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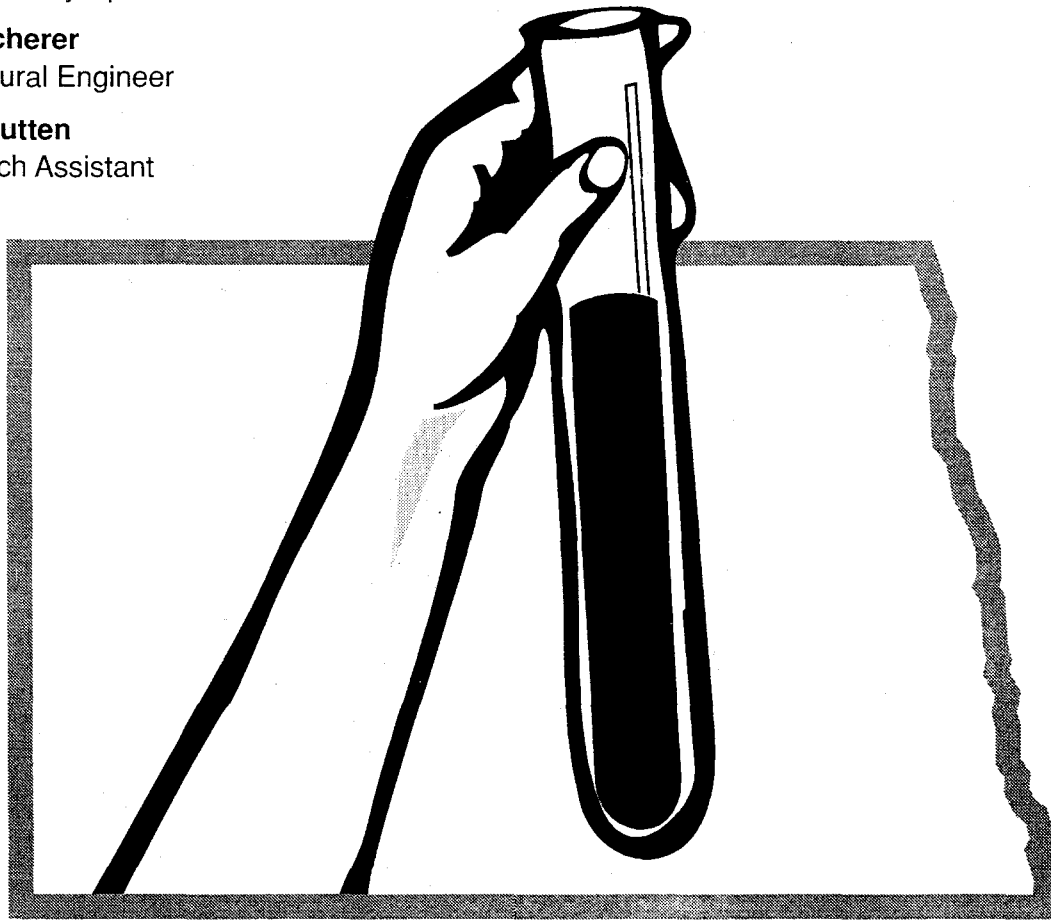
# Water Quality Projects

## in North Dakota

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North Dakota State University, Fargo, ND 58105

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Water is judged by both its quantity (availability) and quality. In a semi-arid to sub-humid state like North Dakota, it may seem that quantity is the first concern; however, quantity and quality issues are so interwoven that attempting to address one without the other is an exercise in futility.

Because water quality issues have been emphasized in recent years, the NDSU Extension Service has gathered information from various organizations about water quality projects throughout the state. This document is the result of that effort and is intended to be a basic reference for people involved or interested in water quality issues.

The projects have been labeled using a numerical system and located on a state and regional map. Project summaries are organized according to regions of the state and water quality topic. Statewide projects are not shown on the maps for obvious reasons, but are discussed at the beginning of the project summary section. For further information on specific projects, contact names and telephone numbers have been included.

All projects included are currently active or have been completed since 1990. The data base was developed with periodic update and expansion in mind. Please contact NDSU Extension Agricultural Engineering to include new or overlooked projects in future updates.

## ***State Water Resources***

North Dakota's average annual precipitation varies from 13 inches in the northwest to 20 inches in the southeast. About 75 percent of the total precipitation falls during the growing season. Significant fluctuations in annual precipitation are common. Flooding and droughts somewhere in the state are regular occurrences.

Groundwater is the major source of drinking water in North Dakota (used by 62 percent of the total population and 97 percent of the rural population). Surface water is used primarily by residents of some of the larger cities including Bismarck, Dickinson, Fargo, Grand Forks, Valley City, and Williston.

### ***Surface Water***

North Dakota is separated into two major drainage basins, the Missouri River basin and the Hudson Bay basin (Figure 1). The Missouri River drainage basin includes the Missouri and James River sub-basins that drain to the south. The Hudson Bay drainage basin includes the sub-basins of the Red and Souris River that drain to the north. Devils Lake drainage basin is a closed system that drains into Devils Lake.

The Missouri River carries the most water in the state, having an annual discharge of more than 16 million acre-feet. Approximately 24 million acre-feet of Missouri River water are stored in Lake Sakakawea. Other rivers and streams in the state are small in comparison. For example, the combined annual flow of the Red River at Fargo, the Sheyenne River at Valley City, the James River at Jamestown and the Souris River at Minot is less than 4 percent of the annual flow of the Missouri River.

### ***Ground Water***

The aquifers in North Dakota are found in both bedrock and surficial sediments. The principal bedrock aquifer systems (Dakota, Fox Hills, and Fort Union) are composed of interbedded layers of consolidated to unconsolidated sand, silt, and clay. The sandy beds yield the most water, but some beds of fractured clay or lignite are sufficiently permeable to yield water.

The main aquifers in surficial sediments are in unconsolidated sands and gravels of glacial origin. These are the most productive aquifers in North Dakota. They occur as broad sheet-like deposits on glacial outwash plains, or as long relatively narrow deposits along glacial meltwater channels that were often buried by glacial till. The principal glacial aquifers are dispersed throughout an area that covers approximately 75 percent of North Dakota (Figure 2). These aquifers underlie about 8,000 square miles and hold about 60 million acre-feet of water.

### ***Water Quality***

Water quality varies with the source. In general, North Dakota's surface water sources are lower in total salts than groundwater sources. Runoff from tilled agricultural land will usually carry larger sediment loads and be higher in total salts than runoff from grassland. With respect to human use, the quality of North Dakota's surface water resources is generally good. However, monitoring and evaluation efforts by the North Dakota State Department of Health indicate that most of the state's streams and lakes are impacted to some degree by non-point source pollution.

Many of the contaminants in surface water are the result of man's activities. Nutrients and sediments have been identified as serious water quality problems in many North Dakota lakes. Because North Dakota is an agricultural state, the source for these contaminants is often runoff from agricultural land. However, urban runoff from city streets, lawns, parking lots, golf courses, construction projects, etc. have also been identified as a sources for nutrients and sediments.

The quality of groundwater in North Dakota is variable. Typically the shallower glacial aquifers have relatively low amounts of total salts but often relatively high levels of calcium, magnesium, and iron. The water quality in the deeper bedrock aquifers is typically just the opposite of that described for the shallow glacial aquifers.

The majority of water quality problems in North Dakota groundwater are related to naturally occurring contaminants such as salts. However, manmade contaminants have been detected across the state as rare unrelated incidents. The majority of serious incidents of manmade contamination in North Dakota are related to leakage or spillage of petroleum products. A few low level detections of pesticides have been reported in groundwater, but no definable trends have been established.

The vast majority of the state's waters are not polluted and very adequately support the needs of North Dakota's people. However, no water resource is immune from

contamination. Just the fact that both serious and low-level incidents of water contamination do occur in North Dakota indicates that water quality problems can occur. Because North Dakota's water resources are relatively uncontaminated compared to many states, protection efforts probably take precedence over clean-up efforts.

Understanding movement of contaminants and water within the natural systems that characterize North Dakota is required. Coordinated objective inquiry is needed to help us understand the fate of contaminants in our environment and how to reduce their potential damage. Study is needed to determine how application of water resource protection and clean-up can be implemented without placing undue financial burden on large sectors of society. Finally, coordinated educational efforts based on the results of rigorous scientific investigations are essential to the development of policies that deal with water quality issues fairly and effectively. This document is one tool that can be used to help advance the objectives implied in these statements.

