow" in the Lake Plain. The James River Water Development District is currently working with the counties and local landowners to determine their interest in pursuing these environmental efforts into the feasibility phase. Point of contact for this project is Mr. Ralph Roza, and he can be reached at (402) 221-4574.

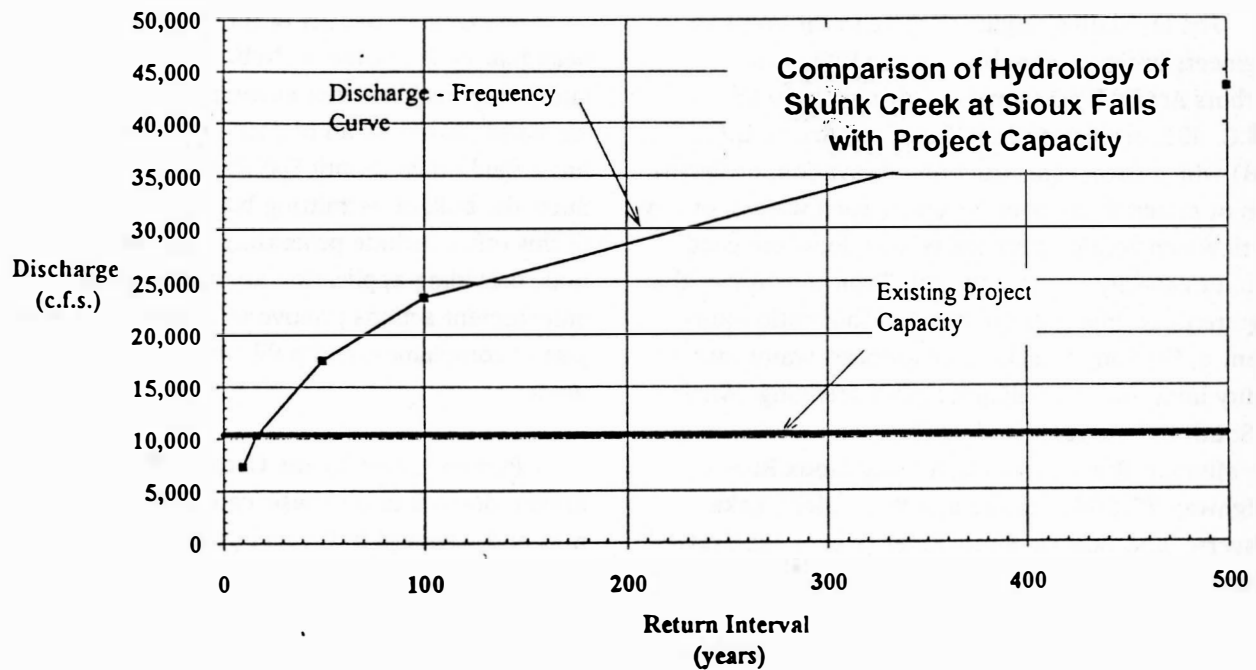
Vermillion River Basin. Flood control studies were conducted in the Vermillion River Basin in 1991 and 1992. The studies looked at ways to provide flood damage reduction benefits for agricultural as well as urban areas. Due to potential severe environmental impacts, channelization of the Vermillion River was considered unacceptable. A series of small dams were evaluated but ultimately rejected for lack of economic feasibility. No additional studies are planned by the Corps of Engineers at this time. Point of contact is Mr. Ken Cooper, and he can be reached at (402) 221-4575.

Big Sioux River. The Corps of Engineers has not conducted a basin-wide analysis of the Big Sioux River since the 1960s. Although there are significant flooding problems in the Big Sioux River Basin, resolution of these challenges will require joint support from South Dakota and Iowa. Large drainage areas in both states contribute significantly to the flooding problems in the basin.

Watertown Area. In 1994, the Corps completed flood control studies in the Watertown area. Significant flood control problems exist around Lake Kampeska and along the Big Sioux River in the City of Watertown. The only feasible method of reducing flood damages to those areas is upstream storage. The study identified a plan which provided a dry dam capable of storing a 100-year flood about 3 miles upstream from Lake Kampeska. The structure would reduce average annual flood damages in Watertown by 80% and by 81% around Lake Kampeska. Only minor environmental impacts would result as a result of the dry dam concept. As a result of two recent local referenda on the project, neither the city nor county may support the project financially for 1 year. Other than addressing the relationship of groundwater and surface water, the Corps will not proceed with the pre-construction engineering and design phase of the pro-

ject until the status of local support changes. Point of contact for the project is Mr. Ken Murnan, and he can be reached at (402) 221-4020.

Sioux Falls Area. The Corps is proceeding with detailed design on a plan to improve the level of protection at an existing Corps project at Sioux Falls along the Big Sioux River. The current project provides protection from a 40-year event, which is inadequate for an urban area. The proposed project would increase the level of protection to a 100-year level from either Big Sioux River or Skunk Creek flooding. The project will improve the level of protection to over 2,000 homes and businesses in Sioux Falls at a cost of approximately \$30 million. Point of contact for the project is Mr. Mike Barnes, and he can be reached at (402) 221-4605.



From U.S. Corps of Engineers flood protection report, 1993.

DISCUSSION OF THE CORPS' SECTION 10/404 REGULATORY PROGRAM

Steve Naylor

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The Department of the Army Regulatory Program is one of the oldest in the federal government. Initially the mission of the program was simple and straight forward: that is to protect and maintain the navigable capacity of the nation's waters. Changing public needs, new statutory mandates, and increased stress on natural resources and the subsequent increased public awareness of the importance of our natural resources have changed the complexion of the program.

The legislative origins of the current Corps of Engineers program date back to the Rivers and Harbors Act of 1890 (superseded) and 1899 (33 U.S.C. 401, et. seq., Section 10 of the Act 33 U.S.C. 403) which covers construction, excavation, or deposition of materials in, over, or under such waters, or any work which would affect the course, location, condition, or capacity of those waters. Typical activities that require Department of the Army authorization pursuant to Section 10 include boat docks, water intakes, utility lines, bank stabilization, and dredging. Waters in South Dakota regulated under Section 10 include the Missouri River, James River, Big Sioux River (Highway 77 Bridge to the mouth-5 miles), Lake Traverse, and Bois De Sioux River (from Lake Traverse to the South Dakota/North Dakota state line).

The other legislative authority administered by the Corps of Engineers is Section 404 of the Clean Water Act. Section 404 of the Clean Water Act came about as a result of amendments to the Water Pollution Control Act in 1972 and 1977. Under the provisions of Section 404, the Secretary of the Army, acting through the Chief of Engineers, is authorized to issue permits, after notice and opportunity for public hearings, for the discharge of dredged or fill material

into waters of the United States. Waters of the United States is defined (33 C.F.R. 323.2) as all Section 10 waters; all interstate waters, including their adjacent wetlands; and all other waters such as interstate lakes, rivers, streams, mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, or natural ponds. In general, 404 jurisdiction extends to all waters of the United States to the maximum extent permissible under the commerce clause of the Constitution.

The Omaha District of the Corps of Engineers, headquartered in Omaha, Neb., has a geographic regulatory responsibility that encompasses all or parts of six states, including all of South Dakota. Each state has a field office (South Dakota's is in Pierre) that conducts the bulk of permitting business. General duties of this office include processing applications for permits, providing application assistance, conducting enforcement actions relative to unpermitted activities, permit compliance, and public education/outreach work.

Permits issued by the Corps of Engineers can be broken down into two basic categories: general permits and standard individual permits. General permits are issued on a nationwide or regional basis. In simple terms, general permits are issued to the general public, or to a specific group or agency, in advance of the discharge, for certain specific activities that have been determined to cause only minimal individual and cumulative environmental impact. Permits for these activities have gone through a public interest review process prior to issuance. Any individual project, to be authorized by a general permit, must meet the terms, limitations, and conditions of the general permit. Examples of types of activities that have been autho-

rized by general permit include boat ramps, backfill for utility lines, fish habitat structures, minor road crossings, minor bank stabilization, and fills associated with wetland enhancement and creation projects. Although regional and nationwide permits are available for use by the general public, many of them require notification to the Corps of Engineers prior to commencement of the activity.

In general, standard individual permits are required for projects that cannot be permitted by general permit. This permit type is the basic form of authorization and generally involves three distinct processes: pre-application consultation, formal project review, and decision making. For the Corps of Engineers to issue a permit, the following four basic standards must be complied with: The project must be found to be not contrary to the public interest (from a local, regional, state and national perspective); the project must be found to comply with all other applicable federal regulations (i.e., Threatened and Endangered Species Act, National Historic Preservation Act, National Environmental Policy Act, and others); the project must not violate the state's water quality standards (i.e., Section 401 of the Clean Water Act administered by the South Dakota Department of Environment and Natural Resources); and the project must be the least environmentally damaging practicable alternative (i.e., 404(b)(1)

Guidelines; 40 C. F.R. 230). Public input is solicited by the Corps via the issuance of a public notice (15 to 30 days) with the intent to obtain the information necessary to evaluate the probable beneficial and detrimental impacts of the project on the public interest. Public hearings are held if comments raise substantial issues which cannot be resolved informally and the Corps determines that information from such a hearing is needed to make a fully informed decision. In making a final permit decision, no one factor by itself can force a permit decision. Instead the decision represents the net effect of balancing all relevant factors. Relevant factors may include conservation, economics,

aesthetics, wetlands, cultural resources, navigation, fish and wildlife values, water quality, and any other factor judged to be important to the needs and welfare of the people.

Today a major portion of the Corps regulatory program is centered around applications for activities in wetlands generally derived from urban expansion activities or from agricultural related activities. The 404 program is generally regarded as the most powerful wetlands protection law on the books. This program establishes high standards of sensitivity to wetlands for their public values of water purification, flood control, fish and wildlife habitat, and other recognized functions and values. The program is also sensitive to our nation's waters in general. The program does, however, also recognize the need to provide for reasonable use of private property and economic development.

When the Corps issues a Department of the Army permit it is because there is a need for the project; there are not practicable alternative sites or methods for attaining the objectives of the project that would have less adverse impact on the environment; and the project is designed to prevent or minimize adverse impacts to the aquatic ecosystem. Many times such

permits are issued only after considerable effort on the part of the Corps, the resource agencies that are involved in the public

interest review process, and the applicant to work out a project design that will meet the objectives and the spirit of the Clean Water Act.

