# Summary Proceedings

# MONTANA GROUND WATER CONFERENCE

## "Planning a Ground Water Strategy"

April 22-23, 1982



MONTANA ENVIRONMENTAL QUALITY COUNCIL
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Helena, Montana 59620
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MONTANA ENVIRONMENTAL QUALITY COUNCIL

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## FOREWORD

The Montana Ground Water Conference held on April 22-23, 1982, in Great Falls, Montana, was jointly sponsored by the Environmental Quality Council, the Water Resources Oversight Committee of the Legislative Council and the Montana Water Resources Research Center, Montana State University.

These proceedings consist of abstracts prepared by the speakers or summaries prepared from their recorded presentations. A complete set of the recorded proceedings are on file at the Environmental Quality Council. Although these abbreviated proceedings do not include the many illustrations and data which were presented visually, it is a summary record of the conference.

Following the conference, an ad hoc technical group was formed by the Department of Natural Resources to review and evaluate the issues and recommendations made during the conference. The technical group then prepared a report on the Status of Ground Water in Montana.

In its regular meetings following the conference the Environmental Quality Council considered the issues and recommendations of the conferees and subsequently recommended to Governor Ted Schwinden that a Ground Water Advisory Council be appointed to develop a comprehensive ground water policy and management strategy. The Governor acted on this recommendation in 1983 by appointing a 16-member council.

JUNE 1983

Howard E. Johnson
Research Scientist
Environmental Quality Council

# INTRODUCTION

Ground water is one of Montana's most abundant and vitally important natural resources. Although inventories of ground water supplies are incomplete, hydrologists have described extensive aquifer systems that exist in several parts of the state. Nearly one-half of the state's domestic water needs are derived from ground water and in some locations it serves as the only available source of fresh water for both domestic and livestock needs.

Unlike many regions of the nation, Montanans have not placed excessive demands on their ground water resources. Except in a few instances, the state's ground water has not suffered either from depletion or contamination. But demands for water are rapidly accelerating and resource specialists generally recognize that competition for water in the western states may reach crisis proportions within the next two decades.

Montanans have not ignored their ground water resources. Beginning in the 1940's, and at various times since, the state legislature has wrestled with the problems of ground water conservation and ground water property rights. Through these efforts the state has established modern laws and institutions to govern the use and development of this resource.

But despite these progressive efforts there continues to be an urgent need to develop an improved ground water information base, to develop policies that meet the future needs of ALL WATER USERS, and to develop comprehensive strategies that provide for optimum sustained yields of all small water resources. These efforts are necessary to protect existing water sources and to aid in the logical development of new ground water sources.

Finally there is a particular need for a greater awareness of our water resources on the part of all Montanans. It is this need that provided the impetus for the Montana Ground Water Conference. The Environmental Quality Council, working with the Water Resources Oversight Committee and the Montana Water Resources Research Center planned and organized the conference to alert legislators, water user groups and the general public to some of the unique properties of ground water and the requirements for its management and protection. The organizers viewed the conference as an opportunity for Montanans to begin planning a ground water strategy.

# GROUND WATER BASICS

Joe Moreland

There are many misconceptions about how and where ground water occurs. An understanding of the hydrologic cycle and the various interrelationships between surface and ground water is important.

Water movement through the hydrologic cycle may begin with evaporation from the ocean surface; it then condenses into clouds and falls as precipitation on the land where it immediately begins its return to the sea. We are all familiar with the part that returns to the sea as a surface stream but much of the precipitation enters the ground. Some is used by crops and other plants but significant amounts move downward to a saturated zone where all void spaces in the ground are filled with water. The top of this zone is called the water table and the water below this point is called ground water. If the void spaces are large enough and sufficiently interconnected to transmit water, the zone is termed an aquifer. Aquifers occur at nearly all locations but at variable depths below the surface.

Water movement in an aquifer occurs in hard rock and in compacted soils. The concept of water movement in the ground has been demonstrated by the use of sand box models. As water moves through the system toward a discharge point, it moves at all levels, not just at the surface. The movement occurs as a laminar flow, along definite flow lines, with very little mixing of adjacent flows. The laminar flow is usually continuous through the aquifer to the discharge point. This physical characteristic of ground water has important implications when considering ground water pollution.

## Major Types of Aquifers

Unconsolidated aquifers - These are areas of unconsolidated, relatively loose sands and gravels that have as much as 30% to 40% volume as void space. These are typical aquifers in the intermountain valleys of western Montana and they underly most of the major streams in eastern Montana. Most aquifers of the world that produce large volumes of water are of this type. Properly constructed wells in unconsolidated aquifers may yield several thousand gallons of water per minute. Through geologic activity some unconsolidated materials have been compacted and cemented to form hard-rock formations including sandstones. Many of these formations retain as much as 10% of the void spaces and they usually are productive aquifers. For example, wells drilled into the Fox Hills sandstones in Eastern Montana produce as much as 100-200 gallons per minute.

Hard-Rock aquifers - Even hard rock, like granite, which has virtually no interstitial pore space, still contains considerable void space in the form of fractures and joints in the bedrock. The spaces may yield water in sufficient quantity (1-2 gpm) to meet domestic or livestock needs.

Limestone aquifers - These aquifers have special characteristics because the ground water moving through spaces in limestone formations actually dissolve the rock and form solution cavities. The Lewis and Clark Caverns are particularly well developed examples of solution cavities. The Madison aquifer in the Powder River Basin of Montana is largely a limestone aquifer with many interconnected solution cavities. Wells in this formation are known to yield up to 6000 gallons per minute.

Coal bed aquifers - Coals are generally impermeable materials without porosity, but coal beds are usually highly fractured and jointed which allows free movement of water. Several thousand domestic and stock water wells in eastern Montana derive water from the coal bed aquifers.

Confined aquifers - These aquifers are overlain or underlain by impermeable materials. Water in a confined or artesian system is usually under pressure. The pressure head depends on the elevation at which the water enters the system (the elevation of the recharge system) and the transmissivity of the rocks. Wells drilled into these formations will usually result in the water rising in the well, and some will produce flowing wells of very large capacity.

## Hydrologic Evaluation of Aquifers

Ground water is present in nearly every location but the problem is to determine how much, at what depth, and of what quality. A hydrologist begins his evaluation of ground water availability by consulting a geological map to determine the types, location and age of rock formations. These data are coupled with information obtained from geophysical surveys e.g., resistivity surveys, and seismic surveys. These studies are followed by collecting data on the volume and quality of water. Existing wells in an area are inventoried to determine water levels and water chemistry. Some selected wells are monitored over longer time periods using water level recorders to determine changes due to recharge and pumping. Pumping tests may be conducted to determine aquifer production and the rate of water decline in nearby wells; in some instances large test wells may be constructed for this purpose. As an aquifer is pumped, the water table declines to form a cone of depression. These data, the cone of depression plus the rate of withdrawal, can be used to estimate the storage capacity of the aquifer (storage coefficient). The cone of depression data also indicates the transmissivity of the aquifer, i.e. the potential rate of water movement within the aquifer.

Usually the hydrology study requires additional wells to be drilled. Test wells in the unconsolidated bed material may be relatively inexpensive, requiring only an auger drill of less than 100 feet. A drilling crew may operate at $300-$400 per day. However for wells of greater depth or for large diameter wells drilled in hard rock, the costs may range from $10 to $20 per foot depending on the types of formations being drilled.

A few years ago the Congress asked the U.S. Geological Survey to investigate the Madison Aquifer in south eastern Montana. The average depth of the aquifer in that area lies about 10,000 foot below the land surface. Construction costs for a single well in this area were approximately $1.5 million.

After a hydrological study is complete the data are available to aid individuals in deciding where to drill wells. To increase the availability of these data for all interested individuals and agencies the U.S.G.S. has developed a computerized data file. The Ground Water Site Inventory System contains information on more than 15,000 wells in Montana that have been inventoried by the U.S.G.S. and various cooperators.

## Ground Water Problems

Any time a well is drilled into an aquifer system it causes changes in the natural flow system. Because individual wells are drawn down at different rates, well interference is a frequent ground water problem. A similar problem exists where a number of wells are drilled adjacent to streams. As wells are developed, the ground water flows to the stream are diminished and the stream flow is reduced or lost.

Another type of problem is over draft. If excessive numbers of wells are installed in a ground water system more water may be withdrawn than is replenished. Water levels will continue to decline causing some wells to go dry or to make pumping costs excessive. This problem has occurred in many parts of the west, especially in the High Plains of Texas and some of the alluvial valleys of the southwest.

Some problems may be avoided by preliminary modeling efforts. Modeling, using digital computer systems, can simulate ground water flow and aquifer response to development. Preliminary modeling of an aquifer is useful in estimating potential yields and management procedures.

Ground water contamination is among the most serious ground water problems. Unlike surface water pollution, which can be observed and more easily tested, contaminated ground water may go unnoticed until after several years or until negative effects begin to show among the user groups - e.g. the Love Canal area of New York.

Those who suggest underground injection of waste products to minimize contamination of surface waters may not recognize the potential impact on ground water quality. If wastes are injected above the ground water table, there will almost surely be contamination of the shallow drinking water supplies. Some have advocated injecting wastes into deep, unused aquifers that are confined by impermeable layers. There are two problems with this concept: (1) There is no certainty that the water in the deep systems won't be needed at sometime in the future -- especially if it is fresh water. (2) There is no guarantee that contaminated water will remain in its deep confined position. Montana has many geologic faults which can transmit water, and major earthquakes could easily open new fractures in a supposedly confined system. It is also possible that old wells drilled in the 1930's or before may not be identified. An abandoned well sufficiently close to an injection well can allow cross contamination to a drinking water source. The potential for contamination of valuable water supplies also can occur due to faulty well design or deterioration of injection wells with age. Although monitoring wells are planned for deep injection systems, there is strong potential for error in interpreting the data due to laminar flows of the ground water. Once a ground water system has been contaminated, the problem is very difficult to correct.

During the 1930's many homesteaders had to abandon farms because of drought. We now have technology available to find sufficient water to sustain farmers through any drought. However if the ground water has been contaminated, it won't be available in time of need.

# THE GROUND WATER RESOURCE IN MONTANA

William Hotchkiss

This conference is an ideal time to begin planning a strategy for managing and protecting Montana's ground water resources. In many regions of the nation failure to conduct preliminary planning and studies has resulted in long term problems that are very expensive and difficult to correct. This presentation provides a brief overview of the types of data that are needed for planning a ground water strategy and a brief description of the types of ground water resources in Montana.

## Ground Water Studies

Because of advances in hydrology and other related sciences, we are now able to model ground water systems and predict changes that will occur with various water uses. These models are dependent on the availability of information and specific data that describe the properties of an aquifer. Some of the key properties of an aquifer include data on the following:

Potentiometric surface - the level to which water will rise in a well. If this information is known for a number of wells drilled into the same aquifer, it is a descriptive property of the aquifer.

Transmissivity - a measure of the rate of water movement in the ground. This parameter is dependent on the porosity of the aquifer system and the rate at which the aquifer can be recharged.

Storage capacity - a measure of the amount of water stored within an aquifer. For example, in the Dakota sandstone, a group of wells may take out 3000 gallons per minute over a year's period, but studies have shown that only about 500 gallons per minute are recharged. Thus, about 2500 gallons per minute are taken out of storage and not replaced.

In a water table aquifer, there is a certain porosity that allows drainage. Generally porosity and the yield from drainage are approximately equivalent, ie. a 20% porosity aquifer will yield about 20% of the water. This is called the specific yield or storage capacity.

Strategies, using these three forms of data, can be developed to allow optimum use of the water. Most data used at present are from wells drilled for other purposes, eg. domestic wells, livestock water or irrigation.

Data obtained from these sources are relatively inexpensive; but we are now at a point in time where we must invest in more expensive sources of data, eg. deep wells of 10,000 ft. or more that have been used to study the Madison limestone aquifer.