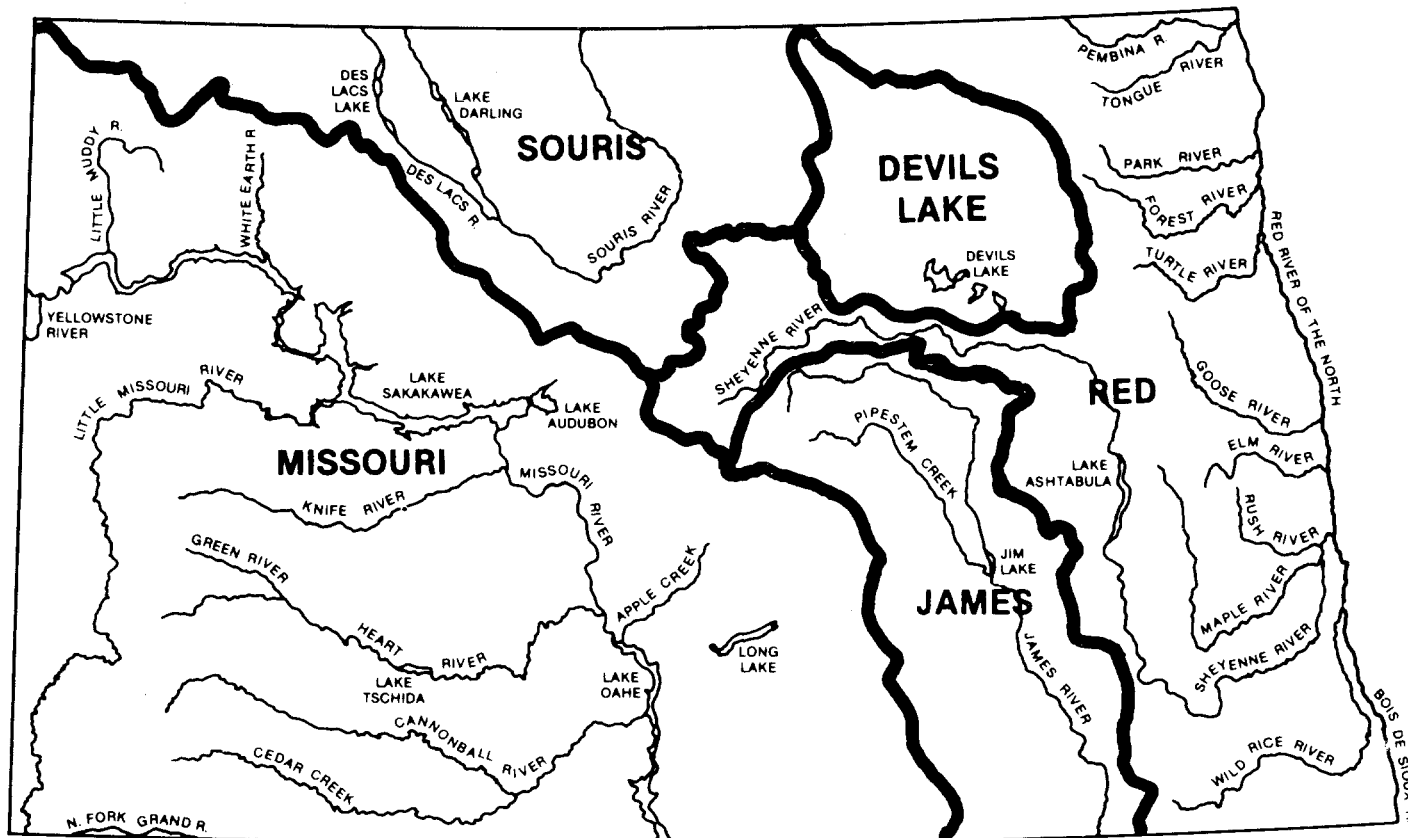
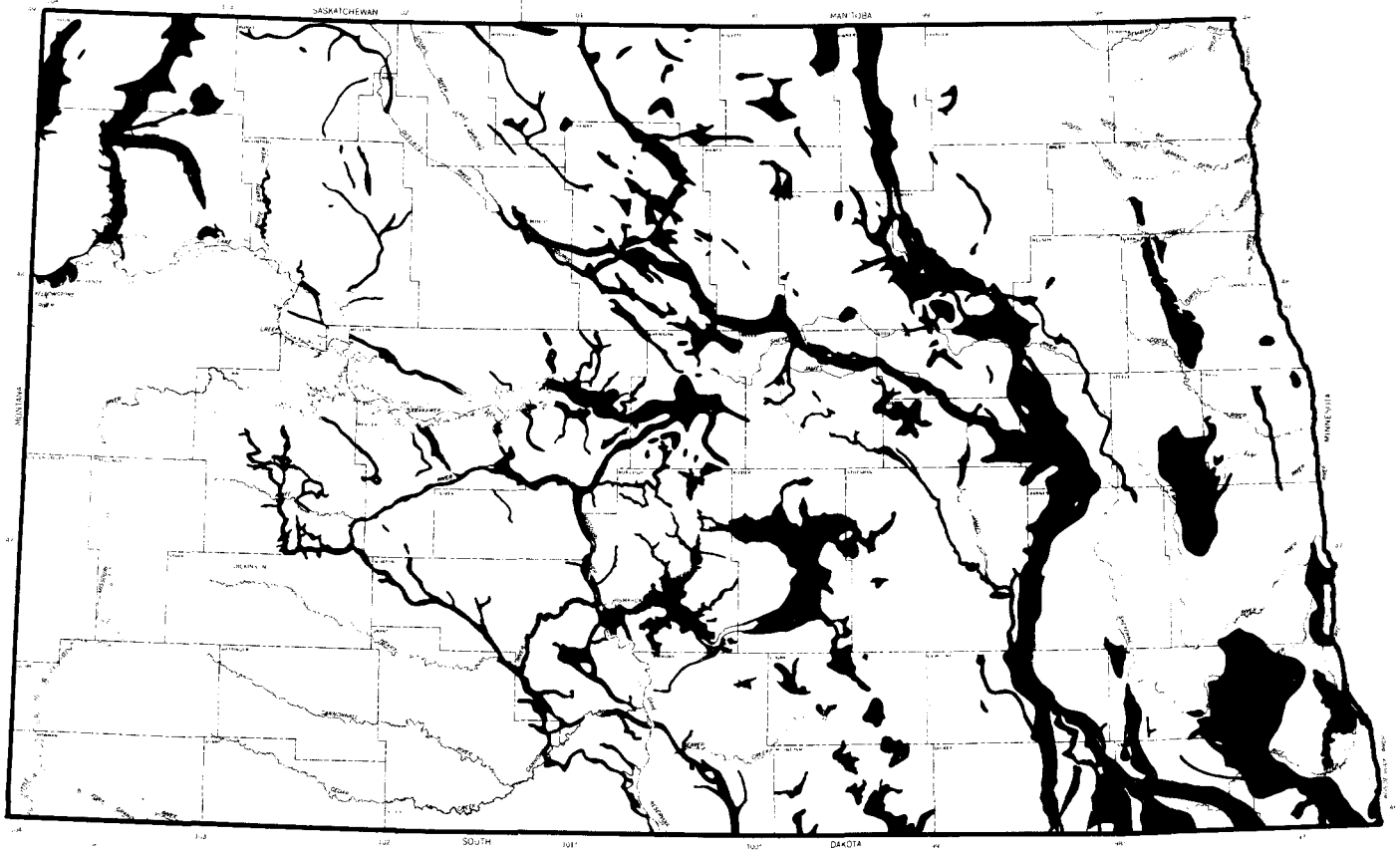


Figure 1. North Dakota's five major hydrological subdivisions.

(from N.D. State Water Commission)



**Figure 2. Major glacial drift aquifers in North Dakota**

(from N.D. State Water Commission)

## ***Organization Abbreviations and Names***

ASCS	Agriculture & Stabilization & Conservation Service
BCEXT	Bowman County Extension
BCSCD	Barnes Co. SCD
BCWB	Bottineau County Weed Board
BSSCD	Bowman-Slope SCD
EERC	Energy & Environmental Research Center (UND)
FCSCD	Foster Co. SCD
LARCD	Lake Agassiz RC&D Office
LCRCD	Lewis and Clark RC&D Office
LFO	LaMoure Field Office
LMGA	Little Missouri Grazing Association
MCSCD	Mercer Co. SCD
MDFC	MinnDak Farmers Coop
MNDZT	Manitoba-N.D. Zero Tillage Farmers Association
NDDOA	N.D. Department of Agriculture
NDGFD	N.D. Game & Fish Dept.
NDGS	N.D. Geological Survey
NDIC	N.D. Industrial Commission Oil & Gas Division
NDSCC	N.D. Soil Conservation Committee
NDS DHCL	N.D. State Dept. of Health & Consolidated Laboratories
NDSUAGEC	NDSU Department of Agricultural Economics
NDSUAGEN	NDSU Dept. of Agricultural Engineering
NDSUAGEX	NDSU Extension Ag. Engineering
NDSUARS	NDSU Department of Animal and Range Sciences
NDSUCE	NDSU Department of Civil Engineering and Construction
NDSUCHEM	NDSU Chemistry Department
NDSUCRC	NDSU Carrington Research Extension Center
NDSUCWS	NDSU Department of Crop and Weed Science
NDSUENT	NDSU Department of Entomology
NDSULRRC	NDSU Land Reclamation Research Center
NDSUSS	NDSU Soil Science Department
NDSUZOO	NDSU Department of Zoology
NDWCA	North Dakota Weed Control Assoc.
NPRCD	Northern Plains RC&D Office
RCSCD	Ransom Co. SCD
RRRCD	Red River RC&D Office
SCS	Soil Conservation Service
SWC	ND State Water Commission
UNDCHEM	UND Department of Chemistry
UNDGEOG	UND Department of Geography
UNDGEOL	UND Dept. of Geology and Geological Engineering
USBR	Bureau of Reclamation, Missouri-Souris Projects Office
USDAARS	USDA-Ag. Research Service
USFWS	U.S. Fish & Wildlife Service
USGS	U.S. Geological Survey Water Resources Division
USGSGF	U.S. Geological Survey Water Resources Division – Grand Forks
WRRRI	Water Resources Research Institute (NDSU)

# Statewide Projects

## ◆ Groundwater

### AQUIFER GEOGRAPHIC TARGETING SYSTEM

The project will develop and implement a statewide geographic targeting system to be used to prioritize aquifers for groundwater monitoring activities. (1992- )

*Radig, Scott* NDS DHCL 701/221-5210

### GROUNDWATER STATIONS

The objective is to collect water-level data sufficient to provide a minimum long-term data base to be used for continued observation of the impacts of climatic variation and man's activities on the groundwater system. The study will also to provide a data base against which short-term records acquired in areal studies can analyzed.

*Harkness, Russell E.* USGS 701/250-4601

### GROUNDWATER PROTECTION MAP PROGRAM

The purpose is educational. The maps produced provide a general guideline for chemical applicators who use leachable chemicals and must avoid locations susceptible to contamination. (1986- )

*Volk, Terrence* BCWB 701/236-4615

### MUNICIPAL WASTE LANDFILL EVALUATION

The state engineer and the state geologist shall complete site suitability reviews of all existing municipal waste landfills within the state of North Dakota. The site suitability evaluations consist of the hydrogeologic characteristics at the landfill and a one-time water-quality analysis of the ground water beneath the landfill. (1991-95)

*Olson, Jeff* SWC 701/224-5210

### NORTH DAKOTA GROUNDWATER MONITORING PROGRAM

The focus is to determine if various agricultural chemicals have entered the aquifer systems of North Dakota. (1992- )

*Radig, Scott* NDS DHCL 701/221-5210

### NORTH DAKOTA WATER PROTECTION STRATEGY FOR PESTICIDES

NDSU Extension has contracted with the North Dakota Department of Agriculture to develop and promote a system of Best Management Practices (BMPs) for ground water protection from agricultural use of pesticides. This project will be accomplished in three phases.