More information on the Corps of Engineers Regulatory Program can be obtained by writing or calling:

Corps of Engineers
Regulatory Office
Rm 317, Federal Building
Pierre, South Dakota 57501
(605) 224-8531

The 404 program is generally regarded as the most powerful wetlands protection law on the books.

SOUTH DAKOTA'S SURFACE WATER QUALITY STANDARDS AND SUPPORTIVE WATER QUALITY MONITORING

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The passage of the Clean Water Act, quickly followed by the adoption of state law, required South Dakota to develop regulations assuring the protection of the state's water quality. The legal definition of surface waters of the state is very inclusive in that it contains lakes, streams, wetlands, stock ponds, drainage systems, and almost any other accumulation or conveyance of water, private or public. The surface water quality standards were developed to clarify just exactly what level of water quality was desired. Basically, the surface water quality standards establish the minimum water quality "goals" for the management of the state's waters, including the application to both regulatory or non-regulatory activities.

The surface water quality standards are multifaceted, applying to the physical, biological, and chemical components of a water body. Narrative statements define broad, general goals for the protection, maintenance, and restoration of water quality. These types of statements include prohibition of visible pollutants and toxic pollutants in toxic amounts and the development of nuisance aquatic life. Concentration-based numeric criteria, including conventional, toxic, and radiological pollutants, compose the major portion of the regulations.

Numeric water quality criteria are assigned to 11 beneficial use designations. If these criteria are met, then the beneficial uses should be supported. A good example is the fecal coliform criterion of 200 colonies/100 mL or less. This concentration generally indicates that few, if any, pathogens may be present, ensures the protection of human health, and supports the beneficial use of immersion recreation. Beneficial uses are designated by rule-making to lakes, streams,

and wetlands in various combinations meant to reflect actual beneficial uses and attainable water quality levels. Beneficial uses designations include domestic water supply use, five aquatic life uses, two recreational uses, wildlife propagation, and stockwatering use, irrigation use, and commerce and industry use.

The surface water quality standards program is also composed of various processes intended to insure the protection of water quality. These processes include water quality certification (commonly referred to as 401 certification), antidegradation, water restoration or enhancement, use attainability, toxics control strategies for the protection of human health and aquatic life, site-specific water quality standards development, surface water discharge permit limits development, and approved test methods and sampling requirements.

Future directives from the EPA in the water quality standards arena will include the development of biological, sediment, wildlife, and possibly riparian criteria, designation of specific beneficial uses for wetlands, and endangered species consultation. It is in these areas especially that assistance and input from water quality professionals across the state would be beneficial.

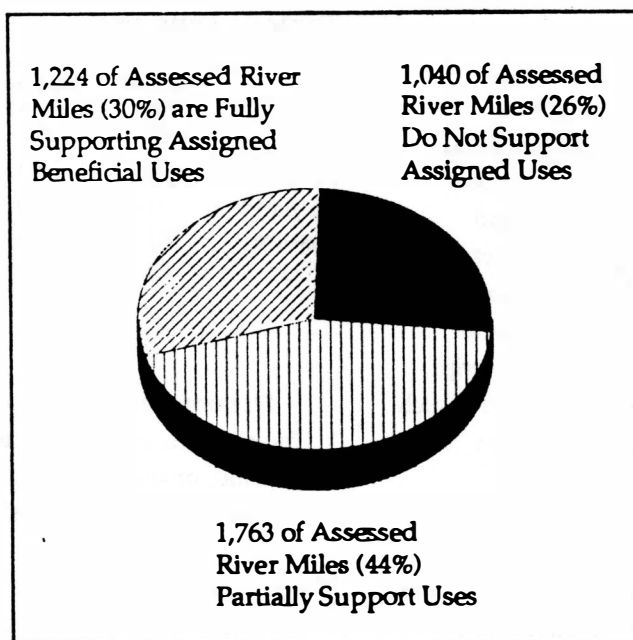
While surface water quality standards are enforceable regulations, they should be used as more than a regulatory tool for determining discharge limits, compliance, or impacts from a pollution incident. They should be used to set targets and goals for water quality projects and to serve as a guide in the interpretation of water quality data when determining the overall health of the waterbody.

Surface water quality standards are dynamic and complex. They reflect scientific principles as well as societal values. Water quality standards and beneficial uses are adopted through administrative rulemaking which is a public process before the Water Management Board. Surface water quality standards are authorized under South Dakota Codified Law Chapter 34A - 2 and are codified by regulation in the Administrative Rules of South Dakota Chapters 74:03:02, 74:03:03 and 74:03:04. The surface water quality standards are reviewed at a minimum of every 3 years.

As a major support to the surface water quality standards program, the department maintains a statewide ambient water quality monitoring network. It is comprised of 98 fixed stations located on major rivers and streams. Water quality samples are collected on a fixed schedule and analyzed for a fixed number of parameters. The samples are taken and field testing performed according to EPA approved sampling methods and quality assurance\quality control

(QA\QC) measures. Samples are delivered for analysis to laboratories implementing EPA approved test methods and strict QA\QC. The sample data are stored on the national EPA STORET computer database system which is accessible to the STORET user community. The department is also able to distribute this information in varying formats upon request, including basin-by-basin reports.

The information gained from this network provides invaluable insight into the status of South Dakota's water resources. The data, used in conjunction with the surface water quality standards, provide water quality professionals the basis for designing wastewater treatment facilities, for implementing or justifying water quality improvements projects, determining existing levels of water quality, determining water quality improvements and trends, determining aquatic health and viability, and implementing water quality research projects. The water quality monitoring (WQM) network sampling plan is evaluated and reviewed annually.



Condition of rivers in South Dakota. (From South Dakota Coordinated Soil and Water Conservation Plan, South Dakota Association of Conservation Districts)

EAST RIVER RIPARIAN AREA IMPROVEMENT DEMONSTRATION PROJECT

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The South Dakota East River Riparian Area Improvement Demonstration Project is an information and education effort designed to develop demonstration projects that will improve the health and vigor of the riparian corridor; conduct a land use statistical survey; and explore a potential riparian area classification system. This project intends to demonstrate the value of the riparian corridor, the corridor's impact on water quality, and the different resource management practices that can be implemented in the riparian and upland areas to improve the vegetation. The target audience includes resource managers, landowners, and the general public.

Demonstration sites are being established throughout eastern South Dakota with willing landowners to see how they can use riparian areas without degradation occurring. Best management practices are being installed on the riparian and upland areas to determine the beneficial impact on erosion, water quality, and cost effectiveness of the practices. Practices include grazing management, cross-fencing, stream bank stabilization, filter strips, livestock crossings, and alternative water sources such as pasture nose pumps, dams, dugouts, pipeline, and tanks.

Nine demonstration projects are in the implementation or planning stage, and it is planned to have at least seven additional projects developed. An economic analysis will be conducted on 10 case studies to determine the cost effectiveness of practice implementation.

A land use statistical analysis of riparian areas for the watersheds of the James, Vermillion, and Big

Sioux rivers has been conducted. The survey will help determine which critical areas could benefit from alternate management methods. Preliminary results have been completed on the Big Sioux River and Vermillion River drainages (see Table 1). The land use information was collected from certified land use files located at the Consolidated Farm Services offices in each county. A random-number sampling method was used to determine which sections would be inventoried. Land use was split into cropland, hayland, pasture, and other.

Table 1. Land use.

| | <i>Big Sioux River (%)</i> | <i>Big Sioux Drainage (%)</i> | <i>Vermillion River (%)</i> | <i>Vermillion Drainage (%)</i> |
|---------|------------------------------------|---------------------------------------|-------------------------------------|--|
| Crop | 33 | 52 | 53 | 55 |
| Hayland | 3 | 40 | 3 | 6 |
| Pasture | 52 | 6 | 43 | 36 |
| Other | 12 | 3 | 1 | 3 |

Streams were split into three classes (Table 2):

1. The riparian zone connected to or part of cropland, hayland, or grazing land. The upper part of drainage areas—not a defined stream.
2. The stream has a defined channel and bank. It may be farmed or hayed, but the channel or riparian area are unused due to wetness.
3. Permanent waters (rivers or large streams).

A riparian area inventory was started in September 1994 to gather information for a potential

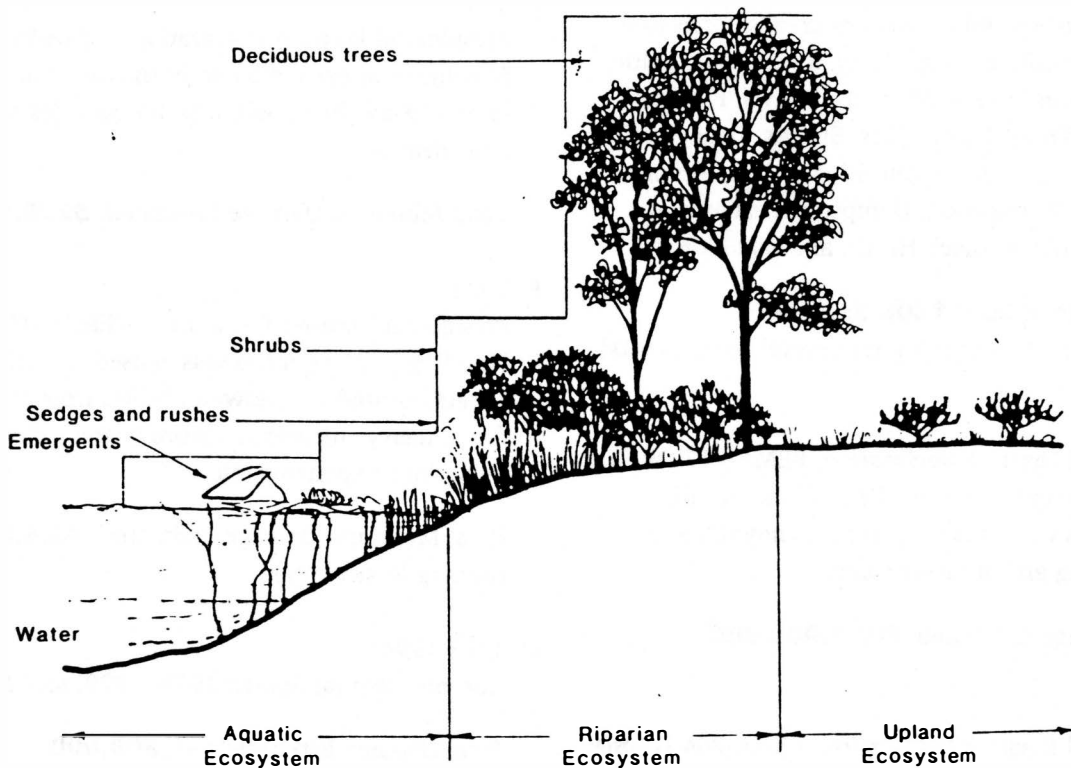
Table 2. Land use by stream class.

| | | Big Sioux Drainage (%) | Vermillion Drainage (%) |
|---------|---------|------------------------------|-------------------------------|
| Crop | Class 1 | 2 | 54 |
| | 2 | 32 | 39 |
| | 3 | 66 | 7 |
| Hayland | Class 1 | 19 | 43 |
| | 2 | 5 | 49 |
| | 3 | 76 | 8 |
| Pasture | Class 1 | T | 19 |
| | 2 | 28 | 67 |
| | 3 | 72 | 14 |
| Other | Class 1 | 0 | 72 |
| | 2 | 7 | 18 |
| | 3 | 93 | 10 |

will be inventoried to see if there are any correlations that may assist land managers in deciding what the potential of a site could be.