It is also essential that we look at these water data over time to determine what changes are taking place. Fluctuations in water levels may occur within days or over several years. The more complete the record is over time, the better will be the predictions and management strategies.

Some of these data must be measured by extended pumping tests in the field. The transmissivity and storage are determined by testing surrounding wells when an aquifer is drawn down to a known level. Water chemistry is also determined in mobile field laboratories to determine the water quality and its potential usefulness.

In agricultural valleys we may develop strategies to recharge depleted aquifers. In California, there were cases where water was pumped from deeper and deeper depths with increasing costs for bringing the water to the surface. A plan was devised to channel water from a river system into a recharge zone. This reestablished the supply and provided cheaper water sources.

In urban areas the loss of recharge zones has occurred due to the impermeable layers of parking lots, streets and buildings. The runoff is rapid at particular points of discharge rather than over wide areas. Information about recharge zones in these areas is also important in developing management strategies.

Data developed from studies can provide predictions on safe yields of water from an aquifer. We can determine how much water is used and how much is recharged. In the adjudication of water rights we can determine how much water can be removed without decreasing storage.

Management strategies are also necessary for multiple aquifers at different depths. In Montana water users have generally sought out first-water for whatever the use. If sufficient water is not available at first-depths then drilling may be continued to deeper levels. A single well may then penetrate several aquifers with potential comingling of one water source with another.

## Ground water distribution and use in Montana

Areas along the Missouri and Yellowstone valleys, the intermountain valleys of western Montana, and the cultivated dry lands of Montana are potential ground water problem areas in the state. The cultivated dry lands also pose potential problems for ground water quality.

In the western part of the state, the intermountain valleys contain alluvium fill along the streams and sedimentary rock. Wells in these areas may yield up to 1000 gallons per minute, usually of high quality water with low total dissolved solids. In total there may be as much as 60 million acre feet of water available throughout this system.

In the eastern part of the state there is alluvium fill in the river valleys that may yield from 10 to 4000 gallon per minute. Along the northern borders there are glacial deposits with diverse materials of various porosity. In the south central valleys, like the Beaverhead, Gallatin, Madison, Helena and Townsend areas there may be up to 6000 feet of highly transmissive basin fill material. In the Gallatin valley, for example, 20,000 to 100,000 acre feet of water may be withdrawn without exceeding recharge rates.

In the dry land cultivation areas such as the Hogeland Basin and the Alberta Basin, saline seep is a problem. Total dissolved solids in these waters may be as high as 30,000 milligrams per liter. Saline seep has resulted in more than 200,000 acres of farming land being taken out of production. The loss can be prevented by use of non-fallowed type crops.

Hard rock aquifers including sandstone exist in the Alberta, Judith, Hogeland, Big Horn, Crazy Mountain, Bull Mountain, Williston and Powder River basins. The Powder River Basin has been used as a conceptual model study area to identify various geological formations that hold water. Wild cat oil well log data have been used to study this region. The geophysical logs are used to determine the thickness of aquifers and to measure transmissivity and storage capacity.

The Powder River basin study was part of a larger study to assess the aquifers of the Northern Great Plains. The study dealt with 21 different aquifers in the eastern two-thirds of the state. Six aquifers were targeted as especially important in most of the basins.

The U.S. Geological Survey studies have concentrated on those areas which are suitable for high capacity wells or where energy needs dictate the need for water data.

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# WATER AVAILABILITY AND THE NEED FOR GROUND WATER IN THE FUTURE

Wayne Wetzel

Montana is somewhat unique among western states, in that unappropriated surface waters are still available in some streams. This fact, coupled with relatively large volumes of water leaving the state each year, has fostered a perception of abundant and available surface water in most of the state. This perception may not be correct in many cases.

Factors which limit water availability over a large portion of the state include downstream hydropower requirements and instream flow requirements. Also, presently unquantified Federal and Indian reserved rights, Federal stored water rights, and water quality limitations create uncertainty about available water.

Claimed rights to hydropower flow rates at generating facilities at Noxon Rapids dam on the Clark Fork and Cochrane dam on the Missouri are well above the average flows at these sites. Waters are considered available for appropriation only when flows exceed the storage and generating capacities of these facilities; a situation which does not occur in some years. Likewise, instream flow reservations on the Yellowstone River and its tributaries have reduced the amount of surface water available for use. On an average annual basis, there is still water available. However, new water users may require a dependable supply, for example, water available eight years out of ten for new irrigation. The reliability of supply to projects not contemplated under the water reservation process could be a limiting factor to development of new ventures.

A final resolution and adjudication of SB 76 claimed water rights and negotiated Federal and Indian water rights is expected to have a significant effect on water availability. In addition, stored water in Federal water projects can result in water being available only through water purchase contracts, as is the case in the Milk River basin. Future uses of water in this basin may require increased water conservation and utilization practices by existing users and/or diversions offering supplemental water. Finally, in certain basins, water quality limitations may restrict any substantial future water development in order to maintain and protect existing users. The most noteworthy example of this is Big Muddy Creek.

For a number of reasons, then, development of ground water may be necessary to supply or supplement future water use. However, development of ground water supplies, especially for large-volume wells, cannot generally be regarded as a panacea for future water supply problems. Most high volume wells for irrigation (the major consumptive water use in the state) are located in shallow ground water systems, which usually have some hydraulic connection with surface waters. Thus, extensive withdrawals from shallow ground water systems often result in streamflow depletions.

Another problem with ground water use is the difficulty in assuring that the initial volume necessary and available for a project will continue to be available over the life of the project. Most water well drillers do not employ scientific techniques to determine aquifer properties and capabilities. This can result in a huge investment that sits idle long before it is paid off because water levels fail to recover in an initially promising well. There is also the tendency for neighbors to try to cash in on the good fortune of one who is successful in the development of a ground water project. This often results in well clusters, without proper regard for well spacing to avoid interference or the ultimate capabilities of the aquifer.

Very little is really known about the potential for development of ground water from deeper bedrock aquifers (e.g. Hell Creek-Fox Hills, Kootenai, and Madison). Frequently water in these aquifers is confined (under artesian pressure) so that even though the wells penetrating these aquifers are deep, pumping lifts are not significantly greater than in shallow aquifers. Under favorable topographic and geologic structural conditions, wells penetrating these formations may flow. In fact, one of the biggest water management challenges is to enforce compliance with Montana ground water law requiring valves to regulate flowing wells and to shut in these wells when not in use. Where such wells exist (e.g. South Pine controlled ground water area) ignorance, apathy, and neglect can result in the waste of a valuable ground water resource.

# THE IMPORTANCE OF GROUND WATER TO MONTANA AGRICULTURE

Dr. Hayden Fergusen

Most ground water in Montana occurs as a result of three processes: (1) Some ground water exists in confined aquifers where it was trapped within impermeable layers during ancient geologic events. (2) Much ground water, especially that in the shallow aquifers, is the result of downward percolation of water through soils and other geologic layers. When this water reaches an impermeable strata it accumulates and forms a water table. This is the source of most ground water of the Montana plains, foothills and intermountain areas. (3) Some of the more important ground water systems occur where very permeable geologic layers intercept free surface waters. Usually these permeable layers are between layers of much less permeability. Water movement within these aquifers is very rapid. Examples of these ground waters include artesian systems and water flowing within coal beds.

Ground water quality is largely determined by the nature of the materials with which it is associated. Water in confined aquifers is often saline because of its long association with marine shales that contained large quantities of soluable salts. Water passing through soils has variable quality depending on the physical-chemical properties of the soils-geologic systems. Water tables that form under coarse textured soils -- sand and gravel -- are generally of good quality for most agricultural uses. Examples of this type of ground water exist in areas of western Montana and in the old Missouri River channels of northeastern Montana.

Many of the soils in northern and eastern Montana plains are "young soils" due to relatively small amounts of water which has passed through them. Prior to farming in these regions, the soil texture and native plants minimized the leaching of salts into the water table. In recent times farming practices have allowed accelerated movement of water and leaching of salts into the water table causing a degradation of water quality. In the mountains-foothills area where precipitation is higher and evaporation is less the soils are, "older," and the ground water is generally of good quality.

Water flowing in artesian systems is generally useable but in areas of limestone the water is very hard. Water flowing through coal beds are of the same type but generally not as hard. Coal mining may modify the water quality around the mine sites, but probably it will remain useable.

Recent activities by man have increased the quantity of ground water in Montana. Irrigation converts a tremendous amount of runoff water into ground water. This process causes the leaching of some nutrients and the salinization of some soils. Most of this ground water is in shallow zones which underlie irrigated river valleys. Waters entering ground water from irrigation may be slowly released back into the streams and thus are a signficant factor in maintaining downstream flows during low flow periods.

Dry land farming in general and summer fallow in particular have resulted in a significant increase in the quantity of water moving through soils and a dramatic build-up of water tables in many areas of Montana. This water has moved through very "young soils" and the developed water tables are of very poor quality. Saline seeps and salinization of surface waters has been the result.

One of the most important long-term beneficial uses of ground water in Montana is for watering of livestock. In many regions, expecially where shallow aquifers are used, the quality of livestock water has decreased and it will eventually be unuseable.

Ground water is and will continue to be important for irrigation. Expansion of irrigation is possible near some of the larger streams and in the intermountain valleys, but it is unlikely that irrigation with ground water will ever occur in other areas. Irrigation in northeastern Montana is a unique case but it may have a very limited life, because the use appears to exceed recharge. Theoretically deep ground water in eastern Montana could be used for irrigation but it is unlikely to occur due to the costs of pumping from such great depths.

# ARIZONA GROUND WATER REFORM

Verne Doyle

In June of 1980, Arizona passed the most comprehensive water management law in existence in the U.S. today. This legislation was considered absolutely essential in order to establish a balance between consumption and supply.

Arizona is currently using water twice as fast as the natural replenishment rate to support the existing population and economy. Arizonans, statewide are consuming 2.5 million acre feet more water annually than is replenished. This is possible only by overdrawing ground water supplies. The problem is compounded by Arizona's growth rate which is five times the national average. Studies have clearly shown that the state's water resources are insufficient to maintain the existing economy, let alone the anticipated growth of the cities and industries. The available supply would support municipal and industrial growth to a population of 20+ million -- but only if all agriculture ceased. This same amount of water would not continue to meet current agricultural needs even if all other uses were to cease. To meet this dilemma, Arizona has acclerated its efforts to establish meaningful water policies.

The only remaining undeveloped water resource available to the state is its remaining entitlement in the Colorado River. This supply is being developed through the Central Arizona Project (CAP). In the act authorizing the CAP, Congress prohibited new lands from being brought into irrigation. Second, the CAP contract provides municipal and industrial uses with a 100% priority over all agricultural uses in times of shortage. Third, the CAP contract requires that agricultural uses must reduce their pumping of ground water by an amount equal to the amount of CAP water they receive. Fourth, the cities and industries were given first priority to contract for CAP water.

The CAP project, when completed will increase Arizona's renewable water supply by almost 50% and reduce by two-thirds the current rate of overdraft. This will improve the state's ability to manage the water supply imbalance, but a substantial reduction in current uses is also necessary

The new water management law mandates three levels of management:

1. Active Management Areas (AMA) - Four management areas have been established which include 80% of the state population and 70% of the water consumption. Three AMA's are urban areas where the management goal is to achieve a balance between supply and consumption no later than the year 2025. One AMA is an agricultural area where the management goal is to extend the agricultural economy as long as practicable through a program of planned depletion.

   Within a management area all water users must apply for a grandfathered right or a new permit. The applicant is afforded a comment and review period and a court appeals process. Once the appeals process is complete, certificates of grandfathered rights are issued.

   Three types of rights are possible:

   (a) irrigation - to qualify the land must have been irrigated at some time between January 1, 1975 and January 1, 1980.

