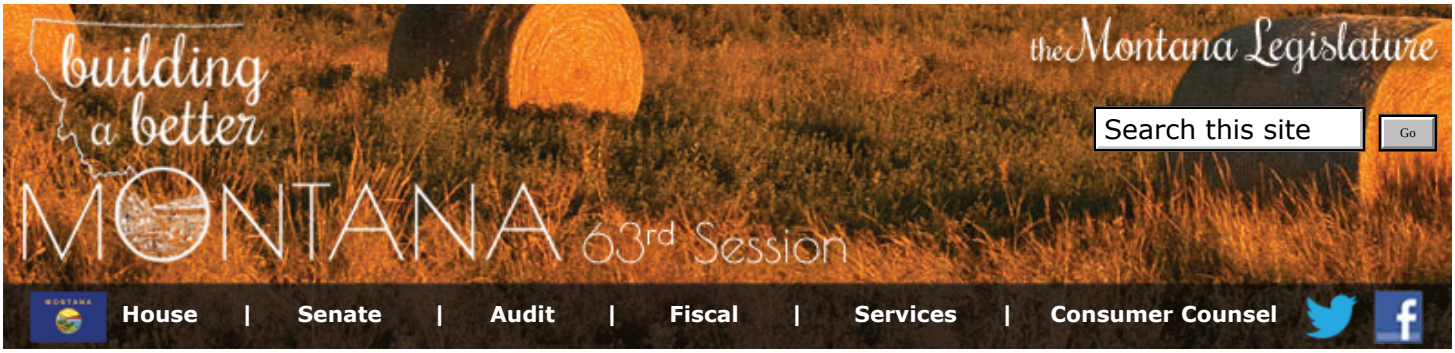

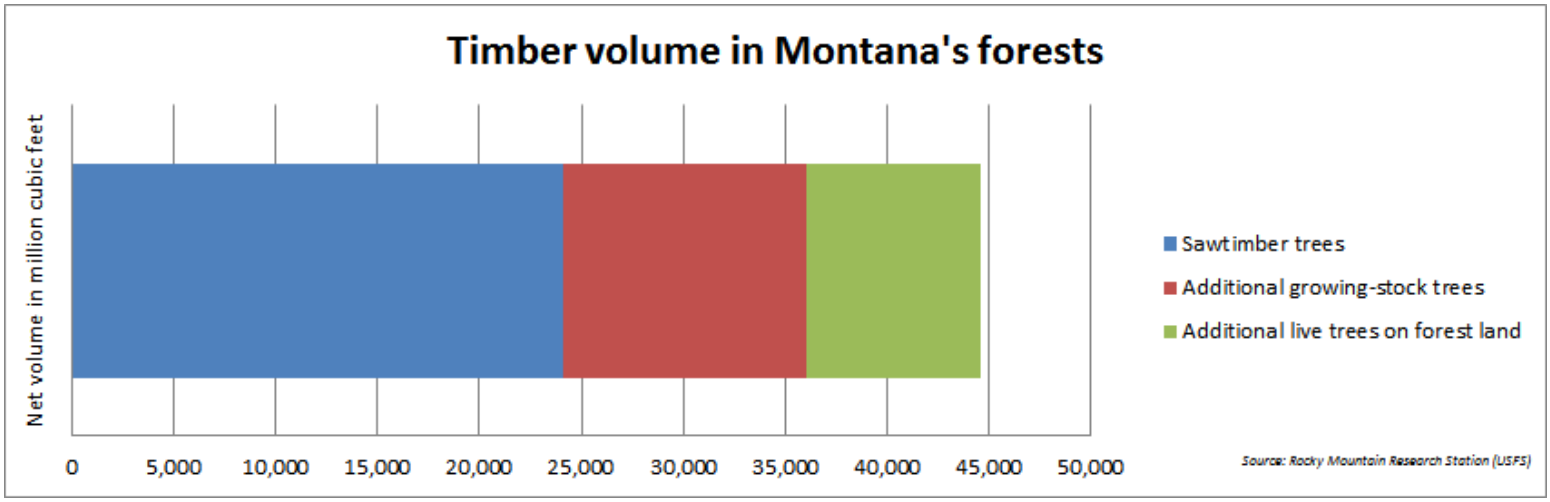

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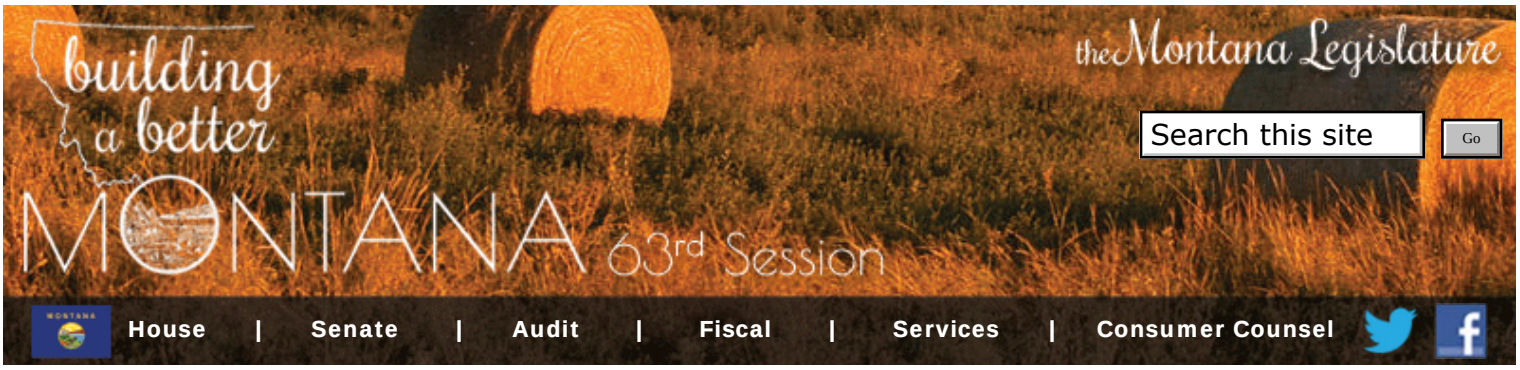
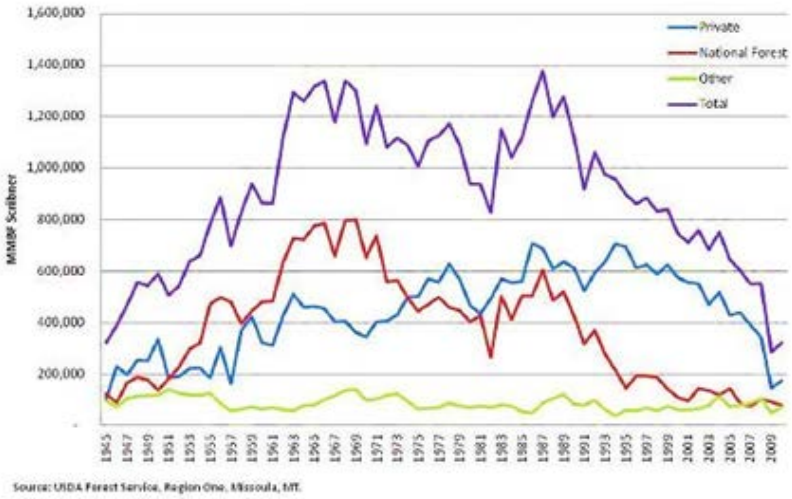


Timber harvest by ownership 1945-2009

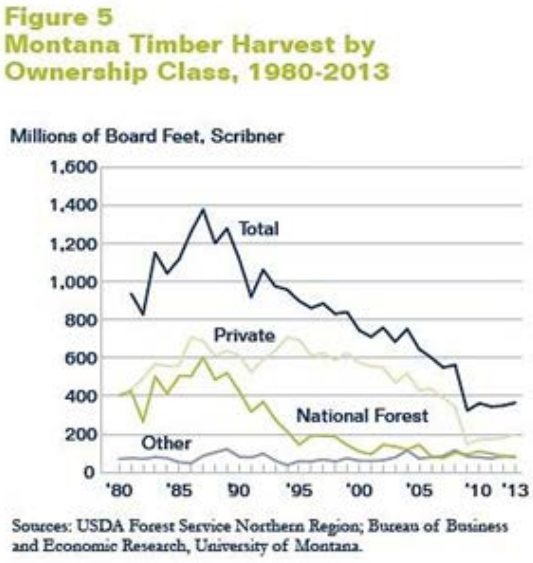


Source: USDA Forest Service, Region One, Missoula, MT.