The project addresses the surface waters in the James, Vermillion, and Big Sioux watersheds within South Dakota. Moody County Conservation District is the principal sponsor with co-sponsorship from Codington, Hamlin, Minnehaha, McCook, Hanson, Davison, Turner, Beadle, Brookings, and Lake county conservation districts. Deuel, Grant, Gregory, Hand, Jerauld, and Miner counties joined the project in 1995 as part of the project extension. The project has been extended from October 1995 to October 1997. The project is a multi-funded effort which involves the Department of Environment and Natural Resources, Division of Conservation, Natural Resources Conservation Service, Environmental Protection Agency, Consolidated Farm Services, Cooperative Extension Service, Fish and Wildlife Service, Ducks Unlimited, local landowners, and other interested groups.

riparian classification system. Sites that appear to be functioning, functioning at risk, and nonfunctioning



Cross-section of a riparian area showing that the riparian area links the upland and aquatic ecosystems. (From Bureau of Land Management)

FEMA'S WATERSHED MANAGEMENT ACTIVITIES IN SOUTH DAKOTA

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I. South Dakota Flood Disasters, Fiscal Emphasis

A. 1878 through 1972

In Spring 1881, the town of Vermillion was floated away by a flood causing \$142,000 in damages. Vermillion was rebuilt on the bluffs behind the old town site to prevent a repeat occurrence. Rapid City experienced major flooding in 1878, 1883, 1907, 1920, 1952, 1962, and 1972. The 1972 flood killed 238 people, injured 3,057, and caused \$66 million in damages to Rapid City alone. During this same period major floods also struck the Big Sioux, Cheyenne, James, Grand, Moreau, Vermillion, Elm, and Maple rivers; miscellaneous creeks; cities and towns of Vermillion, Rapid City, Sioux Falls, Baltic, Brookings, Centerville, Montrose, Davis, Estelline, Flandreau, Trent, Dell Rapids, Sturgis, Deadwood, Egan, Canton, Yankton, Aurora, Mitchell, Renner, Watertown, Whitewood, Dempster, Castlewood, Huron, Aberdeen, Black Hawk, and Box Elder.

Total Minimum Cost: **\$208,252,200**
[fiscal information missing for several flood events]

B. 1984

Presidential Disaster Declaration, FEMA-717-DR-SD: Flooding along the James, Vermillion, and Big Sioux rivers was caused by record snowfall and heavy spring and summer rains.

Total Damage Estimated: **\$289,000,000**

C. 1986

Presidential Disaster Declaration, FEMA-764-DR-SD: Flooding in the Glacial Lakes region and along the Big Sioux River was caused by fall rains and heavy

winter storms (supersaturated ground and spring runoff).

Total Damage Estimated: **\$25,900,000**

D. 1992

Presidential Disaster Declaration, FEMA-948-DR-SD: Flooding was caused by heavy rains in June with accompanying tornadoes, nine counties affected.

Total Minimum Damage Estimated: **\$1,200,000**
[non-ag losses only]

E. 1993

Presidential Disaster Declaration, FEMA-999-DR-SD: Flooding was caused by early snowmelt and heavy rains in May, June, and July, 39 counties affected. Four deaths.

Total Minimum Damage Estimated: **\$228,000,000**

F. 1994

Presidential Disaster Declaration, FEMA-1031-DR-SD: Flooding in 21 counties was caused by residual supersaturated groundwater tables from the 1993 flood, heavy summer rainstorms, and groundwater rising into basements, etc.

Total Minimum Damage Estimated: **\$6,451,000**
[non-ag losses only]

G. 1973-1994

Non-presidential floods: 1976, 1979, and 1983.

Total Damage Estimated: **\$1,500,000**
[non-ag losses only — no fiscal data available for 1979 and 1983.]

II. FEMA Constraints/Concerns

H. Cycle of Destruction: Historically, disasters occur, people rebuild, disasters occur again, people rebuild again, in a never-ending cycle of damage-rebuild repeated damage. FEMA is charged with breaking this cycle and eliminating or permanently reducing the impact of natural disaster on the country.

I. Financial Resources: FEMA has only limited financial resources and budgets are being trimmed. As a nation we cannot count on unlimited assistance from the federal government.

J. National Flood Insurance Program: Increase participation by governments to enable citizens to participate. New changes will help improve insurance coverage in flood hazard areas.

K. Floodplain Ordinances/Restrictions: Improve the effectiveness and participation by local governments.

L. Acquisition & Buyouts: FEMA's preferred solution to flooded areas.

M. Local Responsibility: Breaking the cycle begins at the local level. FEMA emphasizes the formation of local hazard mitigation teams to organize the solutions to flood problems.

III. FEMA Actions, Coordinated through DEM

A. Pre-Disaster Planning/Training:

1. Local Emergency Management Offices
2. Local Emergency Planning Committees (LEPC)
3. Local Hazard Mitigation Teams
4. Disaster Exercises

B. Response:

1. Public Assistance process (only public property)
 - a. Preliminary Damage Assessment
 - b. Disaster Field Office
 - c. Inspection Teams

PA spent \$7,250,841.00 to date since 1986 (does not include local share).

2. Federal Response Plan Emergency Support Functions (ESF) Activation

C. Recovery:

1. Technical Assistance (floodplain, hydrology, engineering) [limited assistance when no Presidential Disaster Declaration is obtained]
2. Individual & Family Grant Program (IFG, only for individuals/families)
 - a. Inspection Teams
 - b. Only available with a Presidential Disaster Declaration of sufficient magnitude

IFG spent \$768,822 during 1993 (the only disaster which activated the program)

3. Hazard Mitigation Grant Program (HMGP)
 - a. Only for governments and certain private non-profit corporations
 - b. Can be used to help individuals
 - c. Only available with a Presidential Disaster Declaration

HMGP has allocated \$5,166,625 for flood mitigation projects since 1992.

D. Mitigation:

FEMA's emphasis on mitigation is to promote local hazard mitigation teams to identify and evaluate potential solutions to local flooding problems.

NONPOINT SOURCE CONTROL PROGRAM

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The South Dakota Nonpoint Source Control Program seeks to improve and maintain the water quality of South Dakota's rivers, lakes, wetlands, and groundwaters through the control of nonpoint sources of water pollutants. Nonpoint sources are those which contribute pollutants from dispersed areas such as land runoff or bank erosion.

Although the Department of Environment and Natural Resources (DENR) is the lead agency for nonpoint source control in South Dakota, the program is really a joint effort of a consortium of federal, state, and local agencies and groups. Efforts are coordinated through the South Dakota Nonpoint Source Task Force, which is an open membership group currently comprised of 32 agencies and interest groups.

The duties of the task force are:

- a) Provide a forum for the exchange of information on activities which impact nonpoint source pollution control.
- b) Prioritize waterbodies for nonpoint source control activities.
- c) Provide guidance and application procedures for funding of nonpoint source control projects and review and approve project funding proposals which request funds under sections 205 (j) or 319 of the Clean Water Act.
- d) Serve as the coordinating body for the review and direction of federal, state, and local governmental programs to assure that the programs allow achievement of nonpoint source pollution control in an efficient manner.

- e) Serve as a focal point for information, education, and public awareness regarding nonpoint source pollution control.
- f) Provide oversight of nonpoint source control activities and prioritize the activities.
- g) Provide a forum for discussion and resolution of program conflicts.

The interagency coordination fostered by the task force resulting in shared goals and resources is the primary reason that the South Dakota Nonpoint Source Control Program is one of the most successful in the nation.

The South Dakota Nonpoint Source Program achieves its water quality goals by implementing watershed-based projects through local sponsoring groups such as conservation districts and water development districts. All activities are nonregulatory. The program promotes voluntary participation by providing information and education, planning and technical assistance, and financial assistance.

The information and education needs are met through activities as diverse as holding water festivals across the state, hosting conferences such as this one, a television advertising campaign, and direct support to project sponsors. Activities are coordinated by the NPS I&E Coordinator who is employed by the Department of Agriculture.

Planning and technical assistance is provided by DENR, DOA, and NRCS. When DENR is contacted by a potential sponsor, we assign a project officer to work

directly with the sponsor to develop the project assessment, workplan, and funding applications. DENR has recently developed a planning manual, the "Citizen's Guide to Lake and Watershed Projects," and associated materials to further assist project sponsors with project development and management.

Funding for nonpoint source projects usually includes a mix of sources. A major source of funds are EPA 319 grant funds. They make funds available on a competitive basis with a 60% federal/40% nonfederal match ratio. Other funds in a project budget typically

include CFSA ACP, Consolidated Water Facility Construction funds, Conservation Commission grant funds, landowner cash, and in-kind services. These and many other funding sources are discussed in "The South Dakota Nonpoint Point Source Program Manual."

At any one time, the Nonpoint Source Control Program is involved in about 60 I&E, development, and implementation projects. Budgets for these projects total approximately \$20 million. These projects are summarized in the "South Dakota Nonpoint Source Program Annual Report."