*Seelig, Bruce* NDSUAGEX 701/237-7236

### PESTICIDES AND GROUNDWATER STRATEGY

Development of a state management plan for North Dakota will promote the environmentally sound use of pesticides that might pose a high risk to water resources. (1991- )

*Junkert, Ken* NDDOA 701/224-4159

### STATEWIDE GROUNDWATER NITRATE DATA ARCHIVE

In 1948, the Health Department began screening groundwater samples for Nitrates. Since 1986 the data has been compiled into a data base. This data will be used to determine if areal concentrations of nitrate are occurring. The study will also look at various point and non-point occurrences of nitrate. (1948- )

*Roberts, Kris* NDS DHCL 701/221-5210

### U.S.T. GENERAL SITE ASSESSMENTS

The purpose is to assess the extent of contamination in the state due to underground storage tanks. If contamination is discovered, the tank owner is advised to remediate the problem. (1988- )

*Berreth, Gary* NDS DHCL 701/221-5210

### WELLHEAD PROTECTION

The WHP program consists of six essential elements which, when used in conjunction with one another, will provide protection for a well or well field providing drinking water to a community. (1989- )

*Luther, Kathryn* NDS DHCL 701/221-5210

## ◆ Surface Water

### AMBIENT STREAM WATER QUALITY MONITORING NETWORK

Grab samples are taken in specific ambient streams. Parameters analyzed are generally nutrients, partial and complete. (1967- )

*Eil, Mike* NDS DHCL 701/221-5210

### INTERBASIN BIOTA TRANSFER STUDY PROGRAM

This long-term, multi-disciplinary scientific research program was developed to provide scientific answers to "biota transfer" questions on the extent and effects of biota transfer between the Missouri and Hudson Bay Basin as it relates to the Garrison Diversion Project. (1988- )

*Leitch, Jay A.* NDSUAGEC 701/237-7441

## **LAKE WATER QUALITY ASSESSMENT PROJECT**

The project assesses 60 lakes. The water column is sampled for general physical/chemical parameters, chlorophyll-a, and phytoplankton. A macrophyte survey is conducted with the goal of describing the dominant macrophyte species and the areal coverage of macrophytes. Also a description of the point and non-point pollution sources. (1991- )

*Ell, Mike NDSHCL 701/221-5210*

## **NATIONAL TRENDS NETWORK FOR ATMOSPHERIC DEPOSITION**

In order to determine atmospheric fluxes within the hydrologic system and man's influences on these fluxes, it is necessary to establish and operate a nationwide, long-term network for monitoring atmospheric deposition of selected chemical constituents. (1983- )

*Sether, Bradley A. USGS 701/250-4601*

## **NORTH DAKOTA WATERBANK PROGRAM**

The Program gives landowners a financial incentive to set aside cropland, while at the same time encouraging preservation of wetlands. The program can accept any size wetland, but it is designed to protect small potholes and marshes most vulnerable to destruction. (1987- )

*Carlson, Judy NDDOA 701/224-4159*

## **SURFACE WATER QUALITY MONITORING PROGRAM**

This is an ongoing program to collect and compile water quality data on the state's surface water resources.

*Ell, Mike NDSHCL 701/221-5210*

## **SURFACE-WATER STATIONS**

Objectives are to collect surface-water data needed for assessment of water resources, operation of reservoirs or industries, forecasting, disposal of wastes and pollution controls, compact and legal requirements, and research or special studies.

*Harkness, Russell E. USGS 701/250-4601*

## **SURVEYS OF CONTAMINANTS AT NORTH DAKOTA NATIONAL WILDLIFE REFUGES**

Studies are being done at Tewaukon NWR, Lake Alice NWR, Chase Lake NWR, all NWR's west of the Missouri River and in the Red River Valley. These studies document baseline concentrations of potential contaminants in fish and wildlife and their habitats. (1990-93)

*Welsh, Dan USFWS 701/250-4402*

## **◆ Both Ground and Surface Water**

### **DEVELOPMENT AND APPLICATION OF GEOGRAPHIC INFORMATION SYSTEM (GIS) DATA BASES FOR NORTH DAKOTA**

The purpose of this program is to help develop GIS data bases for North Dakota and to explore the potential uses of these data bases as an illustrative and analytical tool. (1992-94)

*Reed, Thomas B. USGS 701/250-4601*

### **MANITOBA-NORTH DAKOTA ZERO TILLAGE PRODUCTION MANUAL**

The Manitoba-North Dakota Zero Tillage Farmers Association's primary goals for this project were to distribute 50,000 copies of the Zero Tillage Manual. The manual was developed to promote the use of various land management practices which effectively reduce wind and water erosion and ultimately improve water quality. (1991-92)

*Samson, Lyle MNDZT 701/852-8895*

### **NDSU EXTENSION WATER QUALITY PROJECTS**

This program has been an ongoing educational project that provides information to North Dakotans on a wide range of water quality topics. The main water quality program areas that fall within this broad educational project are: 1) nutrient management; 2) pesticide management; 3) livestock waste management; 4) wellhead protection; and 5) water quality public policy education.

*Seelig, Bruce NDSUAGEX 701/237-7236*

### **WATER QUALITY/NON-POINT SOURCE POLLUTION EDUCATION PROGRAM FOR TEACHERS AND YOUTH**

The purpose of this project is to expand the Water Education for Teachers (WET) program to provide a comprehensive water quality/non-point source component. This project focuses on K-12 teachers.

*Sharff, Bill SWC 701/224-4833*

### **WATER-QUALITY STATIONS**

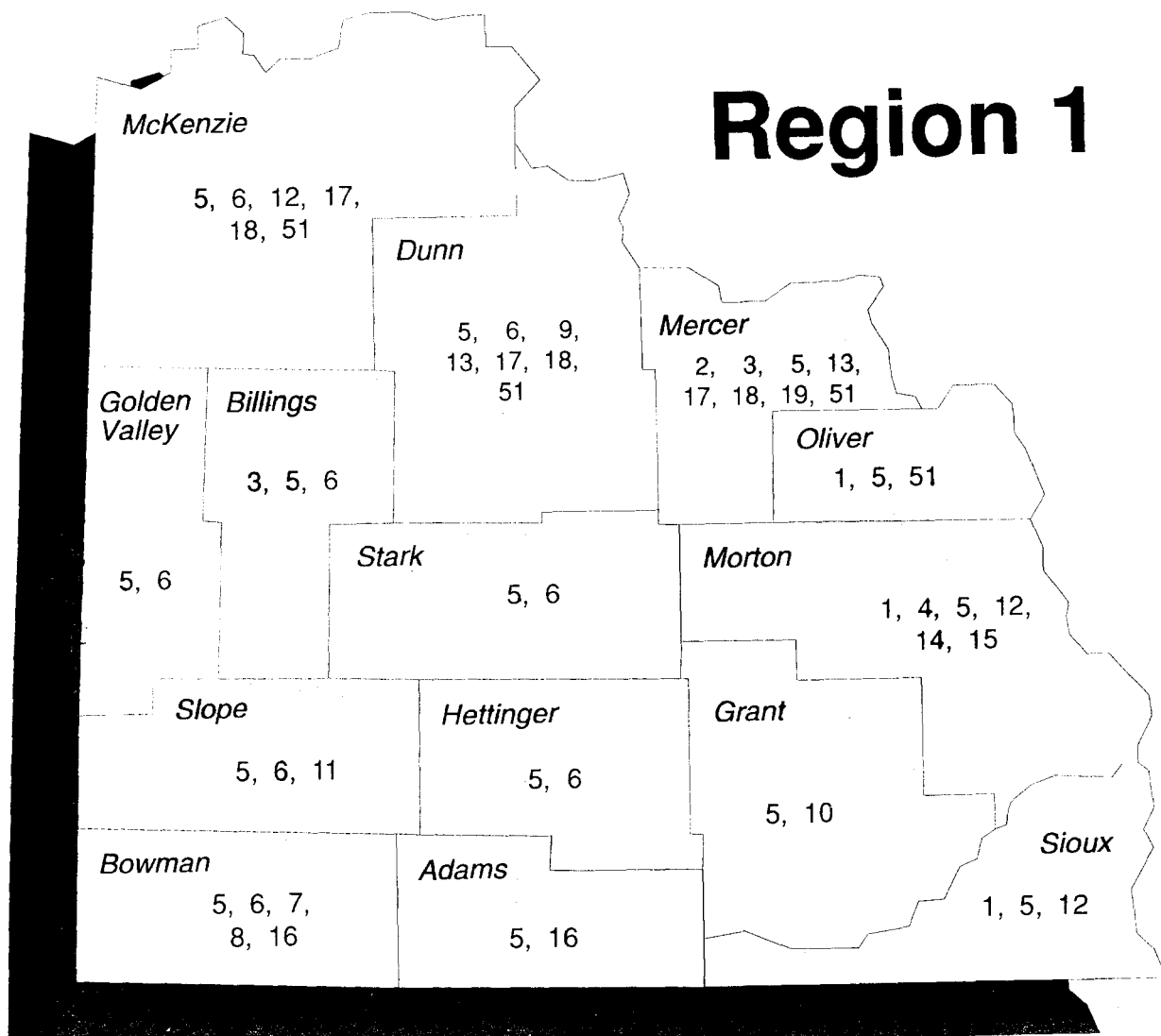
Objectives are to contribute to a national water-quality data base for use in broad Federal and State planning and management programs and provide data for Federal and State management of interstate and international waters.