Figure 35—Montana timber harvest (million board feet, Scribner rule) by ownership, 1945-2010.

Source: "Montana's Forest Resources, 2003-2009," Rocky Mountain Research Station, U.S. Forest Service (July 2012)

Timber harvest by ownership 1945-2009



Source: 2014 Montana Forest Products Industry Outlook, Bureau of business and Economic Research, University of Montana

Additional information (harvest by county): http://www.bber.umt.edu/FIR/HarvestMT.asp

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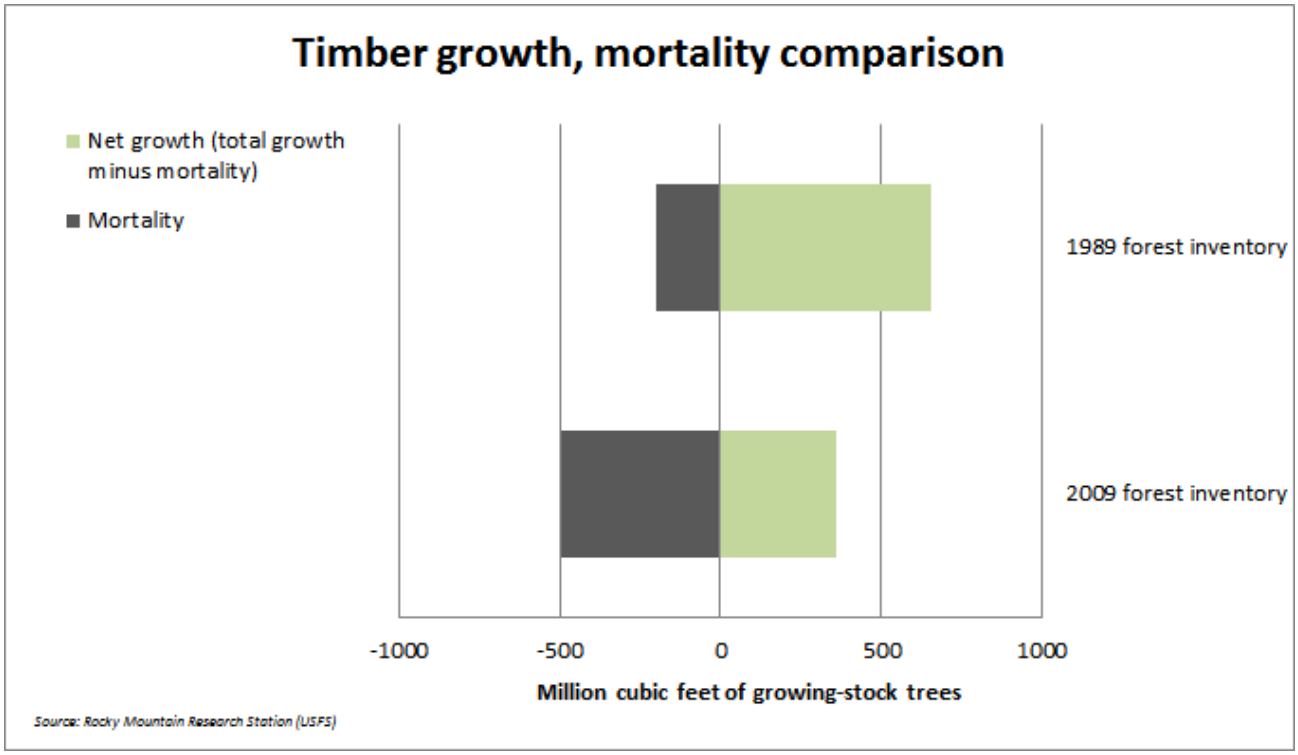
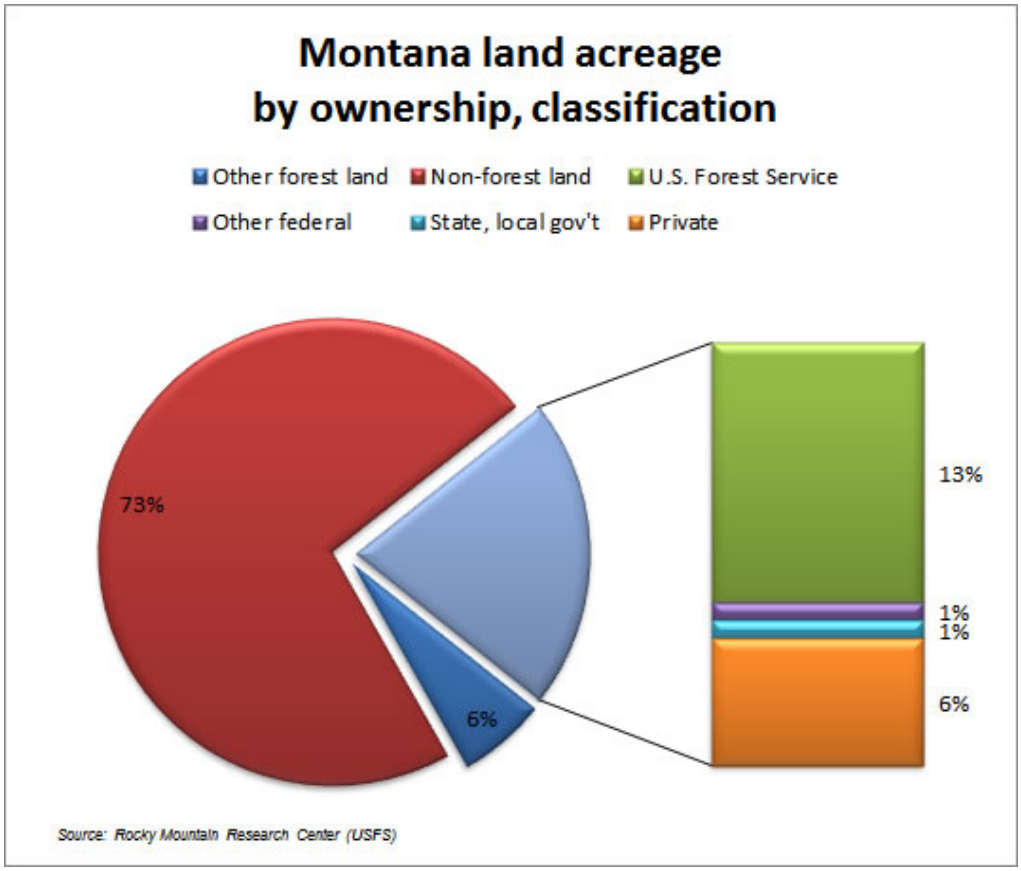
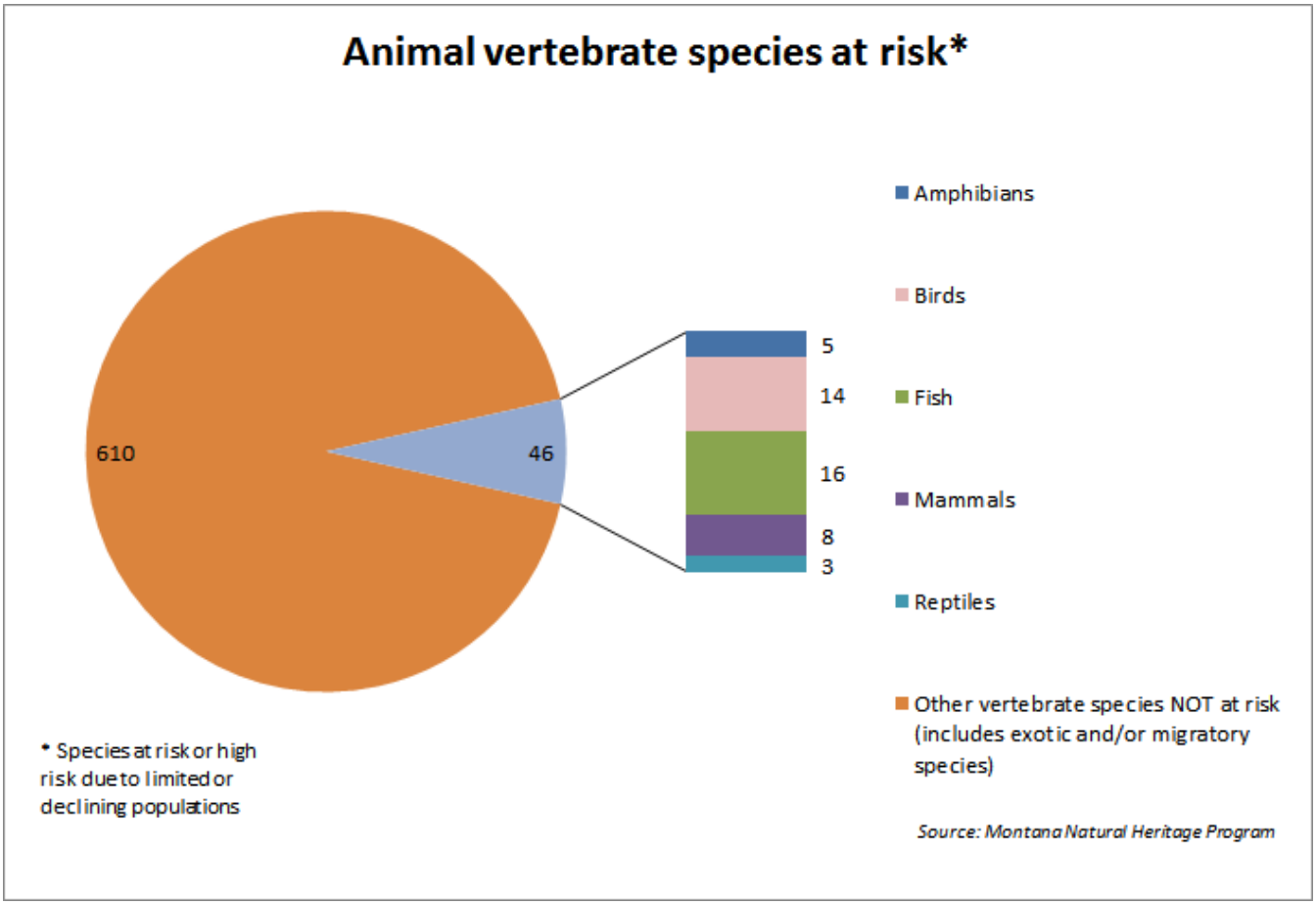
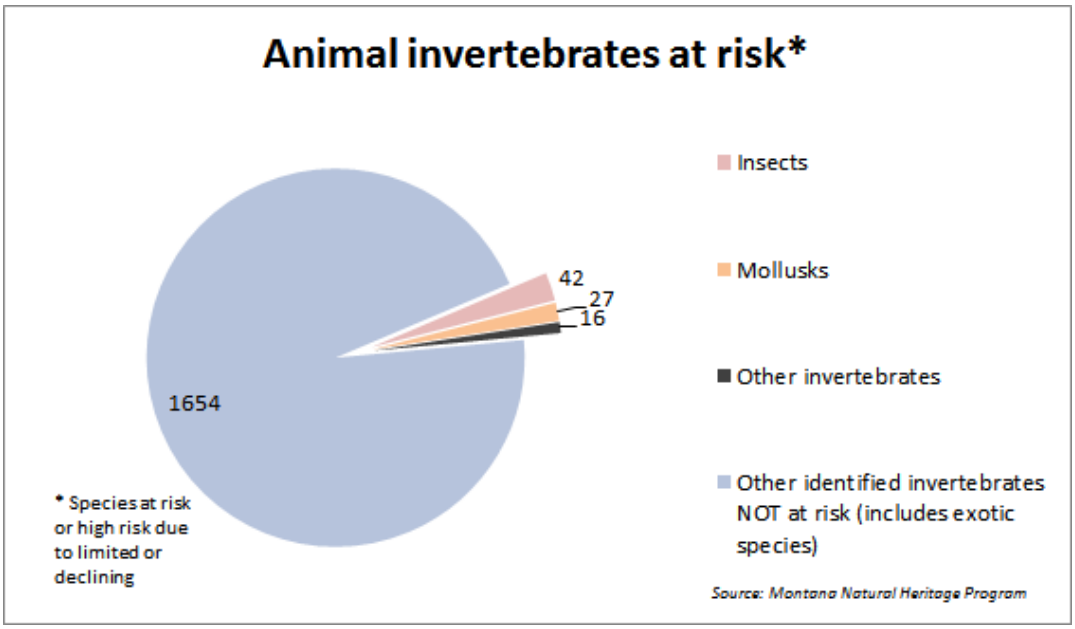