   (b) non-irrigation (Type I) - limited to 3 acre feet per acre; can be established by retiring agricultural land.

   (c) non-irrigation (Type II) - a right aquired by city or industry without purchase or retirement of an agricultural use. The amount is limited to the maximum amount of water pumped in the preceding five years.

Rights may be sold or conveyed to new users but only 3 acre feet/acre/year may be transferred or sold by other than agricultural users.

2. The second level of management applies to critical ground water areas which were not included in the Active Management Areas. In these areas no expansion of agriculture is permitted; all wells are metered but there are no pump taxes, no grandfathered rights and no management plans.

3. The third level of management includes the remainder of the state where old existing laws will prevail except that all wells must be registered and new or modified wells must be drilled by a licensed driller according to standards established by the Department of Water Resources.

Within each Active Management Area, the Director must establish a water duty -- the amount of water that can be used for each farm or a portion of a farm. This duty is based on the historical use of the land, soil characteristics, climate and farming procedures that are representative of reasonably achievable levels of irrigation efficiency. Similarly the Director must establish reasonable limits of per capita consumption for each city and private water company in an active management area.

New management plans must be established at 10 year intervals and in each the Director is required to force improved efficiency of use by reducing the allowed irrigation and per capita use rates.

Up to one-half of the administrative costs can be provided by a withdrawal fee levied on all water withdrawn within an active management area, except for water used for domestic purposes at 35 gpm or less. The remaining one-half of administrative costs are derived from the state's general fund.

The new law also places constraints on new housing subdivisions. A new subdivision may not be developed unless the developer can provide evidence of an assured water supply that will last 100 years.

The new law is progressing well albeit more slowly than was envisioned in the statutes. Economic recession and a decline of state revenues has reduced the available funds and positions needed for the new program. However this is considered a temporary set back. It is necessary that Arizona accomplish effective water management now if her citizens are to be assured a continued vibrant economy and a high standard of living in the future.

# AN OVERVIEW OF PAST AND PRESENT PROBLEMS

Dr. Sid Groff

The collection and evaluation of ground water data is seen as essential for the management of integrated surface and ground water systems. Very modest but productive efforts to inventory ground water in Montana were initiated in the early 1900's. Cooperative studies by the U.S. Geological Survey and the Montana Bureau of Mines were initiated in 1957 when the state legislature began financial support for these efforts.

Various agencies throughout the state have collected a vast quantity of data but access to and the use of the information requires a computerized data storage and aquisition system. The Montana Bureau of Mines has started building a data aquisition system primarily through outside funding. It is important for the state to recognize and support a system which will meet the needs of research, public information, and proper resource management.

Some major problems which continue to exist in the state include the following:

1. There exists a lack of understanding of how ground water systems function. Although ground water is at least 1000 times more abundant than surface water only a small amount is available due to limited well yields and chemical quality that is not suitable for many uses.

2. Protection of water quality is essential. Much of eastern and central Montana is wholly dependent on ground water for stock and domestic use. Although excessive carbonates in some waters limit their use for irrigation, this entire region would be seriously injured if ground water quality is allowed to be degraded.

3. Many municipalities and subdivisions are increasingly dependent on ground water sources. Sewage and other waste disposal practices pose a continuing threat to these water supplies.

4. There is a significant potential for overdraft of some ground water supplies and for well interference conflicts between users. Montana is in an excellent position to control and prevent these problems which have plagued other states.

5. Severe water shortages in other states will increase their demands on water from Montana and from other states with more abundant water resources. This is especially true for the important agricultural regions of the High Plains.

6. The most complex and pervasive problem is the contamination and pollution of existing, useable, ground water aquifers. Our ability to correct past contamination is limited but much can be done now to prevent problems in the future. Saline seep is currently the most significant existing ground water problem. It can be prevented and in most cases alleviated by properly applied agriculture cropping systems.

7. Present legal systems of "first in time - first in right" which has applied to water in the past is not appropriate for developing artesian basins in Montana. Montana should learn from other states - eg. California and Arizona, where artesian basin management has been recognized.

# MINING ACTIVITY AND GROUND WATER QUALITY

Fred Shewman

Mining and related activity is but one of the many potential impacts on water quality that falls within the jurisdiction of the Water Quality Bureau of the Department of Health and Environmental Sciences. Montana has not had large areas of ground water polluted by mining but there are a number of cases where mines have had negative effects in local areas.

Several types of mines and milling activity can cause adverse effects on ground water. To protect against contamination it is necessary that water associated with the mine and milling processes are carefully contained.

Hard rock mines release water with low pH, high concentrations of metal ions, and elevated total dissolved solids. Metal ores are often associated with sulfides which form acids when they are oxidized by contact with water and air. The acid waters in turn increase the solubility of metals which may occur in the water at toxic concentrations. Milling processes for hard rock mines accelerate these conditions through the flotation of finely divided ore particles and the use of various reagents which may also be toxic. The flotation tailings, which are residues of the milling process, act as a continued source of pollutants after mining and milling are completed. These problems are most prevalent in the mountains of western Montana.

The processing of tailings through cyanide leach mills is a mining process which has increased recently due to the increased price of gold. Tailings from previously worked mines are crushed and leached with cyanide solutions to extract gold into solution. The gold is then recaptured by precipitation but the cyanide solutions pose a toxic threat to ground and surface water unless they are carefully contained. Cyanide solutions may move considerable distances in shallow ground water to impact nearby wells or surface waters.

In-situ mining of uranium is a process that has not been developed in Montana, but it has caused concern because of the potential for development in the future. Several locations in the state have sources of uranium which may become important if the demand and price increase.

Uranium and other associated minerals occur in deposits where they were precipitated by reducing conditions in the ground water during earlier geologic events. These materials can be resolubilized by injecting oxidizing chemicals into the water surrounding these deposits and pumping the material to the surface. The uranium is then precipitated and the solutions reinjected into the deposit along with additional oxidizing solutions. These processes pose a potential threat to other ground water users, many of whom are dependent on the same water sources. The Water Quality Bureau has developed regulations to control these operations, but uranium mining is not presently active.

Coal mining creates problems with ground water where the spoils are pushed back into the mined trenches. Water percolating through the spoils increases the sulfate concentrations and other dissolved solids, causing a degradation of the ground water quality.

Most mining-related water quality problems are from past activities. However, due to recent economic conditions, there has been a dramatic increase in new or proposed mining efforts during the past two years. The Water Quality Bureau has received an increasing number of applications for discharge permits for mining operations and plans for ore processing facilities. As another indicator of increased mining activity, the number of Small Miners Exclusions Statements filed with the Department of State Lands has increased from 796 in 1977 to 1275 in 1981.

# COAL DEVELOPMENT AND GROUND WATER IN EASTERN MONTANA

Wayne A. Van Voast

Hydrologic research is providing insight into possible problems with future mining at several mines in southeastern Montana. Results thus far do not indicate any likely catastrophic hydrologic effects from any single mine, but rather some relatively minor changes that in some places can be locally significant. Potential cummulative effects of many mines need careful evaluation, however, particularly with respect to water quality.

Pumping of effluents may be necessary from some mine pits that penetrate the water table. Effects of these discharges do not seem detrimental. The effluents are mixtures of ground waters that in most places discharge naturally to the surface. Pumping of effluents from pits is an acceleration of natural-discharge processes and has not created serious water-quality changes.

Active pits that penetrate the water table cause some declines of water levels in wells. The rapidity of decline depends upon the rate and depth of pit development. Most mine cuts near Colstrip are along coal outcrops where aquifers have low water levels and the resulting water-level declines are almost imperceptible. A mine pit at West Decker penetrates about 40 feet below the water table, and water levels in observation wells have declined more than 20 feet as far as two miles from the mine. No groundwater supplies are known to have been seriously affected by any mining thus far in southeastern Montana, but the losses of some are inevitable as operations expand. Fortunately, other aquifers are present below the strippable coals and they can be utilized by drilling deeper wells.

As individual mines are completed, water supply and chemical quality will attain a new equilibrium depending upon the hydrologic and geochemical character of the mine spoils. To permit an estimation of whether postmining flow rates and patterns will be appreciably different, many aquifer tests have been conducted at research wells in spoils and in undisturbed materials. Inferences are that mine spoils are generally as permeable as the coal beds they replace and that the permeability is greatest along the base of the spoil materials because of accumulations of wasted coal and other coarse rubble. Changes in land surface which will affect surface-runoff patterns (formation of local ponds for example) could affect recharge patterns and thereby alter ground water flow patterns, either beneficially or detrimentally.

Chemical quality of mined-land ground water is different from that in coal-bed aquifers. Research thus far indicates that concentrations of some trace elements are greater in waters from spoils. As a general rule, mined-land water seems to contain two to four times the dissolved-solids concentrations that occur in non-mined-area water. These changes in dissolved solids are considered the most significant effects of mining, and require the most careful evaluations.

## SUBDIVISIONS AND SEWAGE DISPOSAL

Ed Casne

There are two laws which affect subdivision development in Montana: 1) The Sanitation in Subdivisions Act, which is administered by the Department of Health and Environmental Sciences and 2) the Subdivision and Planning Act, which is administered by local governing bodies.

Among other things, the Sanitation in Subdivisions Act provides for the protection of ground and surface waters through rules promulgated by the Subdivision Bureau.* The functions of the Subdivision Bureau were incorporated into the Water Quality Bureau in November, 1982. During the 21 years the law has been in existence, it has been modified several times to improve resource protection and the protection of individuals purchasing land within a proposed subdivision.

All new applications for a subdivision must have the sanitary restrictions lifted before a plat is filed with the County Clerk and Recorder. This requires the developer to show evidence that adequate water supply, sewage disposal, and solid waste disposal will be provided without negative impact on the water resources, neighboring lands, or other resource uses.

The Sanitation in Subdivisions Act has several provisions for protecting water resources. The Act requires the Department of Health and Environmental Sciences to establish rules for various types of water supply and sewage disposal that will protect public health. In establishing these rules the department must take into account other uses of the water, eg. water quality for wildlife, recreation, industry and agriculture. The rules must relate to the size of lots, contour of the land, porosity of the soils, ground water levels, distances to lakes and streams and to other water wells in the area. Adequate evidence must be given to show that water supplies will have sufficient quantity, quality, and dependability.

These rules are especially important in rural subdivisions where individual wells and septic systems are used. Some of the specific rules that are implemented to protect water resources in rural subdivisions are as follows:

1. It is generally required that lots be one acre or more in size to provide adequate space for septic systems and to reduce the chance of ground water contamination.

2. The seasonal high-level of ground water must lie six feet or more below the surface. This minimum depth is necessary to allow adequate treatment of sewage within the soil without contaminating ground water.

3. A one-hundred foot minimum set back from existing wells or running water is required. This protects against direct contamination of surface and ground water sources.

4. Water quality as determined by sample analysis must meet water quality standards.

5. Subdivisions of more than five lots require a hydrogeological report to show evidence that ground water supplies will meet projected demands. Pump tests on wells are necessary to insure that new wells will meet projected demands without adversely affecting neighboring wells.

6. Large new subdivisions using central water systems of over 100 gallons per minute must file for water rights with the Department of Natural Resources and Conservation.

After completing a review of a proposed subdivision the department may issue a certificate of approval, which is assurance that the proposed water supply, sewage disposal, and solid waste disposal plans are satisfactory.

* The functions of the Subdivision Bureau were incorporated into the Water Quality Bureau in November 1982.

# TOXIC, HAZARDOUS AND SOLID WASTE DISPOSAL

James Harris

Solid waste disposal in the State of Montana is regulated by the Solid Waste Management Bureau of the Department of Health and Environmental Sciences under several statutes. The Federal Resource Conservation and Recovery Act (RCRA) also contains criteria for the proper disposal of refuse.