*Harkness, Russell E. USGS 701/250-4601*

### **WATERBANK PROGRAM**

The waterbank projects were developed to restore previously drained wetlands in a wetland complex and to reestablish upland vegetation with the watershed. (1990-95)

*Carlson, Judy NDDOA 701/224-4159*



# Region 1

## Region 1 Projects

### ◆ Groundwater

#### 1 AREA IV ABANDONED WELL SEALING DEMONSTRATION PROJECT

The goal is to reduce the number of open abandoned wells within AREA IV by implementing an extensive educational/informational program. (1991-92)

*Ewine, Wes LCRC 701/250-4222*

#### 2 IMPACTS OF AGRICULTURAL CHEMICALS ON GROUNDWATER QUALITY

The objective is to provide scientifically valid data upon which meaningful agricultural chemical management and regulatory decisions can be made. It focuses on identifying impacts of agricultural chemicals on

groundwater by providing facts on transport, attenuation, and fate of specific chemicals from the soil zone to the groundwater. (1989-94)

*Butler, Raymond D. EERC 701/777-5000*

#### 3 NATIONAL MINE LAND RECLAMATION CENTER: RESEARCH PROGRAM FOR THE WESTERN REGION

This study will develop information and techniques for successful reclamation of abandoned mine lands and areas of current mining, considering differences in geology, hydrogeology, geochemistry, climate, and topography. (1988-93)

*Butler, Raymond D. EERC 701/777-5000*



**4 PESTICIDE MOVEMENT IN IRRIGATED NORTH DAKOTA SOILS**

The potential for any of the pesticides under study to move into shallower groundwater systems under BMPs is minimal within the soils of the Hecla series. (1989-93)

*Halvorson, Gary A. NDSULRRC 701/667-3002*

**5 SOUTHWEST NORTH DAKOTA URANIUM IN GROUND WATER STUDY**

A survey of 3000+ water samples has been carried out to assess concentrations of uranium. Residents in the area will be informed of uranium problems and given recommendations for reducing Uranium intake. (1990- )

*Roberts, Kris NDSDHCL 221-5210*

**6 UIC PROGRAM OF THE SAFE DRINKING WATER ACT FOR CLASS 2 WELLS**

The UIC program controls disposal of produced brines in the oilfield. The North Dakota Industrial Commission is in control of this program for the EPA. (1983- )

*Koch, Charles NDIC 701/224-3722*

◆ **Surface Water**

**7 BOWMAN-HALEY WATERSHED PROJECT**

The purpose of these educational programs has been to inform area residents of the various management strategies/practices which are most effective for erosion control. (1990-95)

*Belland, Kent BSSCD 701/523-3873*

**8 BOWMAN-HALEY WATERSHED EXTENSION PROGRAM**

NDSU Extension is providing water quality educational programs specifically targeted to producers who farm within the watershed that contributes runoff to the Bowman-Haley reservoir.

*Hinrichs, Darwin BCEXT 701/523-3809*

**9 GOODMAN CREEK WATERSHED**

The objective is to improve the water quality within Goodman Creek by promoting land management practices and implementing various BMP's to affectively reduce erosion on 60 percent of the agricultural lands within the watershed. The study will also document the impact accelerated land treatment activities can have on water quality. (1992-95)

*Tagestad, Darrell MCSCD 701/748-2101*

**10 HEART BUTTE RESERVOIR WETLANDS DEMONSTRATION PROJECT**

Three experimental wetlands will be constructed in tributaries to Heart Butte reservoir in 1993. These wetlands are designed to provide downstream water quality benefits and wildlife habitat. Primary interest is on the ability of wetlands created in small tributaries to remove suspended sediments and nutrients. (1992-95)

*Nelson, Rick USBR 701/250-4242*

**11 LOGGING CAMP RANCH PROJECT**

The project's objectives are to develop a grazing system and watering network which would improve cattle distribution and improve the condition of the Little Missouri River riparian zone and adjoining pastures on the Logging Camp Ranch. (1990-95)

*Storlie, Gail LMGA 701/879-6210*

**12 SURVEYS OF CONTAMINANT CONCENTRATIONS IN MISSOURI RIVER FISH**

The US Fish and Wildlife Service has several studies surveying contaminants in Missouri River fish. (1988-93)

*Welsh, Dan USFWS 701/250-4242*

**13 WATER-QUALITY MONITORING PROGRAM FOR LAKE SAKAKAWEA**

Water quality is being monitoring at eight stations along the thalweg of Lake Sakakawea. Water-quality data will be collected to characterize the water-column stratification using standard water-column profile techniques. (1992- )

*Berkas, Wayne R. USGS 701/250-4601*

◆ **Both Surface and Groundwater**

**14 AMOCO OIL CO. - MANDAN REFINERY HAZARDOUS WASTE CORRECTIVE ACTION**

This study will determine the presence, nature and extent of releases of hazardous wastes at the refinery. Technical measures addressing remediation will be determined.

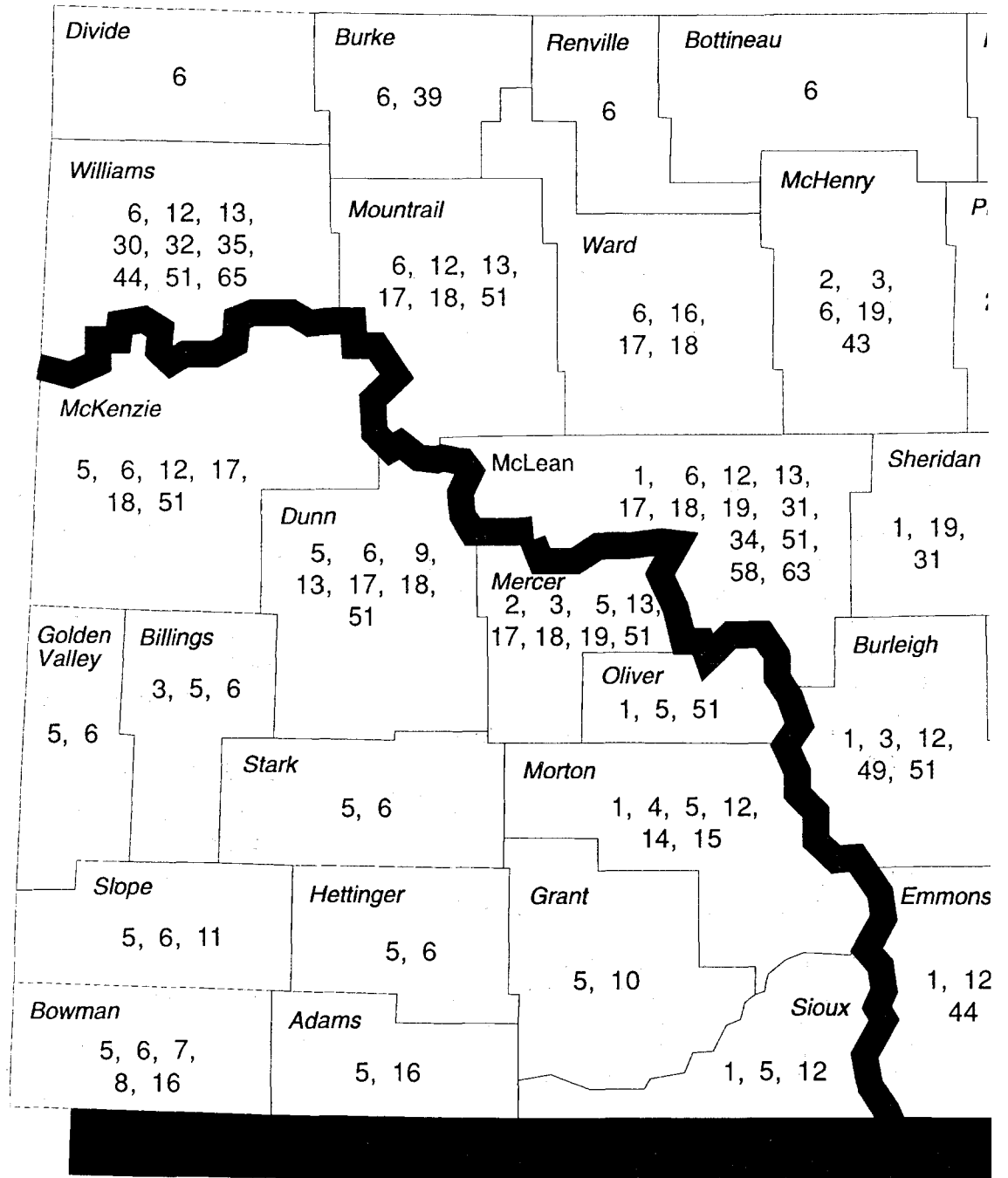
*Roob, Christine NDSDHCL 701/221-5210*

**15 AREA IV FLEXIBLE CROPPING SYSTEMS/ TILLAGE/RESIDUE MANAGEMENT STUDY**

A deep-rooted crop is rotated with short-rooted crops to "mine" water and nutrients from the deeper soil profile. By this mining, the potential for leaching or eroding chemicals into water sources is reduced. (1984- )