STATE CONSERVATION COMMISSION GRANTS

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From Fiscal Year 1987 through FY 1992, the State Conservation Commission administered a small grant program for the State's 69 conservation districts. The program was funded with an annual appropriation of \$300,000 to \$350,000 from the state's general fund.

Many grant projects were completed during those years. However, the size of the grants severely limited the scope of the projects.

Meanwhile, the Conservation Commission, the South Dakota Association of Conservation Districts and the Soil Conservation Service formally agreed to develop a long range plan for direction of cooperative efforts in resource management. A committee of the prime sponsors completed the "South Dakota Coordinated Soil and Water Conservation Plan" in December 1991.

The Coordinated Plan was submitted to the Governor and the 1992 session of the Legislature. With the approval of the Governor, the Legislature also approved the plan by resolution.

One of the recommendations of the Coordinated Plan was an increase in state funding and in local funding. This funding, with all available federal funding, was needed to reach established goals by the year 2005. We were told by the Governor that he would support the identified need for increase of state grant funds from \$350,000 to \$1,500,000 per year if we could find a source of funding other than the state general fund.

A search for alternate funding zeroed in on the refundable taxes paid on gasoline used for off-road

purposes. It was discovered that refunds were not being requested on all that was eligible, and that perhaps as much as \$1.5 million might be available for use. However, it will probably be a declining fund as farmers switch more to diesel equipment.

We presented our proposal to the Governor and the Legislature. We used the argument that the source of nearly all of the tax was from agricultural off-road use of fuel. Since some of the money was not being returned, it should be at least committed to agricultural projects. Our grant fund would do that. The argument was accepted, and we were authorized to use \$850,000 of the fund in FY93. After that, we were authorized to use up to \$1.5 million, if the fund will produce that much.

With this change in appropriations and the fact the fund produces less than \$1.5 million, we do not have as much money for Commission grants as had been anticipated and have less than the need identified by the Coordinated Plan. But, there are still some positive things about the grant funding.

The Conservation Commission has approved 37 grant projects under the new system. These have averaged almost \$48,000 per grant. While this is not a large amount, the money has provided flexibility for significant accomplishments. First, the grants are large enough to be packaged with funding from other sources to increase the economic effectiveness of a project. These other sources include government agencies at the federal, state, and local levels. They also include private organizations—Ducks Unlimited is an example—as well as landowners, who usually provide a fair percentage of the cost.

Projections done by the conservation districts indicate that each dollar of grant funding approved to date will generate \$3.77 of other funds, so \$1,771,365 approved for grants by the Commission will generate \$8,454,499 of other funds.

A second advantage of the present grant system is flexibility of the Commission to direct funding to better quality projects. Each project competes with others for funding. The Commission can give extra weight to those projects which are based on better resource plans, particularly if they are holistic and address watershed areas.

The Commission initially adopted rules for grant administration under the present system in 1992. In

1994, it revised the rules with input from the districts and others. We hope these new rules will streamline operations for everyone.

There are some conditions which must be met if our grant program is to be most effective. The source of funding must remain viable, the appropriations must be made each year, and the conservation districts and other local sponsors must be able and willing to invest time and effort into planning and managing the projects. Another important factor is the availability of funding from the other sources. We will be very limited in our capabilities for resource management, if our only source of funding is the little grants program administered by the Conservation Commission.

RIVER SERVICES AND PROBLEMS FOR RIVER-SIDE COMMUNITIES

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Rivers in eastern South Dakota have had a long history of give-and-take relationships with the people who reside next to them. Before the Dakotas were settled, rivers gave Native Americans food, jewelry, and tools derived from organisms in the river. The power of the falls on the Big Sioux River gave some early settlers the idea that a townsite would prosper; we now know that site as South Dakota's largest city, Sioux Falls. The rivers have also done their share of taking. In 1957, the Big Sioux took parts of Sioux Falls during a flood. At Columbia, S.D., the James took away its water and went dry for a period of 623 consecutive days between July 13, 1958, and March 26, 1960.

To better understand municipal issues along the James, Vermillion, and Big Sioux rivers, engineers, city administrators, and other municipal staff from 27 towns provided information in interviews including demographics, water use, recreation, and problems associated with each river. Towns ranged from Westfield (pop. 160) to Sioux Falls (pop. 81,343) and from Rock Valley on the Rock River in Iowa to Jamestown on the James River in North Dakota. Surveyed towns use river water for homes, industry, sewage disposal, storm runoff disposal, and recreation. Of the 27 towns surveyed, only one indicated that its sewage treatment facility was substandard. Major problems included flooding, growth restriction, erosion, and low water.

River water was used for residences in 60% of the towns on the James, 7% on the Big Sioux, and 0% on the Vermillion. Forty percent of towns on the James used river water for industry, followed by 26%

on the Big Sioux and 0% on the Vermillion. Treated waste water and storm runoff were directed to the rivers in almost all cases. Recreational use by town dwellers was 100% on the James, 80% on the Big Sioux, and 57% on the Vermillion. A general opinion of those surveyed was that the rivers do not contribute substantially to the economies of the towns.

Survey respondents also identified several problems because of the rivers. Eighty-six percent of the towns on the Vermillion reported problems compared to 60% along the James and Big Sioux rivers. Flooding was the greatest concern. Localized solutions to flooding have been somewhat effective, but the ultimate solution includes watershed management.

Most spokespersons indicated that their towns have limited interaction with the rivers; however, some towns have made strides to improve this relationship. The city of Sioux Falls has been developing a greenway project, which limits building near the Big Sioux River and includes parks and trails along its banks. In addition, representatives of several cities indicated that they would like to improve public access to the rivers.

In conclusion, our survey shows that towns derive many services from the Big Sioux, James, and Vermillion rivers. The potential for increased recreational use may be an option too often overlooked. Municipalities need to continue healthy relationships with their river by maintaining acceptable waste treatment and planning expansion and development to avoid flood-prone areas.

WATER APPROPRIATIONS IN SOUTH DAKOTA

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South Dakota uses the "doctrine of prior appropriation" to determine water rights. This is "first in time, first in right," a slogan that symbolizes water appropriation in most western states. The first water rights law was enacted in 1881, and the doctrine became state law in 1907. In 1955, governmental reorganization gave a citizen's board authority to issue water rights, included groundwater, and established a procedure to claim vested water rights.

Water is the property of the people, who obtain the right to use water through appropriation by the Department of Environment and Natural Resources, Division of Water Rights. Domestic use takes preference over appropriative rights. Some examples of domestic use are drinking and sanitary use in house, livestock watering, and schools and recreation areas.

A person wanting a water right prepares an application including the amount, location, type of use, map of area, and application fee. Our staff prepares a report and recommendation and publishes a notice. If the proposal is uncontested, the application is approved in 2 to 3 months. If contested, a decision is made at a public Water Management Board hearing. Board decisions can be appealed to the Circuit and State Supreme courts. For an application to be approved, unappropriated water must be available. The applicant cannot impair existing rights. The water use has to be beneficial and in the public interest.

There are over 6,000 water rights in South Dakota. Irrigators hold 64%. Other rights are held by municipalities (16%), recreational interests (8%), industry and commerce (8%), fish and wildlife (2%), and other miscellaneous users (1%).

On the James River there are 137 rights for 288 cfs (cubic feet per second or 449 gallons per minute). The total is approaching the set limit of 300 cfs. Irrigation accounts for 220 cfs for use on about 18,000 acres. Municipal use is 51 cfs. About 29 cfs is diverted into Lake Mitchell and 2 cfs into Ravine Lake in Huron. Other uses account for 17 cfs, of which 12 cfs is for diversion to Lake Byron for lake stabilization.

On the Big Sioux, there are 67 rights for 126 cfs (plus 2,000 cfs for the Department of Game, Fish and Parks). Irrigation uses 81 cfs to irrigate 6,200 acres; municipalities use 31 cfs. Sioux Falls uses 17.8 to artificially recharge the aquifer. Northern States Power Company uses 11 cfs, John Morrell Company 2 cfs, Flandreau Indian School 1cfs. No limit has been set on appropriations on the Big Sioux.

On the Vermillion River, there are three water rights for 6 cfs. Two rights are for instream storage of water for the City of Centerville and for the Department of Game, Fish and Parks. The third is for irrigation of about 420 acres, and this permittee also uses groundwater. No limit has been set on appropriations on the Vermillion River.

The future of water rights appropriations depends on use. Irrigation appropriations are driven by climate and market; municipal appropriations by population growth. On the James, we may see decreased irrigation although the Garrison Project may affect the amount of irrigation. On the Big Sioux there will be increasing municipal use by Sioux Falls, but the availability of groundwater in the Big Sioux aquifer alleviates the need to use river water. On the Vermillion there will be little change because of the availability of groundwater.

BACKGROUND INFORMATION ON JAMES RIVER RESTORATION PROJECT

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Local, state, and federal interests have long viewed the James River as a vehicle to further enhance economic and environmental conditions for residents in the James River Valley and statewide. Since the late 1800s, these governmental entities have spent millions of dollars on studies, pilot projects, and infrastructure developments.

A fundamental obstacle preventing many of those studies from moving forward was the lack of broadbased support from diverse interests along the entire James River and statewide. Recognizing this deficiency, in 1984, the South Dakota Legislature in cooperation with local interests commissioned the Draft James River Restoration Project Environmental Impact Study to examine all alternatives. Simultaneously, the Legislature abolished the former Oahe and Lower James conservancy sub-districts and established the James River Water Development District to coordinate, evaluate, and develop a coordinated "length-of-the-river" approach to managing the James River.

The 1984 Legislature authorized the James River Improvement Program as part of the State Water Resources Management System. The program is a combination of projects along the James intended to provide flood control and municipal, industrial, agricultural, recreational, and wildlife benefits. Total cost for all projects in the program is \$75 million. Federal legislation (P.L. 99-662) was approved in 1986 authorizing \$20 million for flood control, stream flow improvements, and other features on the James as identified by the Secretary of the Army. A reconnaissance statement report was completed in September 1989. Individual components of the program have been actively pursued by local and state governmental entities.

Attempting to develop a plan that would be supported by all interested parties, the James River Water Development District (in 1987) held hearings at six locations along the James to obtain input into the selection of the appropriate James River Restoration Project plan. As a result, the District adopted a three-stage approach to river restoration: Stage I (limited channel cleanout), Stage II (tributary drainage control), and Stage III (bank stabilization).