Ground water is sometimes contaminated by improper disposal of household garbage, agriculture waste, and trash from municipalities. The ground water may be contaminated directly if the disposal site is dug into the water table or indirectly if leachate is carried out of the site into the ground water. Contaminants may include organic waste, dissolved metals, and pesticides, and other toxic materials. Proper selection of landfill sites and proper coverings of closed dump sites will minimize or prevent these problems.

The Underground Injection Control Program (UIC) is regulated by the federal RCRA. The Safe Drinking Water Act will also address underground injection when regulations for the UIC permit program are promulgated.

Two classes of underground injection wells receive hazardous wastes: Class I wells dispose of wastes below a drinking water source and Class IV wells above the source. Regulations published in February 1981 provide for permitting Class I wells but not Class IV wells.

Underground injection of wastes presents many potential problems. Although the waste is injected into an underground formation that protects against contamination of groundwater, geologic problems can occur when this is done. The waste may migrate from the injection zone through fractures or along faults and thus contaminate water supplies. Improper construction or faulty casing can also create contamination problems. In the case where underground zones are not in a horizontal plane, wells of equivalent depth located in different areas on the surface may inject into different zones and cause contamination.

Nearly any hazardous waste management process, above or in the ground, that is not completely contained, may affect groundwater. These processes include surface storage and treatment lagoons, land treatment and disposal facilities, and surface piles.

RCRA regulations pertaining to these hazardous waste operations will be complete in the near future and there are currently some interim status standards in effect. Permitting requirements are not complete at this time.

The regulations for storage, treatment, and disposal consider ground water protection as a major objective. Construction practices to minimize seepage from lagoons and leachate from land disposal facilities and piles are essential, as is monitoring to detect contaminants leaving a site. Properly installed plastic or impermeable clay liners for ponds, lagoons, and leachate collection systems provide ground water protection when properly installed and operated.

THE REGULATION OF HAZARDOUS WASTES

Roger Thorvilson

I. Legislation

Federal hazardous waste legislation, the Resource Conservation and Recovery Act (RCRA), was passed in 1976. In 1977, Montana solid waste statutes were amended to include state hazardous waste authority comparable to that in RCRA. In 1981, a separate section of state law, the Montana Hazardous Waste Act (MHWA), was created to more comprehensively address hazardous waste management.

II. Regulations

Autumn of 1980 marked the first phase of the hazardous waste regulatory program, both nationally and in Montana. These initial regulations provide a basis for the control of hazardous wastes, but a number of specific technical requirements applicable to hazardouswaste treatment and disposal remain to be promulgated. EPA is finalizing its land disposal regulations now and plans to publish them in the spring of 1982. These will specify the degree of protection required in siting and engineering hazardous waste disposal sites. Montana has adopted, and plans to continue to adopt, regulations fully comparable to EPA's.

III. Description of the Basic Hazardous Waste Program

A. Identification: which wastes are hazardous wastes?

The statutes define hazardous wastes as those waste materials that "may: (i) cause or significantly contribute to an increase in mortality or an increase in serious irreversible or incapacitating reversible illness; or (ii) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported or disposed of or other managed."

Hazardous wastes are identified under the regulations by means of waste lists in addition to the establishment of four waste characteristics. The lists include wastes from non-specific sources (example: organic solvents), industrial process wastes from specific sources (example: certain petroleum refinery sludges) and commercial chemical products (if and when discarded). The four hazardous waste characteristics include ignitability, corrosivity, chemical reactivity, and "EP toxicity." EP toxicity stands for extract procedure toxicity and reflects the fact that the direct toxicity of a material is not considered to be the deciding factor, but rather the toxicity of the extract liquid (leachate) that may migrate from the waste material. A laboratory procedure for evaluating EP toxicity is specified by EPA.

B. Hazardous Waste Generators

The person or company who produces a hazardous waste is the first category of persons regulated under the program. The waste generator may or may not fall subject to regulation for storage, treatment or disposal of the waste. The generator may wish to contract with another company for these services and ship his waste elsewhere for handling. However, under all circumstances the generator must determine if his wastes are hazardous and decide how best to manage each waste material. If he ships hazardous waste off-site, a waste manifest (special shipping document) is used to tracke the waste to its proper destination. The facility receiving the waste shipment returns a signed copy of the manifest to the generator to acknowledge its receipt.

C. Hazardous Waste Transporters

The transporter must deliver the waste to the facility designated by the generator, sign and carry the waste manifest, and obtain the signature of the facility operator. Should a spill occur, the transporter must take corrective measures and report the spill to the Montana emergency response system.

D. Hazardous Waste Management Facilities: Treatment, storage, and disposal

Interim status standards are in place to control existing facilities, pending completion of the remaining technical standards. Interim status standards apply to an existing facility until a final permit is issued. General standards, when fully completed, will apply to all facilities with final permits.

The interim status standards contain general sections applicable to all types of facilities, as well as sections which apply to individual facility types. Facility types under the regulations include containers, tanks, surface impoundments, underground injection wells, land treatment areas (landfarms), landfills, waste storage piles, incinerators, other thermal treatment devices, and chemical, physical or biological treatment processes.

Measures to protect the quality of ground water are a significant feature in the regulations applicable to all facility types. These include requirements that container storage areas have impermeable bases, requirements for inspections of aboveground tanks to detect leakage, restrictions on the disposal of liquids in landfills, and controls on surface water runoff to prevent infiltration of water into disposal areas. A major issue in the forthcoming land disposal regulations, and the reason for their delay, is the question of how to realistically protect ground water from the long-term effects of hazardous waste disposal.

In the interim status standards, ground water monitoring is imposed upon all operators of facilities involving landfills, surface impoundments, and land treatment areas. Soil testing and lysimetry monitoring is also required for land treatment facilities.

Long-term environmental protection is provided for by regulations requiring thirty years of post-closure site care and monitoring and requirements for detailed recordkeeping of the types, volumes and exact location of hazardous wastes disposed of in or on the land. A notice must be placed in the property deed, recording for perpetuity that the land has been used for hazardous waste disposal.

It is hoped that Montana's hazardous waste program will serve as an important tool in protecting the quality of the state's ground waters for future generations.

# OIL AND GAS EXPLORATION AND FRESH WATER AQUIFERS

John Calder III

There are three operations of the oil and gas industry that could possibly impact ground water resources: seismic exploration, development drilling, and production operations.

Seismic operations include the vibrasize, portable, and shot hole methods. The vibrasize operation inputs energy into the ground by thumping the ground with heavy blows. This operation is not hazardous to ground water but it cannot be used in rough terrain where heavy trucks cannot drive. The portable method involves detonation of explosive charges at or above the ground surface. Hazards to ground water are almost negligible. The shot hole method inputs energy into the subsurface by detonating an explosive at the bottom of shallow well approximately 200' deep. This method is much preferred by seismic exploration companies, but it has been blamed for creation of some saline seeps in eastern Montana.

During the drilling operations a barite-bentonite slurry is used to control pressure, lubricate the drills, return the drill cuttings to the surface and to protect water resources. This mud program essentially seals water-bearing strata against intrusion into the well bore by slightly penetrating and sealing the strata. As the well is drilled, a casing is placed into the bore hole which protects the integrity of the well bore and also protects ground water resources. Casing programs are designed by the operating company and approved by state and federal regulatory bodies.

The potential for contamination of shallow ground water with leachates from drilling reserve pits is minimal. The barite-bentonite drilling mud acts to seal the reserve pit and prevent water intrusion into the shallow aquifers.

Non-producing wells are plugged by filling the well with a bentonite-barite slurry, a heavy weight mud; and cement plugs are placed at various points to prevent cross-contamination of drinking water aquifers. The cement is run to the surface, where by law, the well is marked for future location if necessary. The well location is recorded with the State Board of Oil and Gas Conservation.

During production operations, water which may be associated with oil and gas must be separated and disposed of according to state and federal requirements. Fresh water may be of beneficial use to local ranches and wildlife in the area or it may serve to recharge shallow ground water aquifers. Saline waters, depending on the quantity involved, may be evaporated from small pits on location or injected underground for disposal or to maintain pressure in the producing horizon. The underground injection of saline water is regulated by the federal government and the state with stringent requirements to prevent contamination of fresh water with saline water.

Several different types of pipe are used in the casing program. A large conductor pipe is set approximately 100' into the ground. Within the conductor pipe a surface casing pipe is set to a depth that is sufficient to protect ground water and to provide a good base for the drilling operations. Cement is used to seal off the ground water bearing strata and to firmly anchor the surface pipe in the ground. Next there is an intermediate string pipe which, depending on the depth of the hole, is placed to provide additional protection to the hole and to ground water resources. Finally a production string is set from the surface to the producing formation that is the target of the drilling company. Cement is used to bond this to the other pipes to protect the integrity of the hole and to protect ground water resources.

In Montana the oil and gas industry has been working with state agencies, land and mineral owners, and scientists to develop improved regulations to minimize hazards to ground water. Effective enforcement of these regulations should be encouraged.

# COSTS OF GROUND WATER DATA MANAGEMENT

Marvin Miller

## Introduction

Because ground water data are often obtained with little concern for their potential use beyond the original purpose of the collection effort, these data often become difficult to locate and use. For example, ground water quality data collected specifically for siting a coal mine or power plant are often: used for only that specific purpose; published in a document of limited distribution; and commonly misplaced or lost afterwards even though the data may have further use in regional or statewide studies. Data stored in this fashion are difficult for a user to obtain and consequently are rarely used again. This results in duplication of research efforts in the same or similar geographic areas. In order to prevent this, Montana needs to support a central ground water data base or information center to collect, manage, correct and publish ground water data, thereby making them readily available to governmental agencies, private industry and the public.

## Ground Water Data Needs

The type of ground water information necessary to conduct a ground water study depends on the scope and detail of a ground water problem. Table 1 outlines data needs for studies of different areal extents. Almost every site-specific ground water problem would require new ground water information pertinent to the problem area. Existing ground water data available for that site, however, could be used as supplemental data points, and might provide information on historical changes in some data parameter. An investigator planning a site-specific study might feel that analyses of heavy-metal concentrations in the water of a particular aquifer would be useful. These analyses, however, could add considerable expense to the project. A regional data base containing analyses of heavy-metal concentrations in or near the site could show whether or not the effort to collect and analyze for heavy metals was necessary.