More information: Montana's Forest Resources, 2003-2009 (USFS)



Source: Montana's Forest Resources, 2003-2009, Rocky Mountain Research Station, U.S. Forest Service (2012)


Animal vertebrate species at risk*
610
46
5
14
16
8
3
Amphibians
Birds
Fish
Mammals
Reptiles
Other vertebrate species NOT at risk (includes exotic and/or migratory species)
* Species at risk or high risk due to limited or declining populations
Source: Montana Natural Heritage Program



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Draft EQC environmental trend information

Indicator

Agricultural land distribution
Animal Species at Risk
Class II landfill sites, status
Environmental enforcement and compliance history
Fecal coliform and nitrate levels
Federal Superfund sites, status
General Jobs trends, 1990-2012
Hazardous waste rates
Hunting harvest trends
Median Household Income
Mineral production trends
Montana energy consumption by sector, 1960-2011
Montana energy production by type, 1960-2011
Number of days air quality standards exceeded
Number of farms, land in farms, average size (1900-2010)
Oil and Gas wells (map)
Plant Species at Risk
Population increases/decreases by county, 1970-2010
Proportion of Employees by industry, 1990-2012
Recycling rates
State superfund sites, status
Statewide energy production, consumption, 1960-2011
Statewide land ownership
Statewide land use
Subdivisions, 1970-2010
Timber growth, mortality comparison (1989, 2009)
Timber harvest by ownership, 1945-2013
Timber production, growing stock, 2009
Timberland ownership, 2009
Top five sources of water quality impairment
Total population, 1900-2060
Toxic substance reporting
Trends in vehicle miles traveled
Underground storage tank sites, status
Urban/rural proportions, 1900-2010
Water availability
Water consumption trends
Water quality assessment of water bodies
Weekly wages, GDP by industry
Wildlife population estimates

OUR MONTANA ENVIRONMENT...