Stage I, Limited Channel Cleanout

Stage I includes cleanout of the channel and flood plain area, improving recreational opportunities, and the protection or establishment of wildlife habitat areas. The components of Stage I include a coordinated, comprehensive length-of-the-river tree and debris removal program from the channel and flood plain area. The second component is sandbar removal in the southern portion of the James River. Eight sandbars have been identified for removal in the lower reaches of the river.

The third component of Stage I is dam modification, and four have been identified. They are the Third Street Dam in Huron, the Hilltown Dam south of Mitchell, the Wolf Creek Dam in Hutch-inson County, and the Izaack Walton Dam near Yankton.

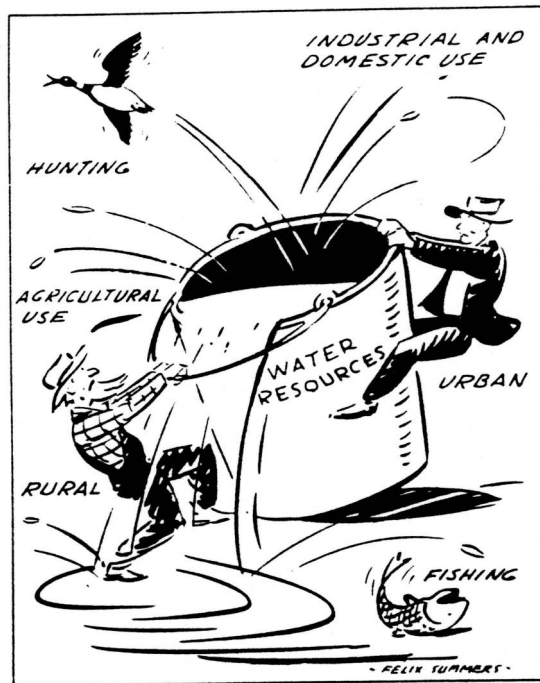
Stage I also includes the procurement of public access sites and the protection or establishment of critical wildlife habitat areas. Specific direction will be provided to implement fish pools to alleviate winterkill of fish and to tree planting for wildlife enhancement, land protection, and erosion control.

Stage II, Tributary Drainage Control

Stage II is a plan for drainage control on tributaries as such as the Elm and Maple Rivers and Dry Run Creek based on the interest displayed by landowners and residents. Specifically, Stage II is intended to provide flood control as well as municipal, industrial, agricultural, recreational, and wildlife benefits.

Stage III, Bank Stabilization

Stage III is a plan to reduce the bank degradation that is occurring along the James River near Yankton. Specifically, the bank stabilization program will assist local project sponsors in protecting valuable shore lines that are being eroded.



Let's get together or we'll all kick the bucket!

AW-191

Another "oldie" from Natural Resources Conservation Service ("old SCS") with a timeless message.

OTHER INFORMATION

A river belongs to no man. And it belongs to every man. And no man has any right to contribute to the desecration of a river by irresponsible and abusive acts, at the expense of his neighbors and fellow American citizens, near or far removed from the stream itself.

Richard J. Dorer
The Conservation Volunteer, Nov-Dec 1968

WORKSHOP ATTENDEES: OPINIONS AND RIVER USES

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Of the 106 workshop registrants, 60 volunteered to participate in a survey. The survey was designed to characterize attendees according to their 1) employment, 2) opinions about river health, and 3) personal uses of rivers. Each respondent was also asked by Tim Bjork at the beginning of the workshop to define four terms - watershed, watershed management, riparian zone, and ecosystem.

Employment Categories

Most people described their job as "conservation oriented," with about equal numbers (N = 11 to 17) of administrators, agronomists, biologists, hydrologists, and researchers. Most held jobs that required work in all three watersheds, but some focused on only one watershed (Figure 1a). Most participants also had other duties and spent only part of their time (mean = 30%) working on issues in the James, Vermillion, or Big Sioux watersheds (Figure 1b).

River Use

Of the 60 participants, 49 lived in one of the watersheds, and all used the rivers for recreation. Fishing was the most popular activity with over half of the group spending an average of 9 days per year fishing. Other popular activities were hunting, sightseeing, birdwatching, picnicking, canoeing, and camping. It is sometimes suggested that today's natural resource workers are less active participants in outdoors activities than workers of years ago (Regier 1994). However, attendees at our workshop appear to have an awareness and appreciation of the rivers and their resources and have used them.

There is little information about the value of South Dakota's rivers for recreation. About 45,000 resident anglers and 20,000 nonresident anglers fish in the state's rivers annually (USDI 1993). A 1970s study of recreation on the James River showed that the river was used for 31 different activities (Hansen 1981). Camping (about 600,000 hours annually) and fishing (140,000 hours annually) were the most popular activities from 1975 to 1979.

Opinions on River Health

Most workshop participants felt that the health of the James, Vermillion, and Big Sioux rivers was "fair." No one reported that river health was excellent, while seven felt river health was poor (Figure 2a). These opinions generally agree with data on how well South Dakota's rivers meet their designated uses (Keiry and Eidam 1991). Of the 3,965 miles of streams that have been designated as fishable or swimmable, about 30% fully support assigned uses, 26% do not support assigned uses, and 44% partially support assigned uses.

When asked to compare the role of tributaries in the watershed with that of the mainstem river, about half of the respondents felt that tributaries were more important. The remainder felt main rivers were more important. Research has shown that the length of small streams in a watershed greatly exceeds that of the main river (Leopold 1964), and some watershed managers have suggested that management should begin in the smaller streams (NRC 1992). Restoration or conservation projects in tributaries may be more successful than those on a mainstem, and the cumula-

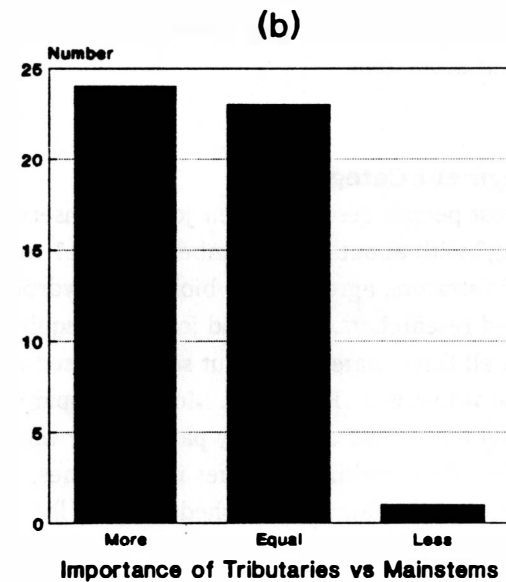
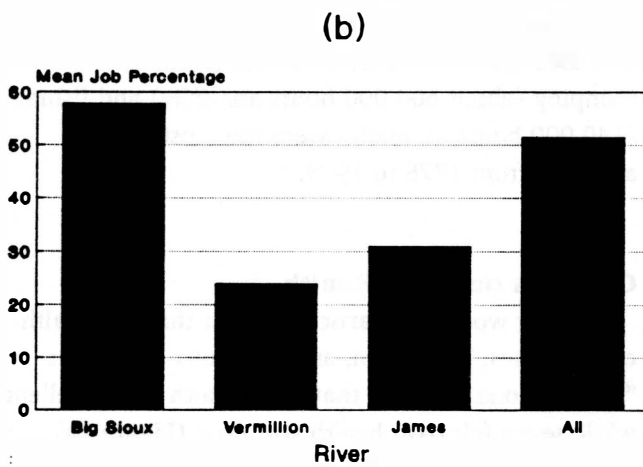
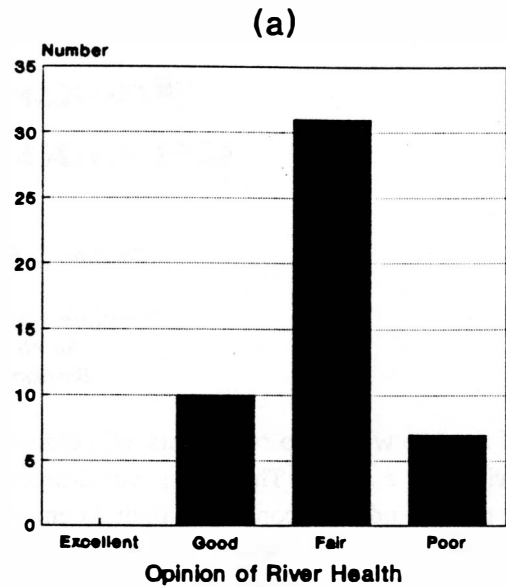
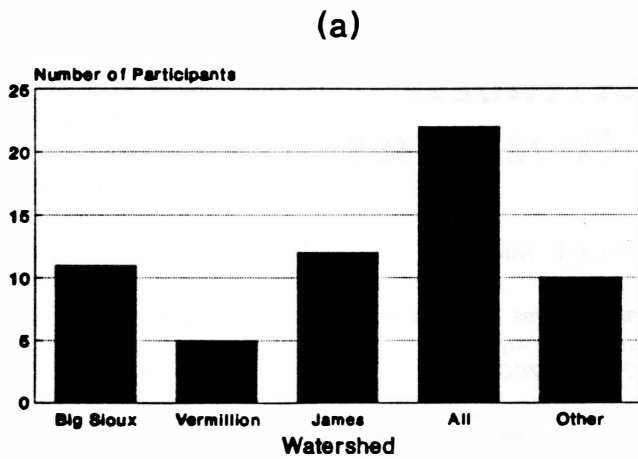


Fig 1. Survey results showing (a) number of participants from each watershed and (b) percentage of their job related to each river.

Fig 2. (a) Opinion of river health by survey participants and (b) their ratings of the importance of tributaries and mainstem reaches.

tive impacts of projects in the headwaters would benefit downstream river reaches. However, sites on mainstem reaches that are affected by local conditions may be improved by a specific land treatment or by a combination of treatments.

Current and Future Issues

Survey respondents listed 44 contemporary issues that they felt were influencing the three watersheds (Table 1). The length of the list is an indication of the complexity inherent in a watershed management program. Issues most commonly listed were agri-

culture waste management, erosion, flood control, pesticides, non-point source pollution, riparian zone management, water quality, and siltation.