Regional studies of ground water often are "filled out" by site-specific data from within the boundaries of the regional project. At present, much of these site-specific data are found in a multitude of reports and booklets, and are classified or organized in a multitude of ways. The

TABLE 1

# DATA NEEDS FOR DIFFERENT SCALES OF STUDY

| | |
|---|---|
| SITE SPECIFIC | — DATA DENSITY IS HIGH AND APPLIES TO A SMALL GEOGRAPHIC AREA. DATA ARE USUALLY COLLECTED FOR SPECIFIC PURPOSES (TO SOLVE GROUND-WATER PROBLEMS) AND GO INTO THE STATEWIDE DATA BASE. |
| REGIONAL | — DATA DENSITY IS LOWER AND APPLIES TO A LARGER GEOGRAPHIC AREA. DATA ARE USUALLY COLLECTED TO ASCERTAIN WIDESPREAD AQUIFER CONDITIONS OR TO SOLVE REGIONAL PROBLEMS (POTENTIAL OR CURRENT). DATA OBTAINED CAN BE USED FOR SITE SPECIFIC STUDIES AND GO INTO THE STATEWIDE BASE. |
| STATEWIDE | — DATA DENSITY VARIES BECAUSE IT IS DERIVED FROM SITE SPECIFIC AND REGIONAL STUDIES. IN ADDITION, DATA MAY BE COLLECTED SPECIFICALLY TO "FILL IN" AREAS FOR WHICH LITTLE OR NO INFORMATION EXISTS, EVEN IF THERE IS NO SPECIFIC PROBLEM AT PRESENT. THESE DATA ARE PART OF THE STATEWIDE DATA BASE AND ARE USED FOR FUTURE STUDIES: SITE SPECIFIC, REGIONAL AND STATEWIDE. |

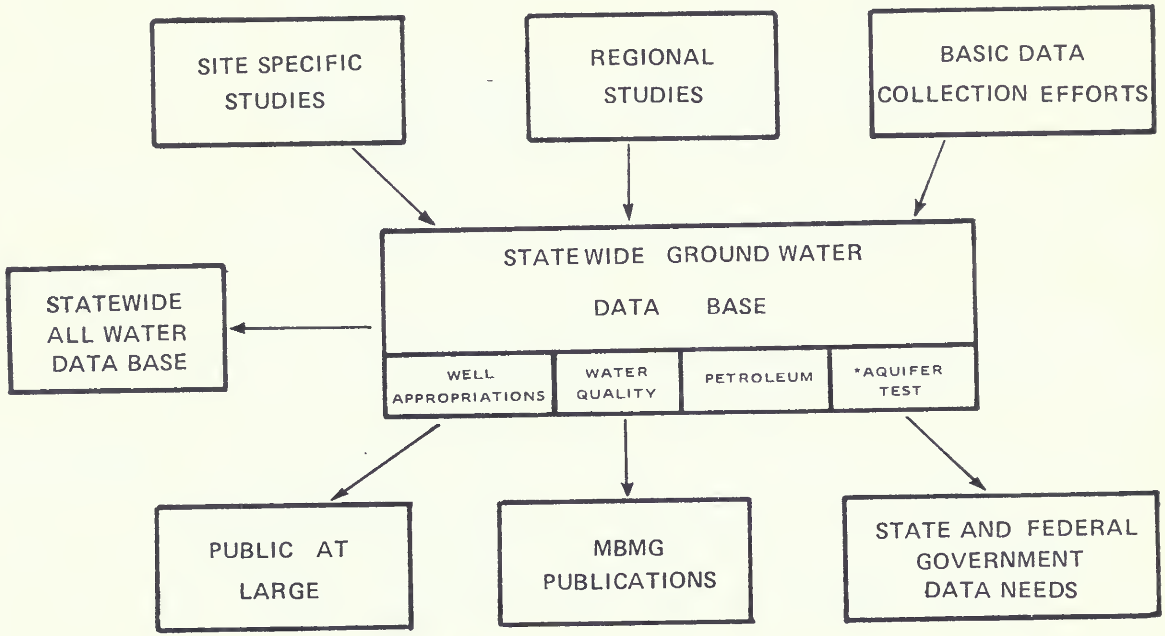
researcher must find, collate, organize, cull and classify these data for his own project. These tasks are greatly simplified if most of the data can be obtained from one source, in a consistent format.
The primary product of the compilation of regional and site-specific data is a statewide data base from which many kinds of questions can be answered. Research questions such as: what data already exist for a project area can be answered. Questions from Montana citizens concerning the present water quality in their well or spring, the depth needed to complete a well in their area and the expected yield of a well in a given area can usually be satisfied quickly and efficiently. Often the data offered the citizen in response to his inquiry has more significance when viewed in the context of wells or springs in similar situations. An inquiry about the concentration of dissolved solids in water produced by a spring discharging from the Fort Union formation, for example, may show that the spring produces water with higher or lower dissolved solids than the average of 1,765 Mg/L for that aquifer based on 1,333 samples.

## The Montana Bureau of Mines Ground Water Data Management System

Figure 1 is a flow chart showing the data-management system which presently is being supported at the MBMG. Ground water data from site-specific, regional and statewide efforts are compiled into four major computer-based groups. These groups are: 1) the well-appropriation file, containing well log and lithologic information on Montana's water wells; 2) the water-quality file, containing chemical data on Montana's ground water; 3) the petroleum-well file, which contains lithologic data on Montana's deeper aquifers; and 4) the aquifer-test file, which is proposed at this time to provide a statewide reference system on aquifer permeability and storage characteristics.

Figure 2 illustrates, in more detail, some elements of data-management operations for the well-appropriation files. New well-appropriation data become part of the file upon receipt of well logs from the Montana Department of Natural Resources. After coding and data entry, geologic sources and altitudes are assigned to each well based on the well's location, depth and lithology. When a field ground water project is undertaken by the USGS or MBMG, listings and copies of the logs for that area are retrieved from the data system and taken into the field. When the field inventory for the project is complete, corrections to the information in the data base are made from the findings in the field.

# FIGURE 1




MONTANA BUREAU OF MINES
GROUNDWATER DATA MANAGEMENT SYSTEM

*PROPOSED

FIGURE 2

WELL APPROPRIATION DATA COLLECTION AND ENTRY TO GROUNDWATER DATA BASE

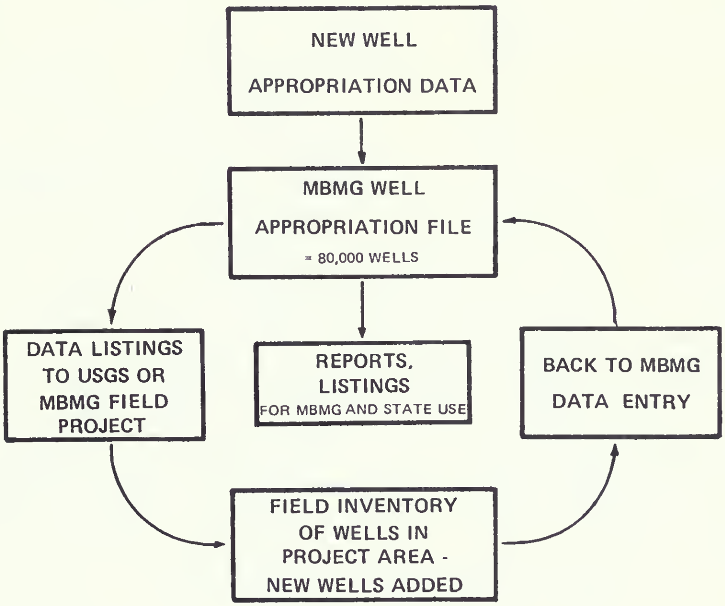


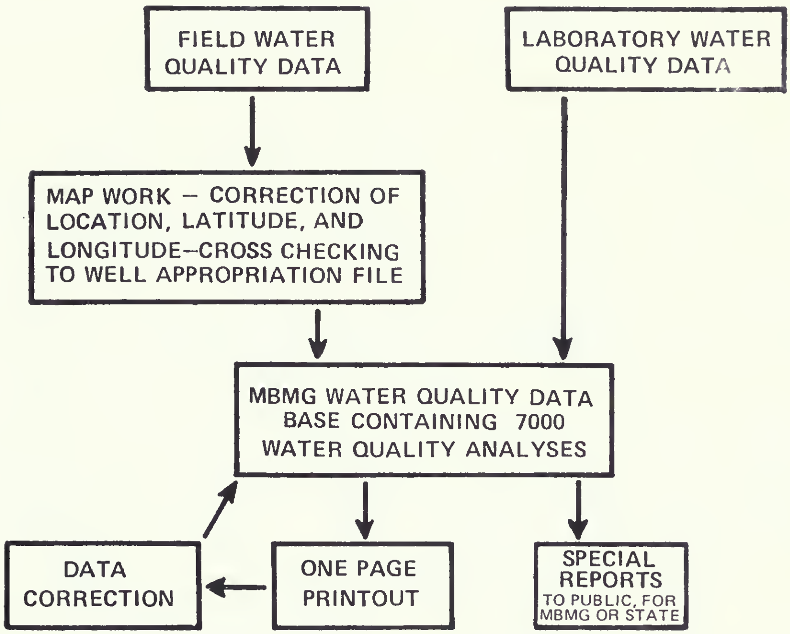
Figure 3 illustrates, in more detail, some elements in the data-management system for the water-quality files. Water-quality data for the ground water data base are usually generated by USGS or MBMG personnel. After the field data are received, the information is checked for correctness, latitudes and longitudes are determined for each site (for computer plotting) and the data are cross-checked with the well-appropriation file. A match between a water-quality analysis and a well log can often be made, allowing corrections to be made to both. Appropriate identifiers, such as an inventory number and the analysis number, are placed on the associated documents and in the computer files to correlate the well appropriation and the water-quality analysis. Once data entry of both the field and laboratory water-quality data is made, the data are printed and distributed. Editing programs in both the water-quality and well-appropriation systems allow errors to be easily corrected.

## Cost of Management System

Figure 4 illustrates estimated costs of operating the data-management system at the MBMG. Approximately 70 percent of the costs are in data collection and correction efforts. Data collection is expensive because of field equipment costs, personnel travel and vehicle expenses, difficult access to some sites and the great size of the state of Montana. The work is often time consuming, requiring close contact with individual well or spring owners. One major problem with large data-base systems is the ease in which poor quality, unchecked data can enter computer storage and become part of the data file. The data verification and correction efforts at the MBMG are aimed at reducing this liability. Correcting field data is time consuming because map work and verification of information is slow and exacting. The effort necessary for data correction (primarily on older data being added to the system) is intensive, requiring map work and double-checking of data printouts against original source publications. Data entry usually proceeds smoothly once the preparatory correction and coding work is done. The volume of data, however, requires that approximately 20 percent of costs for the systems are generated in data entry and correction efforts.

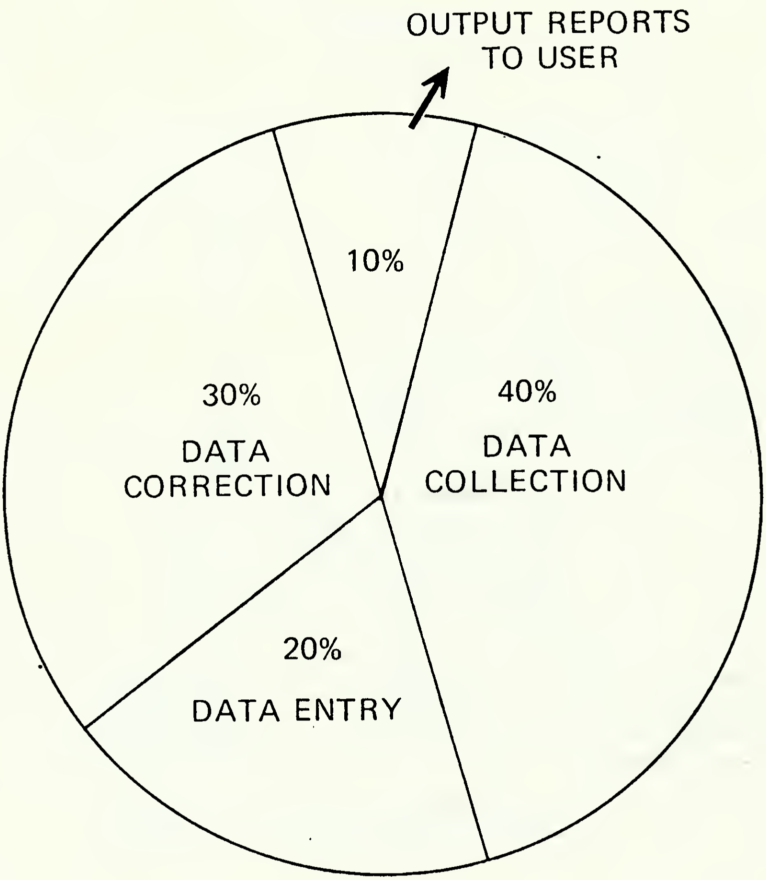
The least expensive part of the system is the 10 percent of costs related to data output to users. Once the programming for producing a report exists, the costs of such reports become minimal relative to the entire data management system.

FIGURE 3




WATER QUALITY DATA COLLECTION AND ENTRY TO GROUND WATER DATA BASE

FIGURE 4




DATA BASE MANAGEMENT COSTS

## FUNDING MECHANISMS FOR RESOLVING PROBLEMS

Mark O'Keefe

Federal funds have played an important role in water development in Montana. Some examples of federal assistance are the USGS - Montana Bureau of Mines study of the Foxhills-Hell Creek Controlled Ground Water area; federal-state cooperative studies on various ground water problems in the state; and the federal funds that have supported the Water Resources Research Center at Montana State University.