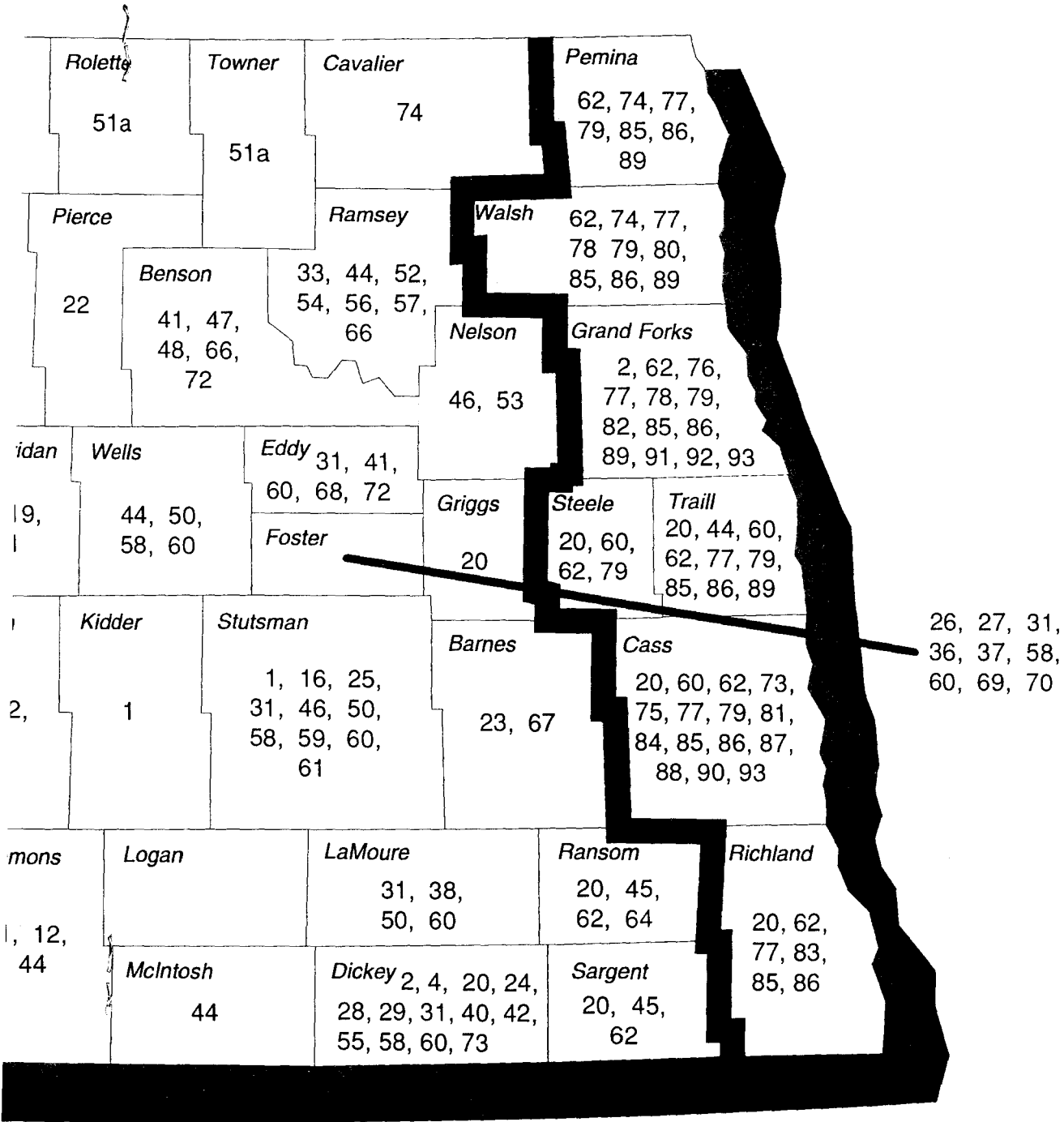
*Black, Alfred USDAARS 701/663-6445*

# Water Quality Proj



## Region 1

# Subjects in North Dakota



Region 2

Region 3

**16 CRP GRAZING AND HAYING DEMONSTRATION PROJECT**

The objective of this project is to demonstrate the potential profitability of beef production on CRP acres after they exit the CRP program. The cooperating producers and project personnel will develop four haying and grazing systems on CRP lands in four counties. (1992-96)

*Ewine, Wes LCRCO 701/250-4222*

**17 HYDROLOGY OF FORT BERTHOLD INDIAN RESERVATION, NORTH DAKOTA**

Objectives are to describe the stratigraphy, distribution, and hydrologic properties of aquifers on the reservation; investigate the quality and movement of ground water; improve the understanding of the surface-water system; complete an inventory of current water use; and add data obtained during the study to an existing GIS data base. (1989-93)

*Cates, Steve W. USGS 701/250-4601*

**18 NONPOINT-SOURCE ASSESSMENT OF THE FORT BERTHOLD INDIAN RESERVATION**

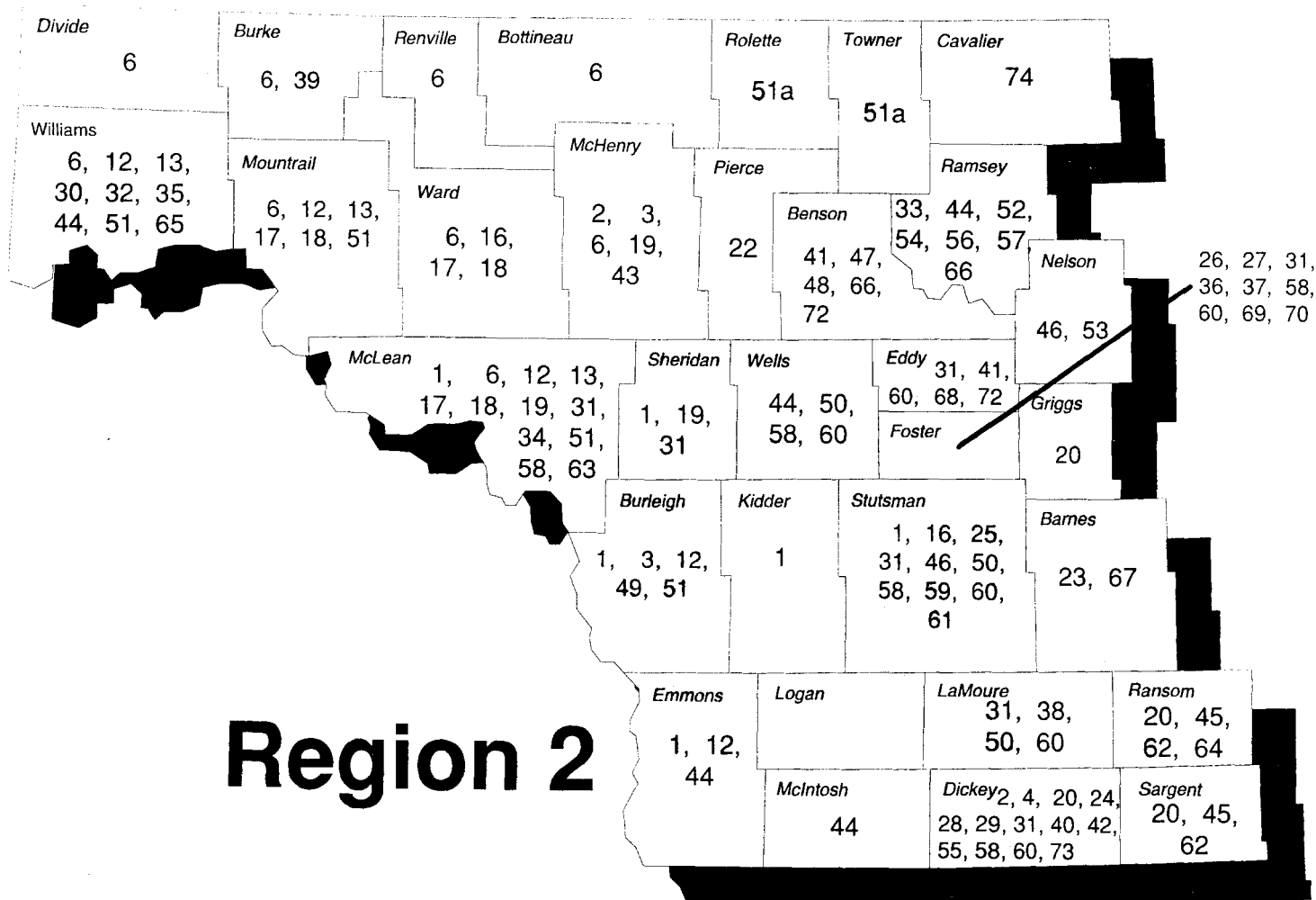
The purpose is to evaluate the effects of agricultural practices on the quality of water resources on the reservation. Particular emphasis was placed on identifying the occurrence and concentrations of agricultural chemicals in surface water and ground water and on evaluating the effects of using riparian land for grazing livestock on surface-water quality. (1992-94)

*Lent, Robert M. USGS 701/250-4601*

**19 WETLAND HYDROLOGY OF MINELANDS**

The goal is to investigate comparative hydrology and evaluate ground water recharge potential of natural wetlands, wetlands created with post-SMCRA guidelines, and inadvertently created wetlands on abandoned mine lands. (1992-94)

*Sharma, Padam NDSULRRC 701/667-3002*



## Region 2 Projects

### ◆ Groundwater

#### 20 AREA II ABANDONED WELL SEALING DEMONSTRATION PROJECT

The goal is to reduce the number of open abandoned wells within AREA II by implementing an extensive educational/informational program. (1992-93)

*Jacobson, Ordean LARCD 701/239-5373*

#### 21 ASH UTILIZATION IN THE STATE OF NORTH DAKOTA

This project will demonstrate the use of coal fly-ash in concrete mix and as controlled-density flowable fill. The impacts on ground water will be evaluated. (1988-92)

*Pflughoeft-Hassett, Debra EERC 701/777-5000*

#### 22 BALTA, ND - L.U.S.T. GROUNDWATER REMEDIATION

A L.U.S.T. in Balta, ND was determined to be a contamination problem. The owner of the tank could not financially carry out a site investigation/remediation. Therefore the ND Health Department obtained federal money to continue cleanup of the contamination. (1988- )

*Cameron, Dave NDS DHCL 701/221-5210*

#### 23 BARNES COUNTY ABANDONED WELL SEALING PROJECT

The goal is to reduce the number of open abandoned wells in Barnes County by implementing an extensive education/information program. (1990-91)