When asked to speculate about issues that future watershed managers would face, the respondents listed a variety of issues such as climate change, coordi-

Table 1. Potential current and future concerns in the management of watersheds in eastern South Dakota as listed by workshop participants.

| Concern | Current | Future | Concern | Current | Future |
|---|---------|--------|--|---------|--------|
| Ag waste management | X | X | Habitat loss | X | |
| Biodiversity, fish, wildlife | X | X | Hard engineering approaches to watershed problems (e.g., dams, riprap) | X | X |
| Channelization, snag removal | X | X | Herbicides/pesticides | X | X |
| City storm sewer | X | | Instream flow, water quantity | X | X |
| Climate change | X | | Lack of data for many disciplines | X | |
| Conservation regulation | X | X | Non-point source pollution | X | X |
| Cooperation/coordination | | X | Non-structural solutions to flood/drought impacts on human habitation | | X |
| Cropland management | X | X | NPDES permitting approach | | X |
| CRP program reductions | | X | Pathogens (water-born) | X | X |
| Drinking water | | X | Point source pollution | | X |
| Economics/stabilized economics | | X | Plant communities | X | X |
| Ecosystem planning | | X | Project implementation, funding | X | X |
| Education programs, resource awareness | X | X | Recreation/aesthetics | X | X |
| Environment health, resource conservation | | X | Riparian zone management | X | X |
| Environmental restoration | X | X | Streambank stabilization | | X |
| Erosion, siltation | X | X | Technical assistance, lack of | X | |
| Flooding/flood management, mitigation | X | X | Urban expansion, runoff | X | X |
| Floodplain encroachment | X | | Water appropriations, quantity | X | X |
| Garbage | X | | Water quality | X | X |
| Geomorphology in stream management | | X | Watershed Management | X | |
| Good crops, sustainable production | X | X | Wetland drainage | X | X |
| Grazing/rangeland management | X | X | | | |
| Groundwater quality | X | X | | | |

nation, conservation reserve reductions, drinking water, stabilized economics, ecosystem planning, education programs, impacts to humans of nonstructural solutions to floods, and sustainable production.

Definitions Offered

All definitions of the four terms provided by participants are in Appendix A. The following are syntheses of participant responses.

What is a **watershed**? A textbook definition is “the entire surface drainage area that contributes water to a lake or river” (NRC 1992). Another textbook definition is “a topographically delineated area

that is drained by a stream system, that is, the total land area above some point on a stream or river that drains past that point” (Brooks *et al* 1991). Some authors use the word “catchment” as synonymous with watershed (Gordon *et al* 1993).

Survey respondents offered 38 definitions of a watershed, but most definitions generally agreed with the textbook definition (Appendix A). Seventeen definitions specifically mentioned a “point” or “destination” as an important part of the definition of a watershed.

What is **watershed management**? An encompassing definition provided by Brooks *et al* (1991) is “the process of guiding and organizing land and other

Table 2. Summary of recreational uses of eastern South Dakota rivers by workshop participants. Sample size is 49. Only activities listed by at least 5% of the participants are given.

| Activity | Number of Participants | Number of Days/Year | |
|------------------------------|------------------------|---------------------|--------|
| | | Mean | Median |
| Camping | 3 | 6.0 | 2.0 |
| Canoeing/boating | 13 | 6.8 | 5.0 |
| Fishing | 25 | 9.1 | 5.0 |
| Hunting | 12 | 12.0 | 5.5 |
| Picnicking | 4 | 8.0 | 4.0 |
| Sightseeing/ birdwatching | 11 | 13.5 | 10.0 |

resource use on a watershed to provide desired goods and services without affecting adversely soil and water resources." They state that this concept recognizes linkages between upland and downstream areas. Many of the 34 definitions provided by survey participants (Appendix A) convey the concepts of minimizing effects of humans on soil and water resources and of recognizing the links between terrestrial and aquatic resources.

What is a **riparian zone**? A dictionary definition is "relating to the bank of a stream or lake." Some authors add points about a special plant community, the duration of flooding, or introduce the idea that riparian zones are "an interface between terrestrial and aquatic systems" (Gregory *et al* 1991).

Workshop attendees offered 37 definitions for the riparian zone (Appendix A). Most definitions agreed with the "textbook" definition of these "green strips that are located adjacent to streams and rivers" (as one respondent wrote). However, some definitions strayed from the accepted, and only four respondents assigned any function to the riparian zone. Respondents mentioned functional attributes using words like filter, buffer, influences, and processes.

What is an **ecosystem**? A simple textbook definition is "living organisms and their nonliving environ-

ment" (Odum 1971). A more complex definition brings in the idea that there is interaction between the environment and the organisms: "Any unit that includes all of the organisms in a given area interacting with the physical environment so that a flow of energy leads to clearly defined trophic structure, biotic diversity, and material cycles" (Odum 1971). Brooks *et al* (1991) say that the watershed is a hydrologic unit often used as a physical-biological unit (i.e., ecosystem) and a socio-economic-political unit for the planning and management of natural resources.

Most survey respondents adequately defined an ecosystem by including the biotic, abiotic, and interaction ideas in their definitions (Appendix A). Some emphasized the biota more than the environment, and vice versa. Many specifically included humans and human activity as a component of an ecosystem, which is certainly appropriate. Experts say that the goal of ecosystem management is to manage the simultaneous sustainability of both the social and natural environments (Pastor 1995). This goal was espoused by Vice President Al Gore in the forward for his book *Earth in the Balance* which he wrote while staying in Sioux Falls in 1992. He wrote "By overwhelming majorities, the American people reject the argument...that we must choose between jobs and the environment. Instead, they believe that we can prosper by leading the environmental revolution and producing for the world marketplace the new products and technologies that foster economic progress without environmental destruction."

Conclusion

Workshop participants had a diversity of background and disciplinary associations. This diversity is reflected in the number of current and future issues that were identified at the workshop. Although the group was diverse, the definitions of four key watershed terms had similarities, which suggest that watershed-based concepts are by no means foreign to the majority of participants. This is encouraging since agreeing on concept definitions is one of the first steps in problem solving and cooperation. Also encouraging is the possibility that many problems with the condition of the soil and water (e.g., erosion, siltation,

runoff, chemical contaminants, biodiversity) can be solved simultaneously by directly addressing land use concerns (e.g., sustainable agricultural, ag waste management, grazing management, riparian management).

If the main objective of agroecosystem managers is maximum productivity with a minimum of external inputs (Campbell *et al* 1990), then managers must understand how physical, chemical, and biological processes govern the flow of energy and material resources from one area to another. Certainly, valuable material resources are soil and water, which are part of many processes. Excessive soil erosion depletes land productivity and results in incorporation of less fertile soils into the plow layer, which may induce farmers to increase inputs of fertilizers. Subsequently, surface waters become degraded due to siltation, chemicals, and nutrients (Campbell *et al* 1990).

Soil erosion is usually coupled with lack of infiltration and substantial increases in surface runoff. As a result, areas lower in the drainage system suffer from increased flooding and decreased channel stability. These symptoms are commonly addressed with symptomatic approaches in the form of dikes, channelization, and rip-rap which require energy and material inputs. Relieving symptoms such as flooding may further exacerbate downstream problems. Eventually there is a breakdown in the sustainability of the agroecosystem, and there is a long-term decline in productivity in spite of increased energy inputs.

In eastern South Dakota, the long-term sustainability of agriculture is linked to long-term social, economic, and environmental concerns posed by workshop participants. Perhaps an ecosystem approach to watershed management is the solution. However, management must be flexible so that use of land fosters rather than compromises the long-term well-being of South Dakotans. The concern and willingness are present, but goals and strategies must be developed.

Literature Cited

- Brooks, K.N., P. Folliott, H. Gregersen, and J. Thames. 1991. Hydrology and the management of watersheds. Iowa State University Press, Ames.
- Campbell, C.L., W. Heck, and T. Moser. 1990. Indicator strategy for agroecosystems. Pages 1-11 of Section 8 in (C.T. Hunsacker and D.E. Carpenter, eds) Environmental Monitoring and Assessment Program: Ecological Indicators. United States Environmental Protection Agency Report EPA/600/3-90/060, Research Triangle Park, North Carolina.
- Campbell, C.L., W. Heck, T. Moser, R.P. Breckenridge, G. Hess, and J.R. Meyer. 1990. Indicator fact sheets for agroecosystems. Pages 1-23 of Appendix F in (C.T. Hunsacker and D.E. Carpenter, eds) Environmental Monitoring and Assessment Program: Ecological Indicators. United States Environmental Protection Agency Report EPA/600/3-90/060, Research Triangle Park, North Carolina.
- Gordon, N.D., T. McMahon, and B. Finlayson. 1993. Stream hydrology: an introduction for ecologists. John Wiley and Sons., New York.
- Gore, A. 1992. Earth in the balance. Houghton Mifflin Co, New York.
- Gregory, S.V., F.J. Swanson, W.A. McKee, and K.W. Cummins. 1991. An ecosystem perspective of riparian zones. *BioScience* 41:540-551.
- Keiry, W., and O. Eidam. 1991. Coordinated Soil and Water conservation Plan. SD Assn of Conservation Districts.
- Hansen, D. R. 1981. angler and other recreational uses of the James River, South Dakota 1975-1979. South Dakota Department of Game, Fish and Parks Final Report 81-6, Pierre.
- Leopold, L. B. 1964. Fluvial processes in geomorphology. Freeman, San Francisco.
- National Research Council. 1992. Restoration of Aquatic Ecosystems. National Academy press, Washington, D. C.
- Odum, EP. 1971. Fundamentals of Ecology. W. B. Saunders Company. Philadelphia.
- Pastor, J. 1995. Ecosystem management, ecological risk, and public policy. *BioScience* 45:286-288.
- Reiger, G. 1994. A blessing in disguise. *Field and Stream*. September:12,14.
- USDI (United States Department of the Interior). 1993. 1991 National Survey of Hunting and Fishing and wildlife associated recreation: South Dakota. U. S. Government Printing Office, Washington, D. C.

SELECTED SOUTH DAKOTA WATER RESOURCES EDUCATION RESOURCES

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State Education Resources

Coordinator, 220 North 7th Street, Spearfish, SD
57501, 605-642-9902.