There are several mechanisms for aquiring federal funds for use in solving water problems. The first is the federal-state cooperative program, which in Montana has primarily involved the U.S. Geologic Survey working with the Montana Bureau of Mines. This typically has involved a 50% match of federal funds with 50% state and local funds. There is an increasing demand for greater local and state involvement as federal funds are decreased. These cooperative programs allow the state to have a say in how development occurs. Occasionally the federal government provides a direct line of appropriation without state matching funds.

A second type of funding is the individual contract or grant from a federal agency that needs a service that a state agency can provide. Usually the state can suggest modifications in the federal plan of operations to meet state needs. A 10% match is often required by the state but it may be a match of in-kind services rather than of new funds. This allows the state to develop a multiagency, coordinated approach to information gathering.

A previously existing source of federal funds was the Old West Regional Commission. The purpose was to solve interstate problems. This was especially appropriate for working with ground water aquifers that transcend state boundaries.

It is now clear that the states will be required to support more of these projects as federal funds become less available. Historically the state legislature has supported these studies; for example in 1977 the state legislature passed the HJR 54 which authorized a ground water study of the state but in particular the study of the Ft. Union Region of the state. In 1979 HB 705 was passed to provide a continuation of the Artesian Basin Studies. These are examples of direct legislative appropriations for ground water studies.

One of the mechanisms which began in 1975 was the state's Renewable Resource Development Program. In the last legislature, the Water Development Program was created. Each of these programs is a potential source of funds to address ground water problems. However these programs are not final answers to the funding problems.

The Renewable Resource Development Program is funded by a portion of the Coal Severance Tax. Its purpose is to protect and develop the state's renewable resources. The funds, which presently amount to approximately $1.6 million per biennium, can be used for grants, to back bonds for loans, or they can be used directly for loans. The funds are available to any unit of state or local government for programs dealing with a renewable resource. The program can grant up to 100% of costs for feasibility studies that address problems dealing with ground water. It can also loan 50% and grant 50% of the funds required for a project that has a potential repayment value. If the funds are used to back bonds or loans at prescribed interest rates, the money may go further.

Examples of the previous use of renewable resource development funds are the Muddy Creek Project and the Triangle Conservation District Saline Seep Project. However, these are long-term projects and the renewable resource funds only provide a fragment of their needs. These programs will require sustained, long-term funding from other sources.

The Water Resources Development Program can fund nearly any type of project that involves surface or ground water. Some of the projects presently under consideration are irrigation system development and rehabilitation, saline seep abatement, small-scale hydropower, off-stream storage, erosion control, rural water development, irrigation canal lining, and stream bank stabilization. Any state or local government or semi-public body or private individuals can apply. The funds available amount to approximately 1.6 million per biennium. There is a $100,000 loan limit per project.

Other methods for solving problems include direct legislative appropriations. These efforts should be directed at problems before a crisis exists and the need for funds is going to continue as the state grows especially in rapidly developing areas such as Ravalli, Gallatin, and Flathead Counties. There is considerable need for federal-state and local support for research in order to expand the development of ground water areas.

# THE LEGISLATIVE NEEDS OF THE MONTANA WATER INDUSTRY

William Osborne

The average citizen has many misconceptions about ground water and its significance as a resource. However, information developed from the U.S. Geological Survey inventories have shown that ground water is a tremendously important resource nationwide. Ninety seven percent of the freshwater resource in the nation occurs as ground water and only 3% occurs as surface streams and lakes. The inventory has shown that at our present rate of use water in storage in the ground can last our society for approximately 7000 years.

There are many myths and misconceptions about ground water, partly because it is not easily observed or measured. Some of the myths and facts about this resource are listed below:

1. Myth - Ground water acts as underground lakes and streams.

   Fact - Ground water resources do not resemble surface water.

2. Myth - Ground water supplies are insignificant.

   Fact - Ground water supplies exceed surface waters by a ratio of 30 to 1.

3. Myth - There is no relationship between surface and ground water.

   Fact - Ground water supplies much of the flow to streams and rivers, and lakes and swamps are merely windows in the water table.

4. Myth - Ground waters flow thousands of miles below the ground surface.

   Fact - Most ground water is replaced in the vicinity of its withdrawal.

5. Myth - Ground water rushes underground so fast that its presence can be detected by listening.

   Fact - Ground water moves only a few inches per day. There are no true underground rivers.

6. Myth - Ground water is mysterious and occult.

Fact - Natural laws control the movement and occurence of ground water and therefore its behavior is predictable.

Some important facts about the use of water have been summarized to indicate its importance in our society.

- an average person uses about 90 gallons of water per day in the home.

- an average person consumes about 16,000 gallons of water in his lifetime.

- industry uses more water than any other material or supply. It requires the following amounts of water to produce various products.

| | |
|---|---|
| 150 gallons | - one Sunday newspaper |
| 160 gallons | - one pound of aluminum |
| 270 tons | - one ton of steel |
| 10 gallons | - refines one gallon of gasoline |
| 10 gallons | - refines one gallon of beer |

- surface water costs range from 30-60 cents per 1000 gallon

- in 1981 there were 730,000 wells drilled in the U.S. at a gross business value equal to 3.2 billion dollars.

Ground water raises some serious areas of concern to hydrologists and others who are aware of its properties. It is especially subject to pollution by those who drill holes in the ground for whatever purposes. Pollution of ground water may take generations to clean up. Present generations must take steps now to prevent ground water contamination.

One of the best instruments available in Montana to prevent ground water pollution is the Montana Water Well Board. Although the Board has been in existence for 20 years its existence is now threatened due to sunset legislation.

Water well drillers must be regulated like any other professional group. Failure to control their activities will allow some non-professional and/or non-ethical operators to harm the activities of others. There is a need for legislative support and funds to properly inspect and enforce rules which apply to water well construction and other activities which impact on ground water. There is a need to establish strict licensing procedures for water well drillers and contractors with provisions to revoke licenses for failure to meet the standards.

Like many other states, Montana has promulgated many rules and standards governing the use and protection of ground water. While these rules are appropriate and necessary, the multiple agency responsibility does cause confusion and added difficulty for those who are regulated.

It is especially important that rules which are promulgated are properly and strictly enforced.

# GROUND WATER AS A RESERVED WATER RIGHT

Henry Loble

When land is withdrawn from the public domain, such as for national forests and Indian reservations, sufficient water to develop the land is reserved with a priority date generally as of the time of the creation of the reservation. Reserved water rights need not be used as other water rights must be. They are reserved for later use, sometimes with a priority date that predates and is senior to non-federal or non-Indian rights in use for many years. These reserved water rights create uncertainty, which prevents planning and development for Indians and non-Indians and for federal and non-federal uses. (Winters vs U.S., 207 U.S. 564, 1908; Arizona vs California, 373 U.S. 546, 1962).

Reserved water rights should be quantified and the uncertainties resolved. Three methods for resolution are: (1) negotiation, (2) litigation, or (3) congressional legislation. Negotiation presents the least expensive, least time-consuming, and most feasible method. The Montana Reserved Water Rights Compact Commission is currently engaged in such negotiation with four Montana Indian tribes and also with the Departments of the Interior, Agriculture, and Defense.

There has been controversy as to whether state governments or the federal governments have jurisdiction of these reserved rights. On June 22, 1979, the U.S. Court of Appeals for the 10th Circuit ruled for state jurisdiction and on February 22, 1982, the U.S. Court of Appeals for the Ninth Circuit ruled for federal jurisdiction. The rulings apply to most western states.

The Montana Water Use Act (Section 85-2-101, et. seq., MCA) and the Montana 1972 Constitution (Art. IX, Sec. 3(3)) assert state jurisdiction over ground water. No court, as of the present date, has held that a reserved right includes ground water.

There are arguments to be made for and against including ground water as a reserved right. However it is apparent that an agreement on reserved water rights would be more complete if it did address ground water.

There are technical difficulties in dealing with ground water as a reserved right. Recognizing the potential conflict between surface and ground water use, the Upper Niobrara River Compact, an interstate water compact between the States of Wyoming and Nebraska, contained an agreement to delay apportionment of ground water in the Niobrara River Basin until adequate data on ground water in the basin are available.

Because shallow ground water is sometimes tributary to surface streams, it may be possible to treat all water within a stream corridor as one source. The water right would then be given for a specific quantity of water from either the surface stream or from ground water. The alternative approach would be to issue water rights for surface and ground water separately; but comprehensive technical studies to quantify available water from each would be necessary prior to execution of the compact.

Technical data concerning ground water sources underlying federal and Indian reservations is limited, and it will take much time and money to amass such data. Therefore at this time the Montana Reserved Water Right Compact Commission might use ground water concession as a reserved water right, as a bargaining chip in the negotiation process. Possibly this could be done in return for concessions that would recognize existing non-Indian uses on the water sources or some other important point by either the federal government or the Indian tribe in question. This negotiation may permit greater flexibility rather than the litigation approach which is "all or nothing."

# LEGAL ISSUES AND GROUND WATER

Sharon Morrison

The legal issues involving ground water in Montana are not well defined. There has never been a Montana Supreme Court case that involved competing interests of ground water users. Some cases have been tried in the district courts but none have been appealed to a higher court. Because we do not have legal precedents, there are no guidelines as to what the Supreme Court would do when faced with a dispute between two ground water users on the same source.

In discussing legal issues affecting ground water, it is necessary to consider the doctrines which have applied to surface water. In the U.S. surface water is divided under two doctrines: the riparian doctrine and the prior appropriation doctrine. The riparian doctrine came from Anglo-American law and it was the only doctrine that we had for centuries. The doctrine states that if a stream runs through your land, you may make reasonable use of it. There is no date of appropriation -- you own the right. If the amount of water is less than you need, then you may take only what is reasonable, so that downstream neighbors may also take what is reasonable for their needs. The doctrine was carried to this county by the early settlers and it is the doctrine that is in use today in the eastern United States.

However, at about the middle of the last century, when mineral prospectors began moving west, they found a desert and abundant minerals. Because water was necessary for production of the minerals, the prospectors moved onto public lands and helped themselves to available water. After a series of decisions were made, it was agreed that this use of water was appropriate for the development of the land. Thus, whoever moved onto public land and used the water to make the land productive, whether by mining or by irrigation, had the right to use it. They had the right from the date they first used it to the exclusion of all people who came along later. This became known as the prior appropriation doctrine. The doctrine is unique to western law and western circumstance.

These two doctrines have been involved in ground water law even though it is a less well developed legal area. The first ground water law case ever recorded was an English case in 1843. In this case one neighbor had drilled a well that drained his neighbors ground water. The courts reviewed the case and concluded that the ground water could not be defined, i.e. the plaintiff could not explain where the water ran, how deep it was, where it started or where it ended. Without these facts the court could not make a legal decision or apply legal principles. Therefore the court determined that ground water belongs to the person who owns the overlying land and he may do whatever he wishes with his water. He may use it or waste it, but legal principles cannot deal with it because the water supply cannot be described. This then became known as the law of absolute ownership. It was the law in England and in the U.S. where the riparian doctrine applied to surface water. This was a harsh result and Americans are inclined not to like harsh results. So the principle of reasonable use grew up in America. This principle is essentially like the absolute ownership doctrine except that the owner may make reasonable use of his water, but he cannot waste it.

In one of the few cases in Montana that touches upon a ground water principle, the courts adhered to the absolute ownership doctrine. The case of Ryan vs Quinlan 45 M. 521 (1912), arose on Dempsey Creek. This is one of an interesting series of cases that began in the 1800's. Mr. Ryan had stored spring run-off water in an artifical lake for use during dry periods. This activity was challenged with the belief that the stored water was actually part of the natural flow to Dempsey Creek and thus belonged to other surface water appropriators on Dempsey Creek.