*Bitz, Judy BCSCD 701/845-3114*

- 24 BEST MANAGEMENT PRACTICES FOR IMPROVED IRRIGATION AND FERTILIZER NITROGEN USE EFFICIENCIES**  
To determine the impacts of BMPs on crop responses and on leachate losses (quality/quantity) at major points of an irrigated hydrologic system. (1989-95)  
*Stegman, Earl C. NDSUAGEN 701/237-7261*
- 25 BIOGEOCHEMISTRY OF CARBON, NITROGEN AND SULFUR TRANSFORMATIONS IN SEASONAL AND SEMIPERMANENT WETLANDS**  
Most of the research conducted in Northern Plains Wetland Systems (NPWS) has concentrated on their role in the breeding and feeding of migratory waterfowl and other nongame species and on their ground water hydrology and chemistry. (1990-92)  
*Biondini, Mario E. NDSUARS 701/237-7664*
- 26 CARRINGTON LISA**  
Investigate the relationship between ag chemicals in ground water and crop practices including LISA, conventional, and integrated crop management approaches. (1991-93)  
*Klinkebiel, David L. NDSUCRC 701/652-2055*
- 27 CARRINGTON RECHARGE**  
This project examines the relationship between ground-water recharge and tracer and agricultural chemical movement on a common rotation in North Dakota. (1987-93)  
*Klinkebiel, David L. NDSUCRC 701/652-2055*
- 28 CHEMICAL AND HEAT TRANSPORT THROUGH SOILS**  
This study will quantify percolation of nitrogen and water beyond the rooting depth of irrigated crops and investigate chemical and heat movement in soil systems. (1992-97)  
*Prunty, Lyle D. NDSUSS 701/237-8901*
- 29 EFFECTS OF EVAPOTRANSPIRATION ON PESTICIDE DISTRIBUTIONS AND TRANSPORT IN THE UNSATURATED ZONES OF NORTHERN CORNBELT SAND PLAINS**  
The objective of this study is to document the effects of evapotranspiration on pesticide transport and distribution in the unsaturated zones of unconfined sand-plain aquifers. (1991-93)  
*Komor, Stephen C. USGS 701/250-4601*
- 30 EVALUATION OF HYDROCARBON AND CAPILLARY FRINGE THICKNESS AND POTENTIAL FOR CONTAMINANT MOVEMENT IN THE UPPER AQUIFER NEAR THE FLYING J FACILITY, WILLISTON, N.D.**  
Objectives are to (1) evaluate the hydrocarbon thickness for the upper aquifer system and (2) evaluate the MODFLOW application used to simulate ground-water flow and potential movement of contaminants on the vicinity of the Flying J Facility. (1991-92)  
*Wesolowski, Edwin A. USGS 701/250-4601*
- 31 EVALUATION OF THE POTENTIAL FOR TOXIC-ELEMENT CONSEQUENCES DUE TO THE GARRISON DIVERSION UNIT, NORTH DAKOTA AND SOUTH DAKOTA**  
This study is to evaluate the potential effects of expanded irrigation within the GDU on the mobility and availability of potentially toxic trace elements, especially arsenic and selenium. Objectives include identification of concentration, distribution, and mobility of potentially toxic trace elements in areas of proposed irrigation development in the GDU. (1988-91)  
*Berkas, Wayne R. USGS 701/250-4601*
- 32 FLYING J PETROLEUM INC. WILLISTON REFINERY CORRECTIVE ACTION**  
The purpose is to develop, evaluate, and select potential corrective measures to be implemented at Flying J's Williston Refinery, that are adequate to protect human health and the environment and to mitigate the release of hazardous waste or constituents from the facility. (1989- )  
*Roob, Christine NDS DHCL 701/221-5210*
- 33 GEOLOGIC AND HYDROGEOLOGIC CONDITIONS IN THE AREA ADJACENT TO THE DEVILS LAKE WASTEWATER IMPOUNDMENTS**  
The study determined the proximity of the Devils Lake wastewater impoundments to the Spiritwood Aquifer. Due to variable water quality it was very difficult to determine whether this groundwater was being degraded by wastewater from the impoundments. (1988-92)  
*Murphy, Ed NDGS 701/224-4109*
- 34 HYDROLOGICAL AND ECOLOGICAL DYNAMICS OF CREATED SEASONAL WETLANDS ON THE MISSOURI COTEAU**  
The purpose is to compare groundwater quality and ecology in created wetlands and natural wetlands. (1991-93)  
*Kirby, Donald R. NDSUARS 701/237-7664*
- 35 HYDROLOGY OF THE FLYING J, INC., FACILITY SITE NEAR WILLISTON, NORTH DAKOTA**  
The purpose of this study is to use existing data to evaluate the subsurface geology and ground-water flow system in the vicinity of the Flying J, Inc., facility with specific reference to the potential offsite release of contaminants. (1991-93)  
*Reed, Thomas B. USGS 701/250-4601*

- 36 INFLUENCE OF CLIMATE-SOIL INTERACTION ON CONTAMINATION OF A SHALLOW AQUIFER UNDER A DRYLAND CROP ROTATION**  
 This experiment is evaluating the occurrence of contamination of a shallow aquifer using dryland farming practices common to the Northern Great Plains. The experiment will evaluate the relationship of pesticide contamination to field water conditions and aquifer recharge events induced by specific interaction with climatic factors. (1987-)  
*Klinkebiel, David L. NDSUCRC 701/652-2055*
- 37 INFLUENCE OF CROPPING SYSTEMS ON GROUND WATER QUALITY**  
 NDSU Extension is assisting the research staff at the Carrington Research Extension Center with dissemination of the results of their study. The study deals with the influences of cropping systems on contamination of a shallow aquifer in the Northern Great Plains. This project is in conjunction with number 36. (1991-1994)  
*Scherer, Thomas NDSUAGEX 701/237-7236*
- 38 LaMOURE COUNTY ABANDONED WELL SEALING PROJECT**  
 The goal is to reduce the number of open abandoned wells within LaMoure County by implementing an extensive educational/informational program. (1992-94)  
*Hugulen, Linda LFO 701/883-5344*
- 39 LIGNITE, ND - L.U.S.T. GROUNDWATER REMEDIATION**  
 A L.U.S.T in Lignite, ND has been known as a contamination problem by the ND State Health Dept.. The owner of the tank did not have the financial ability to swiftly investigate and remediate the problem. Therefore the ND Health Dept. received federal money to continue the project. (1985- )  
*Berreth, Gary NDSDHCL 701/221-5210*
- 40 MANAGEMENT SYSTEMS EVALUATION AREA (MSEA), OAKES, ND**  
 Five MSEAs have been established in the Midwest. This project is a satellite to the main project located in Minnesota. NDSU Extension is assisting the NDSU Soils Department in disseminating the research results. This project is in conjunction with number 42. (1991-1994)  
*Scherer, Thomas NDSUAGEX 701/237-7236*
- 41 NONPOINT-SOURCE CONTAMINATION OF THE WARWICK AQUIFER ON THE FORT TOTTEN INDIAN RESERVATION**  
 The purpose is to assess the impact of various land-use practices on the water quality of the Warwick aquifer. (1993-94)  
*Lent, Robert M. USGS 701/250-4601*
- 42 NORTHERN CORNBELT SANDPLAINS MANAGEMENT SYSTEM EVALUATION AREA**  
 Objectives of the Oakes, ND MSEA site are to employ producer oriented technologies and strategies that reduce the amount of applied nitrogen, water and pesticide that is transported to ground water while providing reasonable economic returns. (1991-94)  
*Knighon, Raymond E. NDSUSS 701/237-8901*
- 43 OCCURRENCE OF PICLORAM (TORDON) AND 2,4-D IN GROUNDWATER IN THE DENBIGH SAND HILLS, McHENRY COUNTY, NORTH DAKOTA**  
 Wells and sediment cores were analyzed for pesticide levels in ground water. (1987-92)  
*Murphy, Ed NDGS 701/224-4109*
- 44 ORGANIC AND INORGANIC CONTAMINANTS IN SHALLOW GROUNDWATER AT SIX MUNICIPAL LANDFILLS IN NORTH DAKOTA**  
 The purpose of this study was to determine the environmental impact of six landfills. The results of this study may be used to predict the extent of groundwater degradation at landfills situated in similar geologic settings in the state. (1987-92)  
*Murphy, Ed NDGS 701/224-4109*
- 45 SAMPLING PROCEDURES FOR PESTICIDES**  
 Investigative efficacy of water wash procedures, and use of PVC Builder for sampling pesticides in ground water. (1992-93)  
*Schuh, Bill SWC 701/224-4109*
- 46 TEMPORAL VARIATIONS IN THE SALINITY OF SHALLOW GROUNDWATER FROM THE PERIPHERY OF SOME NORTH DAKOTA WETLANDS**  
 The study examines temporal variations in the salinity of pondwaters, and near-surface ground waters collected from hydric soil profiles in brackish to subsaline, semipermanent North Dakota wetlands, and places these variations in a geo-hydrological context. (1990-93)  
*Arndt, Jim L. NDSUSS 701/237-8901*
- 47 WARWICK AQUIFER - LEPA IRRIGATION GROUNDWATER MONITORING PROJECT**  
 This project will monitor the impact of LEPA irrigation on groundwater quality compared to traditional, high pressure irrigation and dry land farming fields over the same aquifer. (1992-96)  
*Radig, Scott NDSDHCL 701/221-5210*

**48 WARWICK LOW ENERGY PRECISION APPLICATION (LEPA) IRRIGATION DEMONSTRATION**

The LEPA Irrigation Demonstration Project was developed to demonstrate the economic and environmental benefits of LEPA irrigation systems. This project will demonstrate the water efficiency of the LEPA irrigation systems, as well as the minimal impact these systems have on groundwater quality. (1992-95)

*Van DeVelde, Kieth NPRCD 701/662-7956*

**49 WATER MANAGEMENT FOR SUPPLEMENTAL IRRIGATION OF THE SLOWLY PERMEABLE SOILS OF THE NORTHERN GREAT PLAINS**

The researchers are attempting to characterize the nature of the water flow through the soil and fractures so they can better estimate and manage the impacts of practices such as irrigation management and nutrient management. (1993-)

*Trooien, Todd USDAARS 701/224-4159*

◆ **Surface Water**

**50 ASSESSING THE FUNCTIONS AND VALUES OF RESTORED WETLAND COMPLEXES**

This project will test hypotheses regarding restored wetland complexes. Wetlands will be analyzed for nutrients and other limnological parameters. Invertebrate communities will also be analyzed. (1993-98)