WHERE DO WE STAND?

ENVIRONMENTAL QUALITY COUNCIL 1996

Foreword

Montana has a richly deserved reputation for natural beauty, economic diversity, and high quality of life. For 25 years, the Montana state legislature's bipartisan Environmental Quality Council (EQC) has provided Montana citizens, legislators, state agencies, universities, and others with "timely and authoritative information concerning the conditions and trends in the quality of the environment. . . ." (MCA, 75-1-324). The EQC's unique mission is to facilitate and encourage better, more informed decisions regarding Montana's environment. The EQC continually pursues new and innovative ideas that encourage better decisions. Occasionally, we resurrect imaginative and inventive concepts, such as the EQC's 1975 Montana Environmental Indicators project, to assist us in our statutory responsibilities.

As Chair and Vice Chair, and on behalf of the EQC, we are excited and extremely proud to present *Our Montana Environment: Where do we stand?* This 1996 report represents the EQC's first effort in over 20 years to systematically assemble comprehensive, timely, and authoritative information on the current state of Montana's environment.

This report does not attempt to interpret where Montana's environment stands, but encourages the reader to answer that question. Furthermore, this report is not organized around any preconceived notions of what Montana should be or do to protect and enhance the "quality of life" of its citizens. Our effort here is simply to present facts that document trends.

In 1975, the *Montana Environmental Indicators* report stated that "the EQC has always maintained that no greater challenge confronts the citizens and leaders of Montana than identifying what it is about the state that makes it a good place to live. . . ." Our ultimate objective in producing the 1996 report is to assist Montanans in making informed choices regarding this place we call home.

An insert in the back of the report invites readers to critically evaluate the relevance and utility of the report. We welcome and encourage your comments. These comments will assist the EQC in preparing subsequent reports.

Jerry Noble
Chair
Environmental Quality Council

Representative Vicki Cocchiarella
Vice Chair
Environmental Quality Council

Introduction

Where does the health of Montana's environment stand? How can we tell? What are the best measures of environmental health? What evidence is there that Montana is changing for better or worse? Can we identify any trends and what do they show?

Publication of *Our Montana Environment: Where do we stand?* 1996 reflects the Environmental Quality Council's (EQC) first attempt in 20 years to develop indicators that document trends that assist Montanans in answering these questions. The EQC first initiated an indicators project in 1972. That project culminated with the publication of *Montana Environmental Indicators, EQC Fourth Annual Report* (1975).

Upon examination of the indicators adopted 20 years ago, a number of the "old" indicators were dropped and some "new" ones were adopted. The Council decided to focus on indicators of environmental health and not discuss a number of old indicators pertaining to crime, public health, child welfare, and other social conditions. Data on Montana's air quality is not included because information is not available for a continuous time period or for more than a few specific sources. Statewide trends cannot be illustrated without more comprehensive data. However, the EQC will work to incorporate Montana's air quality in future indicators reports.

The report is organized by topic headings (set out to the right). Within each heading is a series of EQC-selected environmental indicators. An indicator is something that helps you understand where you are, which direction you are headed, and how far you are from where you want to be. A good indicator alerts you to a problem before it becomes severe and may also help you to recognize what can be done to fix the problem. Environmental indicators are measures of environmental quality.

This report attempts to provide a reliable method for measuring environmental quality and contains only existing baseline information from documented and well-established sources. In a nutshell, it presents facts that document trends. It is up to the reader to interpret what these trends show.

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Economic Conditions . . . 4

Land Use . . . 6

Agriculture . . . 8

Forests . . . 10

Wildlife . . . 12

Energy . . . 14

Minerals . . . 16

Remediation . . . 17

Waste . . . 18

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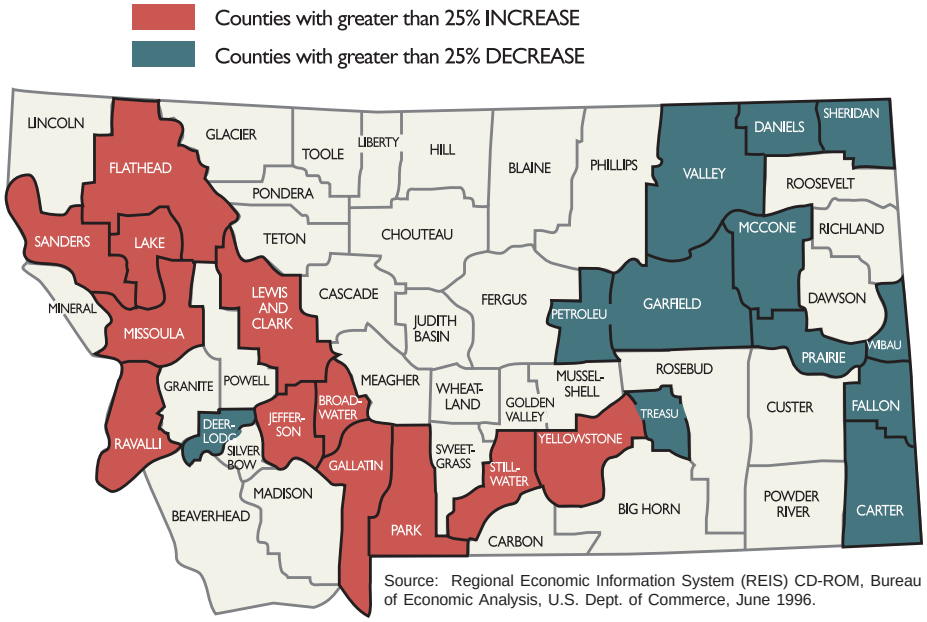
Population

What is the connection between human population and environmental health? When the population grows, does the environment suffer? Greater numbers of people increase stress on the environment. For example, as population increases, so does the demand for resource-based products. The environmental impacts of a growing population are evidenced in many ways, including changes in land use patterns, additional roads, bridges, water and sewer lines, and more congested traffic.

Percent Change in Population Density, 1975-1995

(Figure 1)



Source: Regional Economic Information System (REIS) CD-ROM, Bureau of Economic Analysis, U.S. Dept. of Commerce, June 1996.

Demographic Trends & Comparisons

Montana's population has increased fairly steadily since 1970, when there were fewer than 700,000 inhabitants in the state. By 1980, the number increased to approximately 787,000, and a decade later reached just under 800,000. In 1995, Montana's population was just over 870,000. The U.S. Census Bureau estimates that by the year 2000, we will have over a million residents.

The number of inhabitants statewide has increased, but in an uneven distribution. Since 1975, the 12 counties that experienced a greater than 25% increase in population density were mostly in the western 1/3 of the state. Excluding Deer Lodge County, the dozen counties with a greater than 25% reduction in population density were all in the eastern 1/3 of the state. The data in figure 1 confirm the widely held perception that eastern Montana is shrinking in terms of population, while certain parts of western Montana are becoming more and more crowded.

Figure 2 shows that over the past 20 years, surprisingly, the relative proportions of people living in urban and rural environments in Montana have stayed about the same. This pattern contrasts sharply with a number of other western states (Utah, Idaho, Washington, and Nevada), where urbanization has accelerated and the population in metropolitan areas has mushroomed. The pattern in North and South Dakota and in Wyoming is more similar to that in Montana.

Even though roughly ½ the residents of Montana live in rural conditions, while the other ½ in urban ones, there has been dramatic change in certain regions. A number of counties in the western portion of the state, including Ravalli, Gallatin, Lake, Flathead, and Missoula Counties, have grown significantly in population and in population density. Over the same time period, populations in counties in the central and eastern portions of the state—Petroleum, Prairie, Daniels, Treasure, Valley—have declined. Several of the most sparsely populated counties in 1970 were even emptier in 1990, and they are likely to grow even smaller in the years ahead.