Environment Education Connections of South

Dakota (EECSD). The state organization for teachers and natural resource agency persons interested in environmental education. Contact: Maggie Hachmeister, EECSD Chair, 3305 W. South Street, Rapid City, SD 57702, 605-394-2391.

Wetland Ecology Program. The South Dakota Discovery Center sponsors a program that takes students on a day-long trip to explore wetland ecology with water test kits and plankton nets. Contact: Terry Lewis, Education Director, SD Discovery Center & Aquarium, Pierre, SD 57501, 605-224-8295.

Aquatic Project WILD. An excellent activity guide for teachers and resource agency persons. To obtain a copy, you must attend a 6-hour Project WILD workshop. Contact: Steve Kirsch, Education Services Coordinator, Department of Game, Fish and Parks, 523 East Capitol, Pierre, SD 57501, 605-773-5511.

Prairie Watersheds. A thematic unit and traveling resource box for 7-12 grades. Provides hands-on activities for understanding the watershed concept. Contact: Dr. Gary Peterson, Department of Biology and Microbiology, Box 2207B, Ag. Hall 304, South Dakota State University, Brookings, SD 57007, 605-688-6141.

Project WET. This is a water resources activity guide for grades K-12. This curriculum is new to South Dakota in 1995. Contact: Clark Haberman, Project SAVE Coordinator, Department of Environment and Natural Resources, 523 East Capitol, Pierre, SD 57501, 605-773-6761.

Non-point Source Information and Education Program. Videos, interactive kiosks, storm drain stencils ("do not dump - drains to stream"), and other resources are available. Contact: Roy Richardson, NPS I&E Coordinator, 605-773-5276.

Project SAVE. A home-grown program for K-8 grades that includes a binder with activities on water quality, solid waste, and air quality. Contact: Clark Haberman, Project SAVE Coordinator, Department of Environment and Natural Resources, 523 East Capitol, Pierre, SD 57501, 605-773-6761.

RIVERQUEST. A program in which schools along the Big Sioux utilize the river as a learning resource in environmental studies, math, science, language arts, art, and social studies. Contact: Dr. Steve VanBockern, Augustana College, 29th and Summit, Sioux Falls, SD 57197, 605-336-4620.

Greenworks! In 1994, the South Dakota Project Learning Tree received a grant to seed environmental service projects. Projects can range from adopting a stream or wetland, tree plantings, or coordinating a community collections program for batteries or motor oil. Contact: Beth Broyles, SD PLT

Northern State University CUEST Center is the South Dakota state dissemination site for EPA materials. Write for a 28-page list of educational materials for citizen groups and educators. CUEST, NSU, Aberdeen, SD 57401, 605-622-2527.

National Education Resources

EE-Link. EE-Link is an online source of information about environmental education (EE). It provides teaching resources including full-text instructional materials, articles, catalogs, and grant information. Contact: National Consortium for EE and Training, School of Natural Resources and Environment, Ann Arbor, MI 48109-1115, 313-998-6726. e-mail nceet-info@nceet.snre.umich.edu.

Free Aquatic Education Resources. Includes posters such as "The River Environment" and "Wetlands are Wonderlands," a curriculum entitled "Groundwater: A Vital Resource," and booklets such as "Homemade Aquatic Sampling Equipment" and "Septic Systems." Maximum order is 100. For a complete list of resources, contact: Water Management Library, Tennessee Valley Authority, Haney Building 2C, 1101 Market Street, Chattanooga, TN 27402-2801, 615-751-7338.

Educating Young People about Water: A Guide to Goals and Resources. 1992 (updated appendix included). Contact: Elaine Andrews, University of Wisconsin-Madison, Environmental Resources Center, 216 Agriculture Hall, 1450 Linden Drive, Madison, WI 53706. FAX: 608-262-2031.

Field Manual for Water Quality Monitoring: An Environmental Education Program for Schools by William Stapp. Thomson-Shore Printers, 7300 Joy Road, Dexter, MI, 48130.

Wow! The Wonders of Wetlands. 1991. An educator's guide to providing activities to help K-12 kids understand wetlands, the wetland community, and wetland issues. Contact: Environmental Concerns, Inc., P.O. Box P, Education Department, St. Michaels, MD 21663, 301-745-9620.

Lake Game for Adults. Lake Game for Youth. A game that visually illustrates how individual

actions can pollute a lake. Minnesota Sea Grant Program, Minnesota University, Minneapolis, MN 55414, 612-625-9790.

National Directory of Citizen Volunteer Environmental Monitoring Programs. EPA 503/9-90-004. Contact: Your EPA Regional Office.

Save Our Streams. A Citizen Action Program. Ask for a "Save Our Streams Kit" and "Wetlands Watch Kit." Contact: Izaak Walton League of America, 1401 Wilson Blvd., Level B, Arlington, Virginia, 22209, 703-528-1818.

Promoting Environmental Education: An Action Handbook for State and Local Communities. 1995. This book discusses how to organize state and local EE initiatives. The community of Custer, S.D., is one of the case histories highlighted in the book. Contact: NACD Service Center, P.O. Box 855, League City, TX, 77574-0855.

Terrene Institute. A non-profit organization specializing in environmental education and public outreach. Produces material for government and industry. Write for catalogue, especially good is their publication "Clean Water in Your Watershed: A Citizen's Guide to Watershed Protection" (\$19.95). Also publish *NPS-News Notes*, a free publication dealing with watershed restoration. Terrene Institute, 1717 K Street, N.W., Suite 801, Washington, D.C. 20006, 202-833-8317.

The Water Quality Catalog-A source book for public information materials. Contact: Water Environment Federation, 601 Wythe Street, Alexandria, VA 22314, 703-684-2400.

National Nonpoint Source Federation. Created as a watershed information network for watershed issues. Ask for their *Runoff Report-Watershed Information Network News*. Contact NNPSF, Box 30103, Kansas City, MO 64112, 800-795-3634.

SELECTED INFORMATION SOURCES FOR WATERSHED-RELATED MANAGEMENT

Doppelt, R., M. Scurlock, C. Frissell, and J. Karr. 1993. *Entering the Watershed* (a comprehensive new approach to river protection). 504 pages. Island Press. ISBN 1-55963-275-5. Paperback \$27.50.

A community- and ecosystem-based watershed restoration initiative founded upon principles of watershed dynamics, ecosystem function, and conservation biology.

Hesse, L., C. Stalnaker, N. Benson, and J. Zuboy, editors. 1993. *Proceedings of the Symposium on Restoration Planning for the Rivers of the Mississippi River Ecosystem*. National Biological Service, Biological Report 19. Free from Publications Unit, U.S. Fish and Wildlife Service, 1849 C Street, N.W. Mail Stop 130, Webb Building, Washington, D.C. 20240.

Nontechnical reports on 22 rivers in the Mississippi River watershed. Authors review the status of the habitat and biota. Included are overviews of the Vermillion, James, and Cheyenne rivers of South Dakota, as well as much information about the Missouri River.

LeMaster, D.C., and G.R. Parker, editors. 1991. *Ecosystem Management in a Dynamic Society*. Proceedings of a Conference in West Lafayette, Indiana. Department of Forestry and Natural Resources, Purdue University.

These proceedings provide examples and critiques of ecosystem management, and chal-

lenges to ecosystem management. Midwest forest ecosystems provide the context.

National Research Council. 1992. *Restoration of Aquatic Ecosystems*. National Academy press, Washington, D. C.

This is a report on the status and function of surface water ecosystems; restoration efforts and associated technologies; and the research, policy, and institutional reorganization needed for national aquatic ecosystem restoration.

SD Department of Agriculture. 1991. *South Dakota Coordinated Soil and Water Conservation Plan*. Division of Resource Conservation and Forestry. 523 East Capitol, Pierre, South Dakota.

A plan adopted by State Legislature in 1992 has many facts about South Dakota water resources, problems, and recommended actions.

United States General Accounting Office. 1994. *Ecosystem management: additional actions needed to adequately test a promising approach*. GAO/RCED-94-111.

This report describes ecosystem management, actions needed for implementation, and barriers to implementing ecosystem management.

*For in the end, we will conserve only what we love, we will love only what we understand,
we will understand only what we are taught.*

Baba Dioum
Central African Conservationist

Appendix A. Responses to Workshop Terminology Questions

Watershed (definitions of survey participants)

An area which contributes water to a common point, the boundaries of which are defined by hydrology and one's objectives.

The land area impacting the water under concern.

A geographical area defined by drainage, typically named after the major stream or waterbody. The real need is for clear and appropriate "terms" for the component parts of watersheds.

An area of drainage that passes through a common point.

It is the entire ecosystem that contributes water to a river or stream.

A watershed is all land within an area where all "rain-drops" have the same destination.

The watershed is that area in which all water, both surface and groundwater, flow together and are released at a focal point (usually stream or river mouth). Size can vary.

Any, all, or parts of a drainage basin depending on the specific watershed. It not only deals with the stream/river itself but the land that drains into it.

A watershed to me is the whole basin that forms from the headwaters of the major stream to the point it enters a large body of water. The Big Sioux River is a prime example: from the headwaters in northeastern South Dakota to the confluence with the Missouri River. It includes all feeder streams, riparian areas, and upland land found in that basin.

The land base that contributes runoff to a hydrologic entity.

Acres of cropland, rangeland, and creeks and drainage. These areas eventually are responsible for what ends up in our tributaries, creeks, and then our lakes and rivers.

The drainage area which reaches a given point.

All the land that drains to a particular place.

An area that produces runoff to a water course.

An area with discrete boundaries that constrain the direction of water and sediment to one natural outlet.

Area that sends surface runoff and subsurface water to a certain point.

An area which contributes to a stream or lake.

Water movement over land to a possible common point.

An area that contains an outlet that drains water, sediments, and nutrients into a larger body of water. It can be affected by all people, and animals within that area.

Area of land that gathers water and puts to a central point at a lower elevation.

Area of land that affects a particular body of water, i.e., tributaries, headwaters, pastures, crop fields, etc.

A drainage area.

The area above (upstream) and around a stream, creek or other water bodies.

Area of land which water is geographically confined to drain into a single lake, stream, or river. Watersheds vary in size.

An area that produces runoff water to a specific point, or concentrates runoff water to a smaller area.

The landmass or contributing area of a river.

Includes all the area that drains to a specified point.