*Nelson, Rick USBR 701/250-4242*

**51 ASSESSMENT OF EFFECTS ON SALINITY ON DISPERSAL OF RAINBOW SMELT AND CARP IN WATERS ASSOCIATED WITH THE GARRISON DIVERSION UNIT, NORTH DAKOTA**

The objectives are to assess whether or not water salinity may limit reproductive success of rainbow smelt and carp, especially if either of these species enter waters of the Devils Lake chain. (1989-91)

*Peterka, John J. NDSUZOO 701/237-7087*

**51(a) BIG COULEE DAM WATER QUALITY PROJECT**

The reservoir behind Big Coulee Dam is slowly filling with sediment as a result of soil erosion from the watershed. Also, the reservoir is the source of potable water for the town of Bisbee. This project will try to improve the water quality of the reservoir by introducing tillage BMP's on cultivated land and erosion control on the remaining land in the watershed

*Van DeVelde, Kieth NPRCD 701/662-7956*

**52 BOTTOM-SEDIMENT/WATER-COLUMN INTER-ACTIONS AT DEVILS LAKE, NORTH DAKOTA**

Objectives are (1) to determine the compositions of bottom sediments and pore water in Devils Lake and (2) to determine the influence of benthic fluxes on water-column chemistry. (1990)

*Komor, Stephen C. USGS 701/250-4601*

**53 CARBONATE AND GYPSUM CHEMISTRY IN SATURATED, NEUTRAL pH SOIL ENVIRONMENTS**

The equilibrium geochemistry of CO<sub>2</sub>-calcite-gypsum-water systems is examined. These systems are particularly important for understanding hydric soils of the Northern Plains because calcite and gypsum often exist in conjunction with saturated conditions under relatively high CO<sub>2</sub> partial pressures. (1990-92)

*Arndt, Jim L. NDSUSS 701/237-8901*

**54 CHRONOLOGY OF MERCURY LOADING TO DEVILS LAKE, NORTH DAKOTA, INFERRED FROM SEDIMENT CORE DATA**

The objective of this study is to use core data to construct chronologies of mercury accumulation rates in Devils Lake. These data will represent the only historic record of mercury contamination in the Devils Lake area. (1991-93)

*Lent, Robert M. USGS 701/250-4601*

**55 CONCENTRATIONS OF SELENIUM AND OTHER ELEMENTS IN FISH AND WILDLIFE IN A MARSH THAT RECEIVES SUBSURFACE IRRIGATION DRAINWATER FROM OAKES TEST AREA**

This project investigated bioaccumulation of selenium in relation to irrigation return flows from Oakes Test Area. (1991-92)

*Welsh, Dan USFWS 701/250-4402*

**56 DISSOLVED-SOLIDS AND NUTRIENT BUDGETS OF DEVILS LAKE, NORTH DAKOTA**

Objectives are (1) to quantitatively describe the present quality of water entering Devils Lake and within Devils Lake and (2) to develop a dissolved-solids and nutrient budget for Devils Lake. (1988-91)

*Sando, Steven K. USGS 701/250-4601*

**57 EFFECTS OF BOTTOM SEDIMENTS ON NUTRIENT CYCLES IN DEVILS LAKE**

The primary purpose of this study will be to determine the processes that are responsible for the increase in nutrient concentrations in Devils Lake and for the concurrent algal blooms. (1991-92)

*Lent, Robert M. USGS 701/250-4601*



**58 GARRISON DIVERSION UNIT WATER QUALITY MONITORING PROGRAM**

Water samples are collected quarterly from sites located in the GDU Project Area. Samples are analyzed for Ph, specific conductivity, alkalinity, temperature, nutrients, cation-anion balance, and trace elements. At sites along the James River and McClusky Canal, samples are collected and analyzed for pesticides by the USGS using immunoassays and GC/MS analysis. (1985- )

*Ivey, Patti J. USBR 701/250-4242*

**59 GARRISON DIVERSION UNIT, REFUGE MONITORING PROGRAM**

The objective of the program is to gather pre-project data that could be used as baseline data if the GDU Project were completed as planned. The pre-project data would be used to assess any changes in the refuge pools after the project comes on-line. (1987- )

*Hiemenz, Gregory A. USBR 701/250-4242*

**60 GENERATION OF A DATA BASE FOR THE JAMES RIVER SALINITY MODEL, NORTH DAKOTA AND SOUTH DAKOTA**

The objective is to generate a water-quality data base including dissolved solids, carbonate hardness, sulfate, chloride, and sodium for 1953-84 for the James River basin for use in the USBR's river-salinity model. This includes a similar data base and a monthly streamflow data base for 1931-84 for the Sheyenne River and the Red River of the North. (1985-90)

*Lindskov, Kenneth L. USGS 701/250-4601*

**61 IMPACT OF GLOBAL CLIMATE CHANGE ON THE FUNCTIONS AND VALUES OF PRAIRIE WETLANDS**

The project is designed to; develop models suitable for use in the prairie region of North Dakota to predict changes in climate under doubled CO2 scenario; improve rainfall-runoff models needed to predict the impact to wetland hydrology from potential climate changes; develop or improve a biological model to predict impacts to prairie wetlands from climate change. (1992-97)

*Nelson, Rick USBR 701/250-4242*

**62 NATIONAL WATER-QUALITY ASSESSMENT, RED RIVER OF THE NORTH BASIN**

The purpose of this study is to describe the status and trends in the quality of a large, representative part of the basin's surface-water and ground-water resources and to provide a sound, scientific understanding of the primary natural and human factors affecting the quality of these resources. (1991- )

*Haffield, Norman D. USGS 701/250-4601*

**63 OZONATION AS A WATER TREATMENT METHOD FOR PREVENTION OF INTERBASIN TRANSFER OF BIOTA**

The objective of this study is to evaluate the effectiveness of ozonation and/or filtration-cum-ozonation treatment in the control of fish pathogens and to evaluate the size and operation of a full scale ozonation process for application of Garrison Diversion transfer. (1992-95)

*Richard, Don NDSUCE 701/237-7244*

**64 SHEYENNE RIVER IMPROVEMENT PROJECT**

The goal is to reduce the amount of agricultural pollutants entering the Sheyenne River in Ransom County. (1990-95)

*Breker, Dave RCSCD 701/683-4101*

**65 SURFACE WATER/FISH STUDY ON LITTLE MUDDY CREEK BY US FISH AND WILDLIFE SERVICE NEAR WILLISTON, ND**

This scope of work uses fish surveys and analytical chemistry to assess contamination of the Little Muddy River. This combination of techniques will help identify whether fish are affected by contaminants at the individual and community level, and will identify the specific contaminants causing the effects.

*Herda, Steve NDSHCL 701/221-5210*

**66 WATER-QUALITY MONITORING PROGRAM FOR THE CHAIN OF LAKES NEAR DEVILS LAKE**

Water quality is being monitored on five lakes (Sweetwater Lake, Morrison Lake, Dry Lake, Lake Alice, and Lake Irvine) four times each year. (1993- )

*Berkas, Wayne R. USGS 701/250-4601*

◆ **Both Ground and Surface Water**

**67 BARNES COUNTY ECO-ED CAMP**

The camp includes a variety of activities which help sixth grade students gain a better understanding of woodland and prairie habitats, soil erosion, North Dakota wildlife, water quality, and boating safety. (1990-92)

*Bitz, Judy BCSCD 701/845-3114*

**68 CAMP GRAFTON SOUTH WATER QUALITY**

Assembling ongoing information on impact of military activities on ground-water and surface-water quality at Camp Grafton South. (1991- )

*Schuh, Bill SWC 701/224-2750*

**69 CHARACTERISTICS AND TAXONOMY OF SODIC SOILS AS A FUNCTION OF LANDFORM POSITION**

This study focused on related soil and plant characteristics to differences in soil water regime. (1988-90)

*Seelig, Bruce D. NDSUAGEX 701/237-7236*

**70 FATE OF WASTE PESTICIDE RINSATES DISPOSED IN AN ON-FARM EVAPORATIVE AND COMPOSTED PESTICIDE DISPOSAL SYSTEM**

This study is designed to evaluate one potential solution to the problem of on-farm disposal of dilute pesticide wastes generated by rinsing tanks used during pesticide applications and pesticide containers prior to disposal. This potential solution includes evaporating tanks and composting. (1991-93)

*Meyer, Hendrik J. NDSUENT 701/237-7906*

**71 FOSTER COUNTY NPS EDUCATIONAL PROGRAM**

The Regional Environmental Education Series is an educational project for elementary students in North Dakota. The programs are presented lyceum-style and are designed to educate mainly upper elementary school level students on conservation and environmental concerns in addition to water quality. (1992- )

*Vigesaa, Jill FCSCD 701/652-2551*

**72 HYDROLOGY OF THE FORT TOTTEN RESERVATION, NORTH DAKOTA**

The Devils Lake Sioux Tribe of the Fort Totten Indian Reservation is interested in resolving questions about the availability of water resources on the reservation and in developing a water-management plan. (1992-95)