Along with income and consumption patterns, population levels are a basic determinant of the aggregate demand for natural resources and environmental amenities. As population levels grow, resource depletion and environmental degradation are hastened as the ecosystem is required to support ever increasing numbers of people.

However, while there is little doubt that population growth and environmental stresses are strongly linked, there are still lingering questions about just how much difference the numbers of people make. For example, technological change and environmental regulation can substantially mitigate resource depletion, environmental degradation, and even the character of aggregate demand.

Population growth appears inevitable, but it nevertheless stirs controversy. No one can say with scientific validity

just how many people can fit comfortably in Montana without changing the balance of human and nonhuman resources that make our state such an attractive place to live.

Montana is the 4th largest state in the country in terms of physical space, but also one of the least crowded, with only 5.5 persons per square mile. (New Jersey, by contrast, has a population density of 1,042 persons per square mile.) In the l992 *Montana Futures Project* report commissioned by then-Governor Stan Stephens, 63% of Montanans interviewed by telephone believed that the state's population was just about right, while nearly 10% said it was already too large. With no authoritative estimate of what the carrying capacity of Montana is as a whole and with the extraordinary differences among the landscapes of eastern, central, and western portions of the state in mind, varying interpretations of population figures will no doubt continue to stimulate debate.

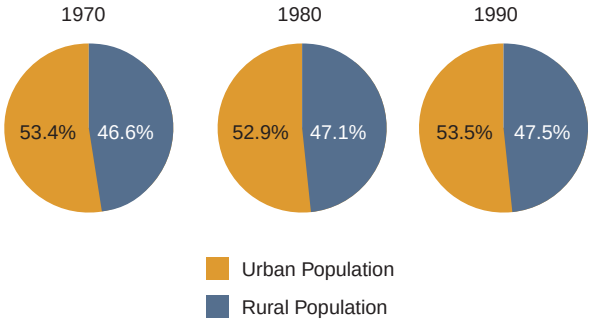
Environmental health consists of many components. While they are indicative of changing conditions, population numbers alone may not be as meaningful as a more complex measure that combines population increases with other factors, such as automobile usage and energy consumption, or one that examines population dynamics in light of other indicators of environmental quality.

Did You Know?

· That the median age in Montana has increased from 29 in l980 to 36 in l995? What does this trend portend for the environment? As the median age increases, do pressures on the environment become more or less forceful and significant? In other words, do grandparents have a softer, gentler impact than their grandchildren?

· That the number of people migrating from one County to another is almost as large as the number of people coming to Montana from other states? In a survey conducted by the Montana Bureau of Business and Economic Research in l995, researchers found that more than 40% of the people moving to new areas of the state were existing state residents. In addition, more than ½ of the people migrating from other states have preexisting ties to Montana, because they or family members had already lived in the state. The same study concluded that the percentage of people moving to Montana from out-of-state during the previous 5 years was just about the national average.

Urban and Rural Population
(Figure 2)



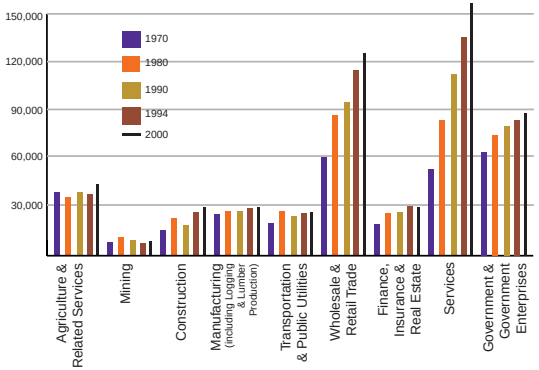
Source: Regional Economic Information System (REIS) CD-ROM, Bureau of Economic Analysis (BEA), U.S. Dept. of Commerce, June 1996.

Economic Conditions

The Montana Environmental Policy Act calls for practical steps to create and maintain conditions under which humans and nature can coexist "in productive harmony". Such steps and conditions are seldom easy to identify, especially since conventional measures of economic well-being are not clearly related to environmental health. For example, does industrial expansion lead to environmental degradation or improvement?

The EQC's 1975 report made little effort to establish direct links between measures of economic health and measures of environmental health. Readers were left to draw their own conclusions as to just how and to what extent economic conditions, such as the unemployment rate and income levels, affected water, soil, and air quality. The authors of the report did, however, include broad quality of life indicators, such as a County health status index, crime statistics, and several measures of social welfare. Moreover, one of the stated purposes of the report was to "begin a new effort of assessing the dynamic interplay of social, economic, and environmental systems within a broad ecological approach to help [achieve] the 'good life' in Montana."

Number of Jobs by Major Industry
(Figure 1)



Source: Regional Economic Information System (REIS) CD-Rom, Bureau of Economic Analysis, U.S. Dept. of Commerce, June 1996.

The bipartisan Governor's Council for Montana's Future concluded in its l992 *Montana Futures Project* report that Montana's economy has experienced a probably irreversible transition, evidenced by the following:

- The percentage of Montana's employment provided by mining, logging and lumber, and agriculture has been cut in ½ over the past 50 years.

- Finance/insurance/real estate, wholesale and retail trade, and general services have tripled in the same period, from 19% to 58% of all nonfarm jobs.

- The traditional natural resource industries are shrinking in percent share, but not in the absolute numbers of jobs and income dollars.

As a result of these structural changes, Montana's economy is not configured in the same way many people think it is. "It is not just an economy that is GOING to change," stressed the authors of the l992 study, "it is an economy that has ALREADY CHANGED." Some people assume that a shift toward services and away from production means reduced stresses on the natural environment. Careful monitoring, comparing, and correlating trends in the economy and the environment will demonstrate whether such assumptions are accurate.

Shifts in Montana's Main Sources of Jobs

The data in figure 1 show how certain sectors of the Montana economy have expanded relative to others in terms of employment. In l994, Montana's largest private industries by numbers of persons employed were, in order: 1) services (including among others: health organizations; hotels; gambling operations; repair businesses; and legal, engineering, and educational services); 2) wholesale and retail trade; 3) agriculture and related services; 4) finance/insurance/real estate; and 5) manufacturing (including logging and lumber production). If federal, state, and local governments were included in the ranking, they would occupy third place. The earnings from these industries in l994 were: from services, $2,384,270,000; from wholesale and retail trade, $1,699,690,000; from agricultural and related services, $887,820,000; from transportation and public utilities, $783,750,000; from manufacturing (including logging and lumber production), $697,540,000; from construction, $596,510,000; from finance/insurance/real estate, $416,560,000; and from mining, $247,000,000.

According to the U.S. Commerce Department estimates, the number one source of employment in the year 2000 will be general services (over 160,000 jobs), followed by wholesale and retail trade (about 127,000), government (89,000), and agriculture and related services (43,000), with construction and manufacturing nearly tied for fifth place (approximately 30,000 jobs in each).

This pattern underscores the Montana Futures Project findings, but it does not lead to any certain conclusion

regarding effects on the environment. The downward trend in the number of jobs provided by such natural resource industries as mining and agriculture (broadly defined) is mirrored by similar trends elsewhere in the western states region and across the country. The corresponding upward trend in services-related employment is likewise typical of the United States as a whole and is generally believed to reflect structural changes in the global economy. The substitution of machinery and technology for workers in a number of resource industries is a major factor to consider.

Income & Unemployment Factors

Jobs and income levels figure prominently in most measures of overall quality of life. A job is a basic requirement of a healthy environment for most adult Montanans. Specifically, personal income plays a significant role in the environment because it provides a measure of personal security and freedom and serves to motivate social and economic activity.