The Montana Supreme Court ruled that the ground water flow to Dempsey Creek could not be identified, and therefore they could not say that water in Ryan's Lake would have made its way to Dempsey Creek. Thus the courts concluded the water belonged to Ryan. Absolute ownership remained the law in Montana for many years -- because the courts would not consider it and could not apply legal principles to the use of ground water.

The next important water law case was handed down in 1962; this was a federal case of McGowan vs the U.S., 206 F. Supp. 439 (D. Mont. 1962). The government had condemned the land of a neighbor and began installing ditches and a drainage system on the land. This caused the spring of McGowan to dry up, and he sued the federal government. The judge reviewing the case considered the Ryan vs. Quinlan case and decided that McGowan had no right of recovery. Thus as late as 1962, the doctrine of absolute ownership was applied.

In a later case, again relating to Ryan vs Quinlan 45 M. 521 (1912), the courts changed their stand. The court recognized that modern hydrology had progressed to a point that ground water could be accurately traced. For this reason, the court felt that the traditional legal distinction between surface and ground water should not be rigidly maintained. This has resulted in a modified absolute ownership principle. If it can be demonstrated that there is a connection between related rights in ground water, then it is possible to obtain recovery.

Currently there are a number of issues and conflicts which must be addressed in the future. Some examples of these are as follows:

(1) Is ground water in Montana administered under the 1962 Ground Water Act or is it administered under the 1973 Water Use Act? The Ground Water Act provided that all ground water will be administered by the Department of Natural Resources and Conservation; but the 1973 act charges the supervision of all water to the District Court. Conflict: Is the DNRC or the District Court responsible for ground water?

(2) The Ground Water Act of 1962 provides for the establishment of Controlled Ground Water Management Areas. If such an area is established a set of rights and duties are established and supervised by the DNRC. After considering the various uses of water, priorities for use may be established without regard to priority dates. Domestic and livestock uses are given first priority. This is the only place in Montana water law that preferences are established. Conflict: Are the users controlled by the general law or under the ground water law?

(3) In a controlled ground water management area the DNRC may hold a hearing for ground water users but all water users including those with surface rights must be made party to the proceedings. Under these statutes, the DNRC cannot decide on priorities for surface rights -- only ground water rights. Conflict: The surface owners expect their right to be litigated in District Court under the 1973 Act. Water commissioners appointed by the court have jurisdiction in these matters. But the DNRC can also appoint ground water supervisors who have jurisdiction over the use of ground water in the area. Conflict: The supervisors and the water commissioners each have jurisdiction -- which one does a water user go to for resolution of problems?

(4) According to the 1962 Act, a user who drills a well must file a notice of well completion within 60 days. This is reiterated in the 1973 Act and it states that the filing date of the well establishes the priority date. This establishes a ground water right except where permits are required before drilling.

Conflict: A main issue concerns what happens if the well driller does not obtain a permit before he drills or if he fails to file a notice of completion. He then has no legal rights despite his expense and the availability of water. This issue has not reached the courts but it suggests that our interrelated water laws may present a conflict for well owners. If a person files a notice of completion at a late date the department may be required to hold a hearing to determine if any other well owners have relied on the fact that there had not been a previous filing or notice of completion. The new well owner could be prohibited from using his water or his filing may be placed behind the person who had relied on the absence of previous filings.

5. According to present Montana law a ground water user does not have an absolute right to his pump lift, e.g. a first appropriator on a ground water source may have drilled a rather shallow well and obtained an adequate supply, but a second appropriator may place a deeper well into the same source and reduce or eliminate the first wells flow. Conflict: Montana law does not protect the water level or existing artesian pressure; the law only requires that it remain reasonably the same. If the well flow is reduced the first appropriator may have to drill deeper but not to an unusual level.

6. How should Montana deal with the problem of "mining" ground water, i.e. the situation where water is withdrawn from a non-renewable source? A method used in some states limits the number of appropriators on a non-renewable supply. The method assumes some length of time that would be required to reasonably repay the expense of drilling and the cost of preparation for using the water. The quantity of water in the aquifer is then estimated and as many appropriators are allowed as will reasonably use the water source in that period of time. If water still exists after that time the water can be reallocated. This raises the question of ownership. Conflict: Is there a constitutional conflict when the government allows one user and not the other? Is the government taking property without due process of law? The question was raised in New Mexico and the court declared it was not a denial of due process. The same response would be expected in Montana where the law claims all water (surface and subsurface) for the State of Montana.

7. According to one case in Lewis and Clark County subirrigation waters are also protected. In this case the federal government condemned a portion of an owner's land and initiated a drainage program that caused a loss of subirrigation water in an adjoining hay field. The court ruled the subirrigation water could not be drained without compensation to the owner.

ADMINISTRATION OF GROUND WATER IN MONTANA
PRESENT AND FUTURE

Laurence Siroky

The purpose of the Montana Water Use Act of 1973 is to provide an orderly procedure for appropriating surface and ground water. The act treats both types of water the same. The act provides a means to resolve conflicts and to protect existing and future acquired water rights.

Specifically the Act establishes the following:

(a) a procedure for identifying and quantifying pre-1973 rights including those for ground water. The 1979 amendments to the Water Use Act in Senate Bill 76 required all water rights to be filed by April 30, 1982. A provision was included to exempt stock or domestic ground water uses.

(b) a procedure for acquiring water rights after 1973.

(c) a centralized records system for water rights information.

(d) a continuation of the provisions for establishing controlled ground water areas and for handling ground water waste.

(e) a procedure for reserving water for future use, including ground water.

(f) a procedure to allow changes and severance sale of water rights.

The provisions of this act provide the "tools" necessary for shaping Montana's present and future water uses. Their success is dependent upon continued legislative support and funding. Fine-tuning modifications of the act may be necessary to insure progress.

<u>Adjudication of Water Rights - Prior to 1973</u>

The adjudication process is described in a brochure prepared by the state entitled, "Adjudication of Montana's Existing Water Rights." The adjudication procedure will continue for approximately 10 years at a cost of about $2 million per year. Although this is expensive, it is less costly than litigation. It is expected that preliminary decrees will be issued in 1983 for the drainage basins of the Madison, Gallatin, Sage Creek (Hill Co.), Sweetgrass Creek, Dempsey Creek, and Rock Creek (Granite Co.), O'Fallon Creek, Judith River, Redwater River and the lower Clark Fork River (Sanders Co.). The claims and preliminary decree information are being computerized. These data will provide useful information for determining impacts of present and future uses; prospective water users will benefit from the available data.

Acquiring Water Rights after 1973

All water rights appropriated after 1973 require a water use permit for (a) any amount of surface water, (b) for any amount of ground water within a controlled ground water area. A permit is not necessary for ground water of an amount less than 100 gallons per minute outside a controlled ground water area.

A new well of less than 100 gpm outside a controlled ground water area must be filed with the Department of Natural Resources and Conservation. A notice of well completion must be filed within sixty (60) days; the date of priority is the date the notice of completion is filed. After receiving a notice of completion, the DNRC issues a certificate of water right which is filed with the County Clerk and Recorder's Office and entered into the computer data file. These data plus the well driller's log are available to assist other prospective water users and well drillers in the future.

A provisional permit is required for all other water uses acquired after 1973, including any amount of surface water, any amount of ground water within a controlled ground water area or ground water in excess of 100 gallon per minute in any area. The permitting process may require six months to more than a year to complete. Sufficient time must be allowed to notify other water users, to issue public notices and if requested, to hold public hearings. Permits that are granted may have conditions limiting water use especially if other appropriators have prior rights. The requirements or criteria that must be met to obtain a provisional permit are outlined in the DNRC pamphlet entitled: "Appropriation of Water in Montana".

In some instances there is not sufficient information available to know all of the possible impacts of issuing a permit. In these instances a permit is usually issued to allow development and to gain more information on the resource in that location.

During the period 1973-1976 the department issued approximately 2100 permits of which about 15% were for ground water. Some of the areas of greatest ground water activity are the following:

-- The Poplar River basin and the Missouri River basin below Fort Peck reservoir. The activity in this area is just beginning.

-- The Upper Missouri River Basin from the Jefferson River to Holter Dam and the Sun River. Activity in these areas is expanding because of limitations on available surface water.

-- The Shoshone River basin to the point where it crosses the Wyoming border. There are several large irrigation wells that have been drilled into the Madison aquifer in this area.

-- The Flathead River Basin. This is an area of extensive ground water activity where water withdrawal may be exceeding the recharge rate. It is a possible candidate area for designation as a controlled ground water area.

Controlled Ground Water Areas -- a controlled ground water area is a specific surface area with defined boundaries within which ground water use may be closely regulated. The procedures offer an effective management tool to address special problems of local concern -- eg. in areas of limited supply, areas of flowing wells, and locations where geothermal resources are to be developed. Additional information is available in the DNRC brochure entitled, "Managing Ground Water Shortages through Controlled Ground-Water Areas."

# PROPOSED GROUND WATER QUALITY STANDARDS*

Steve Pilcher

Montana has long been concerned with the protection of its water resources both from the standpoint of quality and quantity. The state has engaged in a strong program to protect surface water by utilizing the Montana Ground Water Act, the Montana Water Quality Standards, and the National Pollution Discharge Elimination System program. The development of a similar program for ground water has proceeded slowly due to the many complexities and different factors which affect ground water. However the mandate for a ground water pollution control program is obvious. The Water Quality Bureau is currently finding many situations where waste materials are being disposed of through seepage, infiltration or percolation as an alternative to direct discharge into surface waters. This is true for municipal, industrial, mining, and other waste products. In some cases the disposal systems are reviewed and approved by a state or federal office, but in many cases there is no authority for such review. Adverse effects or problems associated with a gound water system may not impact on a beneficial use for many years but by the time a problem is discovered, it may be too late to protect that beneficial use.

The Montana Water Quality Act specifically prohibits pollution of state waters -- defined as both surface and underground water -- the only exceptions are irrigation waters that are totally used within the irrigation system. The law requires adoption of rules governing the issuance of permits to discharge wastes into state waters and it requires the Board of Health and Environmental Services to establish water quality classifications and water quality standards.

The Water Quality Bureau has developed a set of proposed ground water regulations and standards that are based on the following policy:

1. The regulations should not require duplication of permitting with other state or federal agencies which address ground water problems.

2. The regulations should be based on the concept of protecting beneficial uses rather than prohibiting all constitutent-by-constitutent changes.

3. The regulations should provide adequate protection to ground water without placing a prohibition on development.

4. The regulations should constitute a program that can be administered within the resources of the administering agency.

The proposed ground water regulations address pollution regulation in two ways:

I. They establish a ground water classification system that is based on existing or potential beneficial uses. For each classification there are concentration limits for selected parameters or substances which will insure that use of the water can be continued as a beneficial use.

   Under the proposed rules, individual aquifers may be classified on a case-by-case basis as applications for discharge are received. This is necessary because water quality data for many aquifers is inadequate to establish classifications immediately.

   The proposed classification categories are as follows:

      Class I waters, which are suitable for public and private water supplies, culinary and food processing, irrigation, livestock and wildlife watering and for commercial and industrial purposes.

      Class II waters, which are marginally suited for public and private water supplies, culinary and food processing and are suitable for irrigation of some agricultural crops, for most livestock and wildlife watering and for most commercial and industrial purposes.

      Class III waters, which are suitable for some industrial and commercial purposes and as drinking water for some wildlife and livestock and for some salt-tolerant crops using special water management practices.

      Class IV waters, which may be suitable for some industrial, commercial and other uses. These waters are unsuitable or for practical purposes untreatable for Class III uses.