*Wesolowski, Edwin A. USGS 701/250-4601*

**73 NUTRIENT MANAGEMENT TO SUSTAIN PRODUCTIVITY WHILE PROTECTING SURFACE AND GROUND WATER QUALITY**

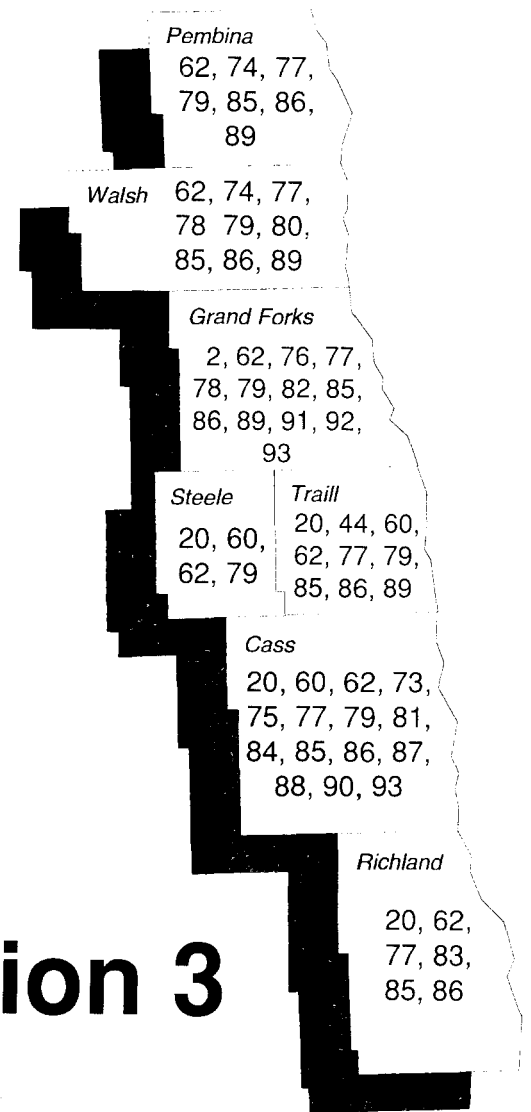
Determine applicability of the pre-sidedress soil nitrate test and develop complementary means for predicting crop N needs which will protect water quality. Determine the impact of nutrient, soil, water, and crop management systems on nutrient cycling and leaching using the NLEAP simulation model and develop improved systems to reduce contamination potential. (1990-95)

*Prunty, Lyle D. NDSUSS 701/237-8901*

**74 RENWICK, HOMME, AND MT. CARMEL WATERSHEDS AND ICELANDIC AQUIFER PROJECT**

The objectives are to improve water quality within the three reservoirs by reducing sediment and nutrient loading and to preserve the water quality of the aquifer. (1991-96)

*Wellman, Paul RRRCD 701/352-0127*



# Region 3

## Region 3 Projects

### ◆ Groundwater

**75 CONTROL OF ANNUAL WEEDS IN CROPS**

Research is in progress to determine the influence of salts in spray carrier water on herbicide efficacy. Results to date have shown that sodium bicarbonate in the spray carrier antagonized sethoxydiun (Poast) and glyphosate (Roundup) phytotoxicity. (1992-97)

*Nalewaja, John D. NDSUCWS 701/237-7971*

**76 DEVISING A WELLHEAD PROTECTION STRATEGY USING GEOGRAPHIC INFORMATION SYSTEMS TECHNOLOGY**

A pilot wellhead protection program has been initiated in which the primary objective is to determine how the implementation of a comprehensive wellhead

protection strategy can be achieved through the use of GIS technology. (1991-93)

*Hammen, John*    *UNDGEOG*    701/777-4246

**77 GROUND AND SOIL WATER MOVEMENT IN DISCHARGE WETLANDS, RED RIVER VALLEY, NORTH DAKOTA**

The objective is to characterize, through measurement and modeling, the interaction between surface water, soil moisture, and ground water in the Lunby-Stewart wetland of the central Red River Valley, and to develop and calibrate a generalized hydrological model of prairie discharge wetlands. (1990-92)

*Gerla, Philip J.*    *UNDGEOL*    701/777-2811

**78 MECHANISMS THAT CONTROL SEEPAGE OF SALINE GROUND WATER THROUGH GLACIAL CONFINING UNITS BENEATH THE RED RIVER OF THE NORTH AND ITS TRIBUTARIES**

An evaluation of the geo-hydrologic factors acting within the basin will benefit the overall analysis and assessment of the water quality in the Red River of the North. (1991-93)

*Strobel, Michael L.*    *USGSGF*    701/775-7221

**79 PATHLINE AND GEOCHEMICAL EVOLUTION OF GROUNDWATER IN A REGIONAL DISCHARGE AREA, RED RIVER VALLEY, NORTH DAKOTA**

Pathline analysis of ground-water flow in a transect across the valley combined with chemical equilibrium and mass balance relationships explain the processes responsible for the observed geochemical evolution. (1988-91)

*Gerla, Philip J.*    *UNDGEOL*    701/777-2811

**80 PROTECTION OF GROUNDWATER QUALITY IN THE FORDVILLE AQUIFER**

Because of highly permeable soils and shallow depth to the water table, the aquifer is highly susceptible to contamination. Ground water analyses obtained during past years suggest that the aquifer has been impacted by nitrate. The extent of the impact has not varied significantly. (1990-92)

*Gerla, Philip J.*    *UNDGEOL*    701/777-2811

**81 SUPERCRITICAL FLUID CHROMATOGRAPHY/ELECTROCHEMISTRY: A NEW ANALYTICAL METHOD FOR DETERMINING THE CONCENTRATION OF HERBICIDES IN NATURAL WATERS**

This project is exploring the feasibility of combining the highly sensitive and selective technique of electrochemical detection at microelectrodes with the new, powerful separation method of supercritical fluid chromatography. (1991-94)

*Tallmann, Dennis E.*    *NDSUCHEM*    701/237-8694

**82 VERTICAL NITRATE DISTRIBUTION IN THE ELK VALLEY AQUIFER; NORTHEASTERN NORTH DAKOTA**

The purpose was to establish the role of biological denitrification in minimizing concentration and distribution of nitrate and to determine the effect irrigation practices have on groundwater flow and nitrate distribution in the saturated zone. (1990-92)

*Mayer, Gale*    *EERC*    701/777-5000

**83 WAHPETON BURIED VALLEY AQUIFER; WHAT WE DON'T KNOW CAN HURT US**

In 1984, the water treatment plant manager in Wahpeton noticed a chlorination problem with one of the wells. The source of contamination was found to be holding ponds of a nearby sugarbeet plant. Remediation of the problem has been generally successful.

*Ripley, David*    *SWC*    701/224-2750

◆ *Surface Water*

**84 CHARACTERIZING THE QUALITY AND QUANTITY OF URBAN RUNOFF FROM WITHIN THE FARGO-MOORHEAD AREA. PHASE I: RUNOFF FROM A RESIDENTIAL AREA**

The objective of this program is to determine the significance of the pollutant concentrations and loads generated by urban storm runoff from the Fargo-Moorhead area and to evaluate the impact of the runoff on the receiving Red River water quality. (1992-93)

*Richard, Don*    *NDSUCE*    701/237-7244

**85 IMPACTS OF DISPLACED WIND EROSION SEDIMENTS ON SURFACE WATER QUALITY IN EASTERN NORTH DAKOTA**

This study will obtain information on the impact of clayey wind erosion sediments as nonpoint sources of NO<sub>3</sub>-N and chemicals that can pollute surface waters of eastern North Dakota. (1992-94)

*Cihacek, Larry J.*    *NDSUSS*    701/237-8901

**86 SOIL EROSION AND PRODUCTIVITY**

This study will attempt to characterize displaced wind erosion sediments over a large area and evaluate their potential for non-point source pollution of surface waters in the Red River Valley of the North. (1987-93)

*Cihacek, Larry J.*    *NDSUSS*    701/237-8901

**87 WATER-QUALITY ASSESSMENT OF THE RED RIVER OF THE NORTH NEAR FARGO, NORTH DAKOTA**

The objective is to document water-quality conditions and processes that affect water-assimilative capacities of a 31-mile reach of the Red River of the North downstream of Fargo. (1989-91)

*Wesolowski, Edwin A. USGS 701/250-4601*

◆ **Both Ground and Surface Water**

**88 A FEASIBILITY STUDY OF FIELD ANALYSIS OF PESTICIDES AND HERBICIDES BY LUMINESCENCE**

An innovative laser system for field analysis of organic contaminants in water has been developed at NDSU. The feasibility of this method is being studied. (1991-93)

*Gillispie, Gregory D. NDSUCHEM 701/237-8694*

**89 EFFECTS OF SALINE GROUND-WATER DISCHARGE ON WATER QUALITY OF THE RED RIVER OF THE NORTH, NORTHEASTERN NORTH DAKOTA**

The purpose of this study is to evaluate the impact of ground water discharge from bedrock sources through surficial Pleistocene sediments on water quality of the Red River of the North. (1991- )

*Strobel, Michael L. USGSGF 701/775-7221*

**90 GRADUATE STUDENT FELLOWSHIP**

An investigation of the possible use of High Performance Liquid Chromatography/Pulsed Amperometric Detection (HPLC/PAD) in analyses of natural water contaminants is being carried out. (1990-91)

*Wutzke, Mark Alan NDSUCHEM 701/237-8694*

**91 REMOTE SENSING OF ORGANIC CONTAMINANTS IN WATER BY In Situ LIQUID-PHASE MICROEXTRACTION AND INFRARED FIBER-OPTIC DETECTION**

The objective is to construct a remote fiber-optic sensing system which is general for the quantitative and qualitative detection of all organic compounds in water and has the sensitivity (low ppb) to be used on a real-time basis. (1993-95)

*Tilotta, David C. UNDCHEM 701/777-2741*

**92 SUPERCRITICAL FLUID EXTRACTION (SFE) METHODOLOGY FOR LABORATORY AND FIELD USE**

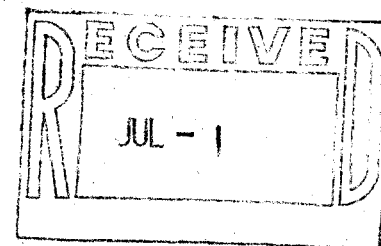
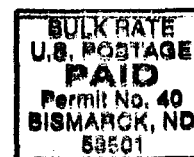
The study will investigate and develop the use of SFE and coupled SFE-GC for the rapid and quantitative extraction and analysis of organic pollutants from environmental matrices related to chemical spills, including soils and sediments, water, and air samples collected on resins. (1991-94)

*Hawthorne, Steven B. EERC 701/777-5000*

**93 SYNTHESIS, CHARACTERIZATION AND STABILITY OF OXYANION-SUBSTITUTED ETTRINGITES**

The objectives were to: explore synthesis; define the ranges of solid solution substitution and characterize each of the substituted Et phases in the solid state; determine the extent of removal of borate, chromate and selenate on precipitation of an ettringite structure phase; determine the stability of each phase in simulated ground water. (1990-91)

*McCarthy, Greg WRRRI 701/237-7193*



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