When per capita income goes up, people are presumably better off—happier, healthier, and perhaps more hopeful about the future. What, then, is the link between changes in per capita income and the quality of Montana's natural environment? As incomes increase, does the environment get better or worse? It is difficult to answer this question in a scientifically verifiable manner without looking at a variety of indicators all at once. Prosperity may facilitate investment in relatively clean processes and advanced technologies. At the same time, economic growth increases the amount of resources that is extracted, processed, packaged, refined, transported, and ultimately used by consumers.

Average per capita earnings have gone up over the past 20 years. After adjusting for inflation, however, increases in average incomes have been modest. Some exceptions are emerging. For example, data compiled by the Montana Department of Labor and Industry indicate that Gallatin County alone experienced a greater that 5% increase in per capita personal income between 1993 and 1994 (the latest year for which accurate numbers are available).

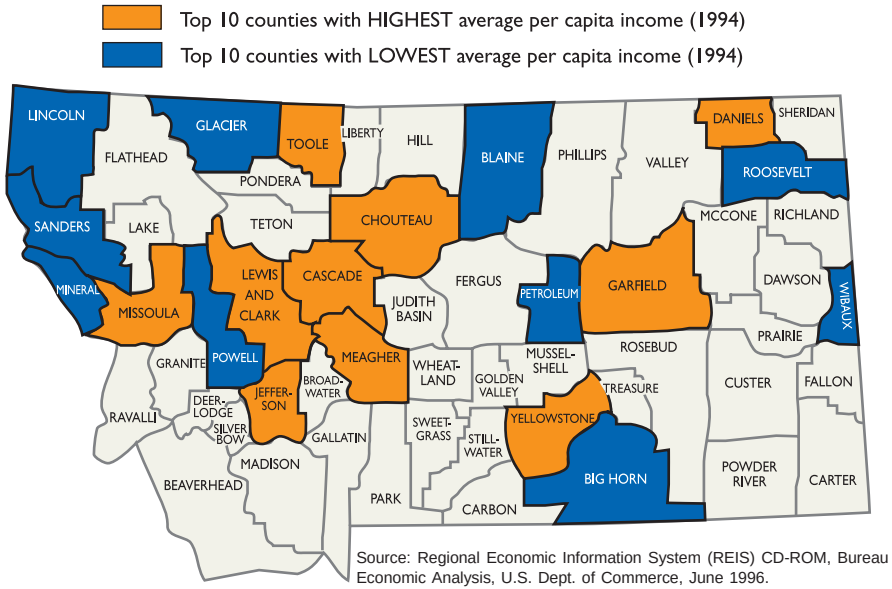
The 10 Montana counties with the highest per capita incomes in 1994 were, in rank order: Yellowstone, Daniels, Lewis and Clark, Garfield, Cascade, Meagher, Toole, Jefferson, Missoula, and Chouteau. The 10 Montana counties with the lowest income figures were, starting at the bottom rank: Big Horn, Blaine, Mineral, Petroleum, Wibaux, Roosevelt, Glacier, Sanders, Powell, and Lincoln. Figure 2 shows the average per capita incomes for each County in both groups. In 5 of the 10 counties with the highest per capita income, the earnings from agriculture were higher than the earnings from other industries.

In 1980, economic conditions were somewhat different. Custer, Dawson, Fallon, Musselshell, Richland, Toole, and Treasure Counties were among the top 10 (along with Yellowstone, Cascade, and Lewis and Clark) in terms of per capita income. In that same year, Petroleum, Phillips, Meagher, Mineral, Lake, Lincoln, Judith Basin, Golden Valley, Carter, Broadwater, and Blaine Counties registered the lowest income figures.

Did You Know?

That Montana's largest, fastest growing source of personal income over the past 30 years is unearned income, composed of dividends, interest, rents, and government transfer payments (such as Social Security). This sector grew from 23% of all income in 1960 to almost 40% by 1990, and in 1990, unearned income was 2.7 times greater than earnings from mining, lumber and other manufacturing, construction, and farming/ranching combined. This shift is probably closely related to changes in the migration pattern (most people moving to Montana in recent years are in the 45-64 years of age category) and to the steadily increasing median age of Montana residents.

Per Capita Income
(Figure 2)

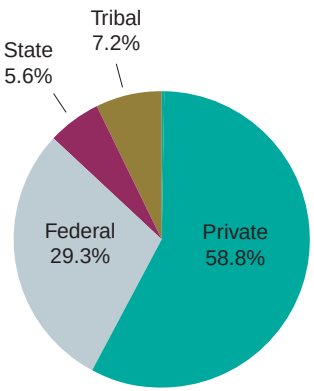


Source: Regional Economic Information System (REIS) CD-ROM, Bureau of Economic Analysis, U.S. Dept. of Commerce, June 1996.

Land Use

Land use in Montana is determined by land type, climate, ownership patterns, history, and public policy. Montanans and their policymakers have some choice on how, and to what extent, land is used, and may thereby determine the benefits and impacts of such use.

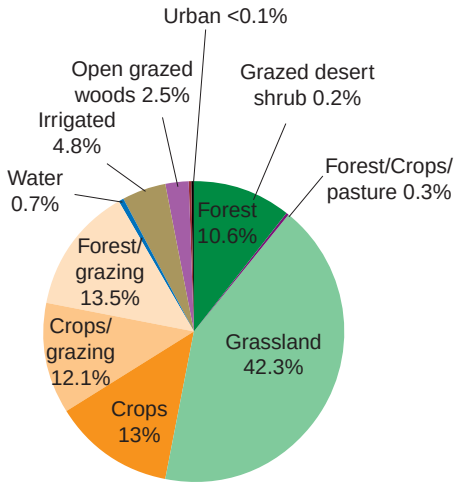
Land Ownership, 1984
(Figure 1)



Estimated total acres in Montana: 94,100,000.

Source: U.S. Bureau of Land Management, 1984; Natural Resource Information System (NRIS), 1996.

Landuse, 1970
(Figure 2)



Source: U.S. Geological Survey, 1970; NRIS, 1996.

Approximately 60% of Montana's land base is privately owned; the remainder is either tribal or public land [figure 1]. Federal land management accounts for almost 30% of Montana's total land base; the state manages slightly over 5% of lands in Montana. Land ownership balances have not changed much in the last 20 years.

The only available statewide characterization of land use in Montana dates back to 1970 [figure 2]. At that time, almost ½ of Montana consisted of grasslands used for grazing. The other ½ was fairly equally distributed between forests and woodlands and croplands. Grazing occurred on about ½ of each of these land types. No comparable update of these 1970 figures is currently available.

Satellite images are being used to more accurately map land cover. This effort, entitled "Gap Analysis," has only been completed for the western ½ of the state. When complete, it will provide a detailed assessment of current land cover and wildlife habitat and will provide a means to assess changes since 1975.

Residential Development

One of the major and most noticeable changes in land use in Montana is the increase in residential lands, notably new developments in the rural outskirts of urban areas. Many of these developments involve the subdivision of large tracts of agricultural or rangeland into smaller residential developments. Over the past 10 years, state staff reviewed over 11,000 subdivision proposals (for a total of 34,000 proposed residential parcels). Proposals in this period were, by far, the highest in Flathead, Gallatin, Yellowstone, and Ravalli Counties, which together accounted for 48% of the total proposed parcels. These numbers exclude parcels greater than 20 acres and do not account for any proposals that were denied at the local level. In 1995, Flathead County approved 43 subdivision proposals, to create 178 residential parcels on 1,185 acres.