II. The proposed regulations establish a permitting requirement. A waste discharge permit is required from the Department of Health and Environmental Sciences for any sources that may potentially discharge pollutants into ground water, provided that a similar permit is not required by another agency. Those activities or discharges which have been specifically exempted from permitting under the proposed rules are:

1. Discharges for activities regulated under the proposed Federal Underground Injection Control Program.

2. Approved sanitary landfills which are licensed by the Solid Waste Management Bureau of the Department of Health and Environmental Sciences.

3. Water injection wells, reserve pits, and production water pits employed in oil and gas field operations and approved by the Board of Oil and Gas Conservation.

4. Agricultural irrigation activities.

5. Individual septic tank drainfields and waste treatment facilities that are approved in relation to discharges currently approved by NPDES programs.

6. Uranium solution mining, which is covered by In situ Mining Regulations already in effect.

7. Mining operations that are subject to operating permits in compliance with the Strip and Underground Mine Reclamation Act or the Metal Mine Reclamation Act.

The permit procedure requires the applicant to submit adequate information to determine the impact on ground water quality and may require the collection of additional data to support the application. The permit procedures include provisions for public notice and hearings when there is adequate public interest.

The proposed rules are an important link in developing the state's ground water management strategy.

* The ground water quality rules were adopted by the Board of Health and Environmental Sciences in Spetember 1982.

GROUND WATER MANAGEMENT STRATEGY

Gary Fritz

The Department of Natural Resources and Conservation (DNRC) has the responsibility for evaluation of ground water management needs in Montana. Many other western states have placed severe demands on their ground water resources. These demands have resulted in recent, innovative ground water management statutes, such as the new law enacted by Arizona. The primary difference between Montana and other western states is that ground water problems of depletion and contamination are not yet widely manifest in the state. Thus, Montanans have not been forced into imposing restrictions and expensive corrective measures on ground water use in reaction to these problems. In many ways Montana has the luxury of viewing problems and solutions in adjoining states and resolving early manifestations of similar problems, before management options are cut off. This is the objective of the DNRC and input from this conference will be central to this effort.

To accomplish our objectives, the DNRC plans to accomplish the following tasks:

(1) Prepare a status report on the ground water situation in Montana. This task will include an identification of the geohydrologic characteristics of Montana's aquifers; a quantification of the depletion from existing uses; a projection of future demands and rates of depletion; the effects on water quality and other concerns regarding the development of ground water in Montana. The report will also address the current ability to manage ground water resources efficiently under the existing statutes.

(2) Prepare a ground water strategy report. This task will include a review of existing ground water management statutes in other states and then develop alternatives which suggest which components of these management strategies are best suited to Montana's ground water situation.

(3) Conduct public hearings on the proposed ground water management plan.

(4) Finalize the plan.

(5) Draft legislation if necessary.

The ideas and issues that have been raised in this conference will be included in the status and strategy reports. Some specific questions which may be considered by participants at this conference are as follows:

(1) Are there threats to Montana's ground water that mandate a ground water management strategy? Will there be increased ground water development? Will there be an increased use of surface waters? Are there problems with contamination of ground water?

(2) How can we expand the information and data base for the future? Who should do the studies? What funding sources are available? How can we get the information in a useable form?

(3) What are the priority areas for ground water research? Who should do the studies? How can we make existing data more available?

(4) How do we prevent saline seep and reclaim salinized lands? Do we know enough about this problem? Who should be charged with the mitigation of this problem? How should control be funded?

(5) How should we manage shallow aquifers in conjunction with surface waters? Is this an important issue now or in the future? What agency should be the focal point? What are the priorities?

(6) What procedure should be used to allocate ground water? Should we adopt local standards for control and allocation? Should aquifers be drawn down to insure they are used or should use be equal to recharge? Is legislation necessary for establishing these policies?

(7) What is the nature and scope of ground water contamination? Is our existing water quality program adequate? What are our data needs for water quality management?

(8) What is the extent of free-flowing wells and how should this problem be addressed? Who should control these wells and how do we fund the control?

(9) How should be coordinate local, state, and federal agencies concerned with ground water? Are the existing agencies adequate to handle ground water problems? Should one agency be charged with the entire policy?

(10) Are there legal impediments to wise ground water management and to ground water use?

(11) Do we need greater control on water well drilling operations?

(12) What should be the format for a plan or strategy which develops from this conference? Do we need a comprehensive plan or a strategy for separate units? Should there be a plan approved by the Legislature?

## DISCUSSION SESSIONS: ISSUES & RECOMMENDATIONS

At the conclusion of the individual presentations, the conference participants separated into three discussion groups to identify specific problems and to suggest recommendations. The three topic areas and the co-chairpersons were:

1. Groundwater quality - Senator Dorothy Eck and Senator Paul Boylan

2. Legal Issues - Senator Larry Stimatz and Representative Gay Holliday.

3. Management Strategies -Representative Audrey Roth and Representative Dennis Iverson.

There was considerable overlap of the issues identified in the discussion sessions and in the recommendations from each group. A brief summary of the issues which were discussed is given below, followed by specific recommendations.

Issues

1. Proposed Groundwater Quality Regulations and Standards.

Several participants expressed concern with some parts of the groundwater quality regulations and standards as proposed by the Water Quality Bureau, Department of Health and Environmental Sciences.

(a) The proposed classification system may place a stigma on the use of domestic water supplies in much of eastern and central Montana. Many of the domestic water sources in these areas would be categorized as Class II or III waters based on one or two chemical parameters. However in most instances these are the only sources of water available for human consumption. The classification system should recognize the domestic value of Class II and III waters.

There was also concern that domestic water supplies in Class II or III categories may not be protected for domestic needs in the same manner as water in Class I categories.

(b) The proposed regulations state that, "a mixing zone shall be granted to pollutant discharges. The Department will set the mixing zone boundaries on a case by case basis."

The mixing zone concept for groundwater was disputed by hydrologists as posing a threat to other beneficial uses of the groundwater resource. It was their opinion that mixing zone boundaries cannot be controlled or predicted with sufficient accuracy to protect water quality for other beneficial uses. Although degradation may not occur rapidly, once it occurs the resource may be damaged for a very long time period.

It was recognized that not all waste products pose the same hazard to groundwater quality, but there are some waste products which should be specifically excluded from ground-water systems.

2. Enforcement of Regulations and Compliance Monitoring.

There was concern expressed that agencies charged with regulating and enforcing groundwater protection are not adequately funded to carry out their responsibilities. Special concern was given to the job classification and pay scale for enforcement personnel. The inadequacy of funding was blamed for a high turnover of personnel and inadequately trained staff at the enforcement level.

Excessive delays in obtaining permits and in other regulatory processes are partly due to insufficient numbers of trained personnel to perform the work.

3. Saline Seep Control.

Saline seep is recognized as a critical groundwater and agricultural problem. Past efforts by state and federal agencies have identified the causes, and the detection and control methods. Current efforts by the conservation districts and the agricultural community are making progress in implementing controls but eventual success will require continued incentives and intensive demonstration and education programs.

Federal, "set aside" programs are sometimes a disincentive to the needed control programs.

4. Disposal of Toxic and Hazardous Wastes.

There was concern expressed that we may not have sufficient knowledge to insure groundwater protection in areas used for underground injection of toxic and hazardous wastes. There were reservations about the advisability of the state taking the responsibility for the federal Underground Injection Control Program. Will the state be able to meet the monitoring needs?

5. Data Needs.

Although considerable data has been developed to define the quantity and quality of Montana's groundwater, there is a continuing need for data to provide a base for management decisions. Much of the data collected in earlier years is not in a readily accessible form.

In some instances the lack of adequate data is an impediment to the development of groundwater resources due to the risks of unknown quantity and quality. In other cases the lack of adequate data complicates legal decisions on water rights and the granting of permits.

Because of multiple agency involvement with different aspects of groundwater development and management there is duplication of effort in data collection and storage.

6. Abandoned Wells.

There are a number of old wells in several regions of the state which were not properly capped or the well casing has disintegrated. These wells pose a contamination hazard to wells and aquifiers in the nearby area.

Existing statutes specify responsibility for new wells but liability for old wells is not clear.

There is an urgent need to identify and cap problem wells. Legislation may be necessary to identify funds and responsibility for this problem area.

7. Regulation and Licensing of Water Well Drillers.

Some water well drillers are not providing adequate or complete data in their drilling logs. These and other improper activities have caused difficulty for the industry and the regulatory agencies.

There was support expressed for increased and effective enforcement of regulations. There is an urgent need to continue the Board of Water Well Contractors and to strengthen their licensing requirements.

8. Surface - Groundwater Interactions.

Shallow groundwater aquifiers and surface waters are inseparable resources in many areas of Montana. This fact has been often misunderstood or not recognized in the past. The relationship between these resources is especially relevant to water appropriations in relation to seasonal conditions and uses of water in many of the stream valleys.

9. Coordination and Cooperation of Agencies.

The administration, regulation and research on groundwater resources is shared by a number of different agencies in state, local, and federal government. Although informal cooperation often occurs, a more formal agreement may be necessary to develop a coordinated strategy and action programs. The agreement is needed to reduce duplication of effort, to centralize data storage and aquisition systems, establish priorities and improve enforcement effectiveness.

10. Coal Bed Hydrology.

There has been considerable study and research on groundwater in the coal bed regions of eastern Montana. Much of the needed information is incomplete until after further developments have occurred. Because the groundwater in these areas is essential for livestock and domestic uses, the state should provide ongoing assistance for monitoring changes in water quality in the region.

<u>RECOMMENDATIONS</u>

(1) The state should continue to support the programs for implementing control of saline seep. A sustained funding support is needed to insure continuity and to provide the necessary incentives for involvement by the agricultural community. An effort should be made to eliminate disincentives of the federal "set aside" program where it impedes progress of the necessary control programs.

(2) Improve and strengthen enforcement of regulations to protect water quality. Increased funding is necessary to provide higher job classifications and to discourage "turnover" of qualified personnel in the enforcement positions.

(3) Provide improved enforcement of regulations governing oil and gas industry operations and especially the plugging of seismic shotholes.

(4) The state should take the initiative to develop a comprehensive groundwater management strategy. There was general concensus that the governor should appoint a mini-cabinet group or steering committee to identify actions necessary to provide a coordinated approach to protection of groundwater quality and the management of groundwater resources.

Some specific topic areas which should be considered are:

(a) A formal agreement for the coordination and cooperation of state, federal and local agencies concerned with groundwater resources.

(b) Methods to finance the groundwater program needs.

(c) Methods to reduce duplication of activities between governmental agencies, eg., regulatory activities; data collection and storage.

(d) Identification of specific problem areas, data needs, responsibilities and priorities.

(e) A central computer-based, data storage and aquisition system which would serve needs of the various agencies.

(f) A study of the roles of groundwater in the overall water needs of Montana and how it relates to the water needs of downstream states.

(g) A clarification of the authority of local and state agencies to protect ground-water resources in local areas.

(h) A groundwater management strategy based on the various uses of groundwater. Specific management alternatives which might be considered are management as:

- a renewable resource
- a non-renewable resource
- a transmission system
- a water-quality tool
- an energy resource because of its constant temperature and pressure
- a waste disposal system

The identification of various uses of water and the relations, if any, of these uses to each other helps to better identify the data needs.

(5) The state should increase efforts to build a data base necessary for specific management decisions. The federal-state cooperative programs should be encouraged.

(6) The Board of Water Well Contractors should be continued with increased enforcement and licensing requirements.

(7) The state should explore the feasibility of up-stream storage reservoirs as part of a long-term strategy; agreements with the US Forest Service for storage reservoirs should be explored.

(8) The state should establish a policy on the "mining" of groundwater, to determine if and how much groundwater should be mined. Previous legislation is not explicit.

(9) Rules should be adopted to define an "adequate diversion" or "reasonable effect" as it pertains to well interference. Without formal definition, legal disputes are difficult to resolve and a "first" appropriator may limit use of an available resource.

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