A 3-dimensional area including a river, all its tributaries, drainages, all the water and land above and below ground that drains into the rivers. Could also include the air, flora, and fauna. This definition should also apply to lakes and maybe even aquifers. A watershed is a type of ecosystem.

Easy in a closed system such as a lake. Watershed is lowest gathering point for water, along with land area and associated water courses draining into that low point along with associated groundwater systems. Less simple for open systems such as riverine - these are more a matter of how large an area one wants to deal with - could say every water course draining into the point on the river above your arbitrary stopping point, along with the land area drained by these water courses and associated groundwater system.

The geographic area that is hydraulically connected to a river or stream.

They are geographic areas that contain several natural processes, i.e., sedimentation, flooding, evapo-transpiration, that will ultimately drain into much larger water bodies. These areas, in addition, act as filtering areas, filtering sediments, and various pollutants.

My definition is: any drainage area with common problems and of a size compatible with holistic treatment.

Area of drainage defined by topography. The area of land contributing to the flow of the body in question. That area of land that drains to a given point. A unit of landscape which all drains into a single creek, stream, or river. Hydrologically, a watershed is defined as the area contributing surface water to a specified point in a system. Is the area of the surface in which water flows. From the very highest elevation flowing down hill (and standing bodies) to the oceans.

Watershed Management (definitions of survey participants)

A suite of management practices used for the purpose of sustaining the physical, chemical, and biological integrity of the cultural and natural resources within a watershed.

Consideration by all landowners and operations of the impacts of their management decisions.

Who knows?

Planning with water resources and goals in mind.

It is the entire management (water control, water quality, erosion control, livestock management, cropland, wildlife, etc.) within the macrocommunity of the watershed. It includes all tributaries and associated uplands within the watershed.

Some type of objective that may look at a single goal or several goals, watershed management may be no "management" at all. No management is still management.

Watershed management is managing at a watershed level. This constitutes managing all biotic and abiotic factors in such a way as to maintain stability and ecological integrity, again in a state of dynamic equilibrium.

A comprehensive approach in managing watersheds, looking at the whole and determining the direction to go.

Total management of everything within that watershed basin, from farming practices on the upland to instream management to enhance fisheries populations.

Practices undertaken to affect the runoff of a hydrologic entity.

To Implement BMPs. To improve lakes and rivers water quality. To encourage people to improve habitats around rivers and lakes for cleaner water. Educate the public on what a watershed does.

An attempt to minimize the negative impact of human activities.

It is the proper use of a drainage area to make sure that all uses (ecological, physical, quality, etc.) are improved or sustained.

Management of ecosystem components in a collective, cooperative manner so that these systems operate functionally to provide the long-term benefits required for future generation to come.

Manage natural resources in a watershed to maintain or develop the desired use of the watershed resources.

Managing those things which contribute to a stream or lake.

To work toward sustainable physical, biological, and economic stability of a complete drainage basin.

A coordinated effort among all parties involved for betterment/sustenance of environmentally beneficial practices.

Managing all resources in a watershed, so there is a minimal effect on all living and non-living things in a watershed.

Practices for protecting condition of river or lake by managing the whole watershed.

The use of land and water in an area.

A holistic plan for everything that affects the water quality such as animal waste, no till, minimum till, buffer strips, etc.

Practices implemented to cause a positive impact on the entire area and ecosystem.

The utilization of land and water resources within a watershed for the sustainability of those who depend upon it for survival. Proper use of soil and water resources throughout the drainage area. Managing all the above (plant, animal, earth, air and human) in a watershed for the purposes decided on by consensus.

Attempts on the part of human beings to control and/or understand, then control a watershed as an ecosystem.

Managing the resources (SWAPA) within the watershed to meet the goals and objectives of the stakeholders.

Watershed management is management that is designed to provide benefits for all aspects of the area it encompasses. Management should limit soil erosion, provide stable stream banks, provide vegetation that will benefit stream bank stabilization, contain and control pollutants, and provide for a multiple of uses by both land users, owners and dwellers.

It is holistic management of a watershed which will allow sustainable levels of production to meet the economic and other needs of people.

Managing the watershed in a way that takes in all social, environmental, and economic factors to ensure the quality of the watershed.

The process of managing and maintaining healthy interactions between man and land.

Wise, sustained use of a watershed according to a set of pre-determined goals and principles.

Management is difficult to define. The best way to describe it is an attempt to control the reaction of the watershed. Another definition might be maintaining the integrity of the watershed.

Riparian Zone (definitions of survey participants)

An area bordering a water body on the landscape with abiotic and biotic characteristics which are transitional between upland and lowland habitats.

A buffer zone impacted by, and impacting, open water drainages.

This one is just like wetland definitions with all the same controversy stemming from an all-encompassing ecological definition vs. any regulatory definition.

The transition zone between upland and aquatic areas.

It is the immediate upland area adjoining a river or stream. The riparian area is usually a permanent cover type that may vary in width and that is nominally protected from agricultural practices and other developments.

Riparian area is the zone between water and upland.

A riparian zone is the portion of land immediately adjacent to the stream.

The area between the terrestrial and aquatic zones. It is in the active floodplain and has great diversity in slope, plant life, animal life, etc.

I interpret this as the area from the water's edge to established successional terrestrial vegetation, i.e., trees.

That transition zone between water areas and upland areas.

An area which is adjacent to water - streams, creeks, rivers, that carry our waters through the state.

The floodplain which is affected by the water/water table of a river/water body.

That area along a stream which are (or would be) occupied by hydrophytic plants.

It is the ecosystem that is associated and located near a water body.

Streamside vegetation zone where the river or stream interact on a regular basis.

Area between a surface water area and land that is usually free of surface water. This area is subject to intermittent flooding.

An area adjacent to a stream (50') or lake.

Zone of natural or restored permanent vegetation in active floodplain area. But what about this zone that doesn't have permanent vegetation?

It is the lush green area of natural vegetation at the edge of a stream that filters everything entering the water, and securing the banks of the given stream/river.

Area of land in which soils and vegetation are a product of what they receive from surrounding uplands.

Stream and adjacent area that is affected by stream, or will influence stream conditions.

It's a relationship between use practices and the environment.

The land bordering a body of water (creek, stream, etc.).

Area along a body of water which is affected by that water.

An area of land with perennial vegetative growth which is adjacent to a water body. The specific purpose is to treat runoff water before it enters the water body.

The upland area (corridor) immediately adjacent to a stream.

The area near a stream that is influenced by the water table.

Ecotone or area of tension affected by flooding - between stream at lowest point and definite upland (not flooded). Can see vegetation zones and these are dynamic in composition.

The physical and biological components associated with a stream or river.

Riparian in simple terms are the green strips that are located adjacent to streams and rivers. They are very

important components to both the entire watershed they are in and the ecosystems that are contained within.

It is that area adjacent to any water body or stream that receives more than normal moisture through runoff from surrounding areas.

Area along the drainage that has vegetation different from its surrounding area due to increased water. A boundary zone between rivers and land.

The zone of influence that is affected by the additional moisture that results from adjacent or adjoining upland, and related aquatic area if present.

A streamside ecosystem with organisms dependent on streamside processes such as flooding, high water table, etc.

The definition depends on the discipline. I would define it in terms of the one 100-year flood event, or the extent of characteristic riparian vegetation.

A riparian area is an environment that is related to water bodies: creeks, rivers, streams, ponds, lakes, waterland, and oceans. For plant and animal alike.

Ecosystem (definitions by survey participants)

An integrated system formed by the interaction of organisms (including humans) with their abiotic and biotic environment.

Def. 1-the earth and incoming sunlight. Def. 2-much more limited.

Like the term "economy," ecosystem is a multiscale word to describe an association of living organisms and their physical environment and their interrelationships.

The interaction of all physical, environmental, and sociological parameters in a given system.

It is the interaction of all species within a community - which can be either micro-communities or macro-communities.

Ecosystem is an area with similar biota or plant and animal life relating to their environment.

An ecosystem is an unspecified unit of area where all the biotic and abiotic factors interact in such a way as to maintain a level of stability, sometimes fluctuating in dynamic equilibrium.

An ecosystem is a system and the relationships that the components of the system have with each other.

Ecosystem includes all biota found in your area of interest.

The entire assemblage of biomass of a particular unit.

A complete cross section of our environment, wildlife, habitat, and all things that make up our lands.

All the plants and animals and microorganisms in an area. All the environmental factors in an area and all the relationships between all of these things. An ecosystem is more than the sum of its parts.

It is the interactive system of soil, water, plants, air, and animals within an area.

All biotic and abiotic components and their interactions within a watershed area.

Interaction of all biological species in a particular area.

A water system with a broad spectrum of animals.

Interaction of soil, water, air, plants, animals and the human factor with some economic influence.

An area that involves interactions among/between all living and nonliving things affecting each other.

All organisms and surroundings in harmony with the environment.

Area that encompasses all biological flora and fauna (and people), and is influenced by or influences external biological/environmental factors.

The biological activity in an area.

It encompasses everything in nature as it works together.

The entire relationship between plants, animals, air, water, and soil.

The physical and living resources in a natural setting, and interaction of these resources to maintain sustainability.

The combination of physical and biological elements throughout a watershed.

The entire area that exists considering plant, animals, earth, air and human factors.

Could be anything you or I are willing to work with as small as a closed petri dish containing living organisms or as large as the earth within the solar system. I think that the main defining characteristics are that the living and non-living components of any given ecosystem are interconnected and that change in one component eventually resonates to other components of the system.

The interrelated physical and biological processes that define the environmental functioning of a system or area of interest.

Ecosystems are defined by their unique characteristics and compositions. A watershed along with the actual riparian area with their individual components would make up what is referred to an ecosystem. It's an area that contains many processes, functions, and provides a multitude of benefits to society as a whole.

It is a system of living organisms, including crops and livestock, that is capable of being managed for sustained production at an economic level, where economics must be an important consideration.

Ecosystem is all the organisms and their environment.

A web consisting of all living things in a system, both plant and animal.

All the physical, cultural, and biological factors that influence a system in natural function.

A unit of nature including organisms and the physical environment which exchange matter and energy.

What is not an ecosystem? Might be an easier question to answer.

Appendix B. Workshop Attendees

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Another "oldie" with a current
message from Natural
Resources Conservation Service.

STOPPING A BARREL OF TROUBLE

AW-200

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