The subdivision of large holdings and subsequent development can change overall land use patterns in rural areas. To investigate such changes, we looked at rural Montana in terms of average acres per residential unit and average age of residential units—those counties with low numbers for both are likely experiencing recent land use changes resulting from residential subdivisions in rural areas [figure 3]. The numbers reflect Flathead County's high subdivision rate—residential land holdings outside of municipalities in Flathead County have recently become smaller.

Conversion of open land to residential use can affect water availability, ground water quality, aesthetics, public access, extent and quality of wildlife habitat, provision of public services, and other amenities. The direction and magnitude of change is determined by what scale and type of use is replacing the former scale and type of use. As rural development gets more dense, concern over ground water quality increases—many of these homes dispose of waste via septic systems and obtain water via wells.

In general, the closer the facilities are

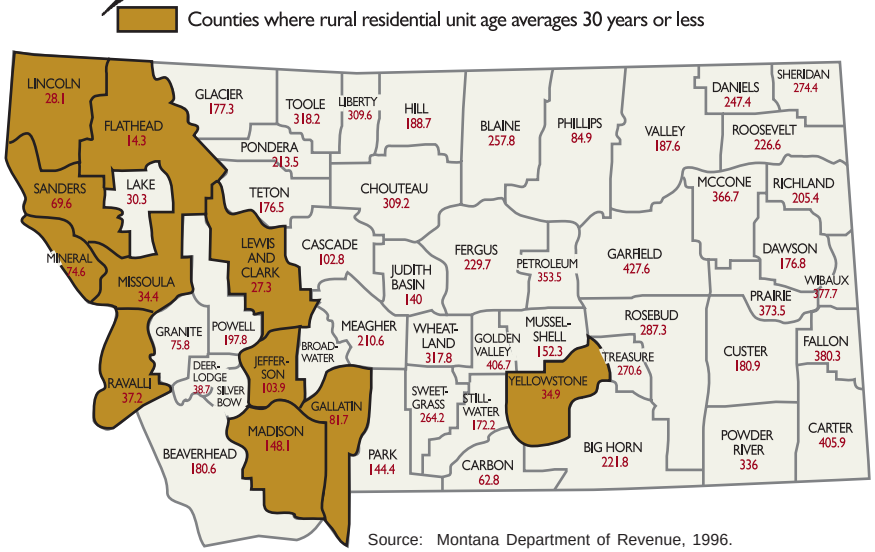
to each other, the higher the likelihood for well contamination and subsequent risk of illness. Also, depending on underground characteristics, septic system concentration (and functionality) can pose potential threats to surface water quality. Currently, there is no convenient source of data on the location and density of septic systems. There is, however, information on well density and development. As shown in figure 4, Garfield, Madison, Powder River, and Prairie Counties average more than one well per person. Pondera and Madison Counties showed the largest growth, since 1990, in wells per capita. For these counties, a very high proportion of new residents are likely installing wells as their drinking water source.

Conservation Easements

Development pressures, among other reasons, have motivated Montanans to protect open space, wildlife, wetland, riparian, recreational, or historic values by placing land in conservation easements. These agreements between a landowner and a public agency or nonprofit group set parameters for land use, for example, by restricting development. Between 1978 and 1996, state acreage in conservation easements increased from 840 acres to almost 500,000 acres, with over ½ of the increase occurring in the last 5 years [figure 5]. The 1996 total equates to about 0.9% of total private holdings in Montana.

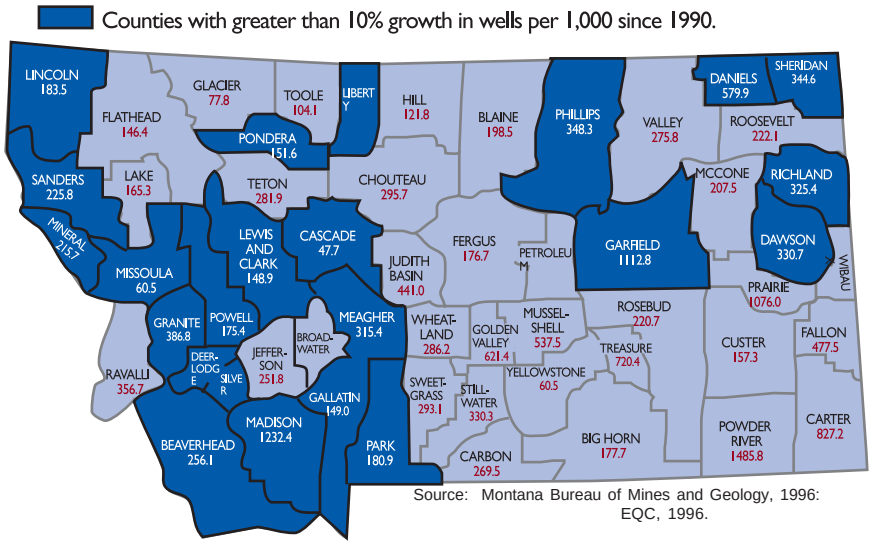
According to the Land Trust Alliance in Washington, D.C., in 1994, Montana ranked first for acreage in conservation easements; California ranked 8th. All other states that ranked in the top 10 were in the northeastern United States.

Average Acreages of Rural Residences by County, 1995
(Figure 3)



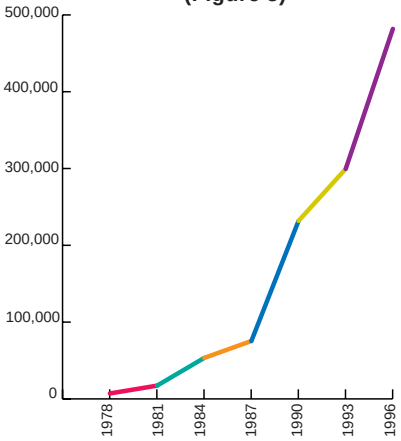
Source: Montana Department of Revenue, 1996.

Water Wells Per Thousand Population, by County, 1995
(Figure 4)



Source: Montana Bureau of Mines and Geology, 1996: EQC, 1996.

Total Acres in Conservation Easements
(Figure 5)

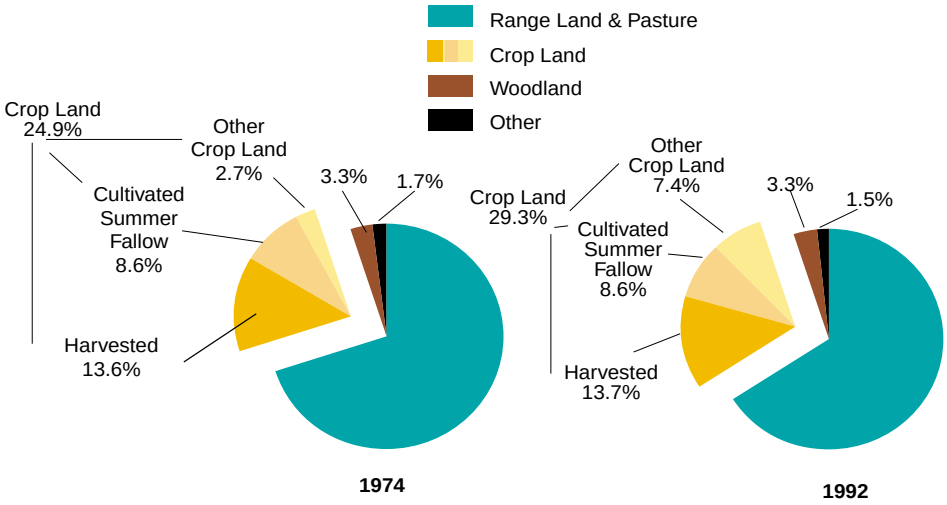


Source: EQC, 1996.

Agriculture

The mosaic of Montana's landscape includes vast agricultural lands that contribute to our economic, recreational, and ecological well being. Montana's farms and ranches are important to the state's environmental health because they provide critical wildlife habitat, scenic beauty, and wide open spaces. The indicators included in this section measure the productivity and quantity of our agricultural lands, farms, and ranches.

Agricultural Land Distribution
(Figure 4)



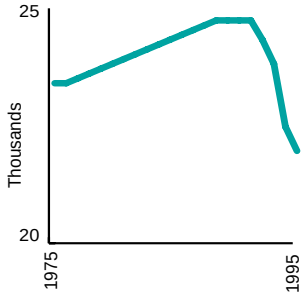
Source: Montana Agricultural Statistics which used data from Census of Agriculture, 1974, 1992

In 1995, Montana had 22,000 operating farms and ranches that each had annual sales of agricultural products of $1,000 or more. Mirroring national trends, Montana indicators reveal that since 1990, the number of farms and ranches has decreased approximately 11%, or by 2,700 farms and ranches [figure 1], while the average size of the farms and ranches has steadily increased since 1991, reaching an all-time high of 2,714 acres in 1995 [figure 3].

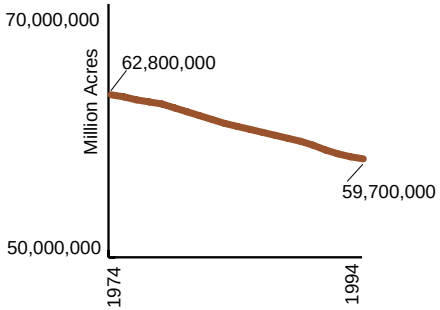
In 1974, land in farms and ranches (see definition of "land in farms" on page 14) accounted for 66.9% of the state's land area. In 1994, these agricultural lands covered only about 64.2% of the state's land area. Between 1974 and 1994, lands in agriculture decreased by 3,100,000 acres [figure 2]. Rangeland and cropland indicators reveal a steady decrease in nonfederal agricultural acres over the last 20 years.

Between 1974 and 1992, the largest decreases in lands in farms were in the northwest corner and the southwest to south central counties with large population growth [figure 5]. The acreage in agricultural land in north central counties has remained somewhat constant. The northeastern counties show significant decreases in farmland based on U.S. census data. According to the U.S. Bureau of the Census and the Montana Department of Agriculture, this decrease may be a result of accounting discrepancies involving reservation lands within the counties. Some counties, including Glacier, Jefferson, Broadwater, Madison, Yellowstone, and Big Horn,

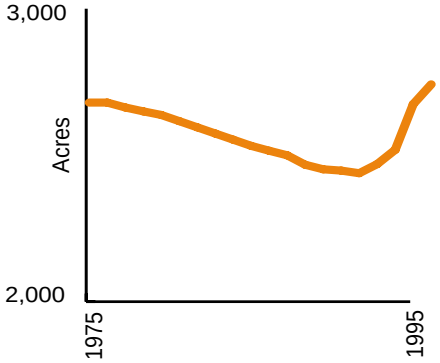
Number of Farms
(Figure 1)



All Land in Farms
(Figure 2)



Average Size of All Farms
(Figure 3)



Sources for Figures A,B,C:
Montana Agricultural Statistics, 1995.

actually show an increase in land that is used in farming.

Soil Erosion

The productivity of Montana's agricultural lands depends on the quality and abundance of topsoil. Erosion of topsoil adversely affects agricultural productivity as well as water quality in streams and rivers. However, soil conservation techniques, coupled with lands set aside through the federal Conservation Reserve Program (CRP), have greatly decreased erosion rates on Montana's nonfederal cropland. Erosion rates on nonfederal cropland have declined an average of 11.5 tons per acre a year in 1982 to 2.7 tons in 1992. Of Montana's 14 million acres of highly erodible farmland, 29% or 2.16 million acres have been set aside in CRP.

Productivity

Agriculture is Montana's largest industry in terms of gross income. In 1990, Montana's 24,700 farms and ranches generated approximately $2.1 billion in gross sales.

In 1994, with 2,700 fewer farms and ranches, Montana agriculture productivity increased 12.5% to $2.4 billion in sales. This increase is attributable to advances in machinery, technology, soil conservation techniques, and the use of agricultural fertilizers and pesticides. The sale of fertilizers in Montana averaged 406,355 tons per year from 1989 through 1994, peaking in 1994 at 469,707 tons.

Montana livestock and poultry productivity reflects changes in national market forces and consumer attitudes. The number of cattle in the state has steadily increased from 2,450,000 head in 1987 to 2,700,000 in 1995. The number of sheep has steadily decreased since 1987, dropping to 490,000 in 1995. Hog populations have remained fairly consistent, while the chicken population has decreased 48% between 1987 and 1994.

Irrigated Farmland

Water is a scarce commodity in many areas of Montana (see Water Quantity). The lack of water affects both agricultural production and the productivity of Montana's lakes and streams. Irrigated farmland in Montana peaked in 1978 at 2,069,531 acres and subsequently declined to 1,978,167 acres in 1992. Year-to-year variations occur in irrigated farmland because of fluctuations in weather, market forces, and the number of acres that are idle under U.S. Department of Agriculture programs. The water applied per acre in Montana has declined due to more efficient irrigation technologies and practices.

Conclusion

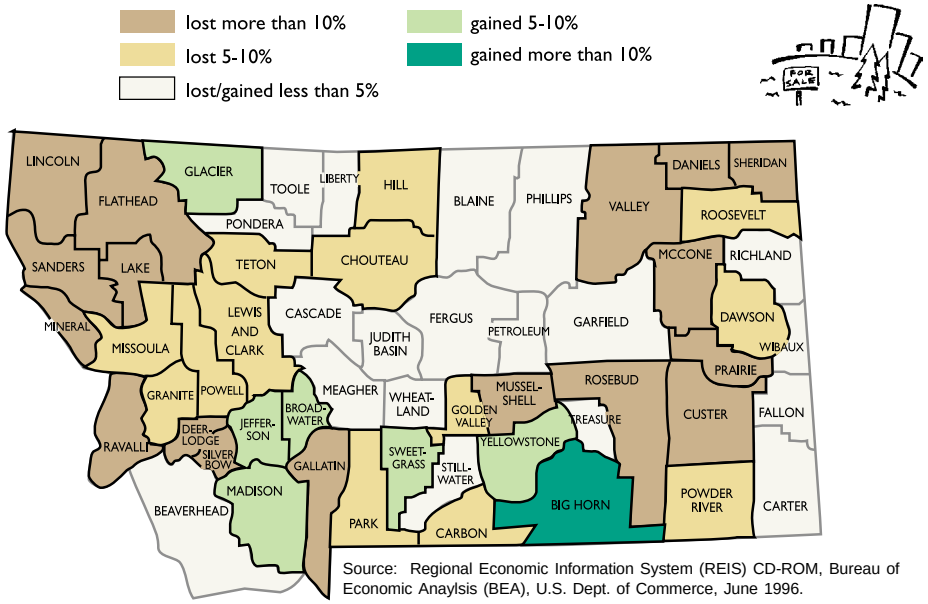
Montana's rural landscape is changing. Montana's land in agricultural production is decreasing. The number of farms and ranches has decreased significantly in the last 5 years, but the average size of those operations has increased along with productivity.

Land in Farms

The acreage designated as "land in farms" consists primarily of agricultural land used for crops, pasture, or grazing. It also includes woodland and wasteland not actually under cultivation or used for pasture or grazing, provided it was part of the farm operator's total operation. Large acreages of woodland or wasteland held for nonagricultural purposes were deleted from individual reports during the processing operations. Land in farms includes acres set aside under annual commodity acreage programs as well as acres in the Conservation Reserve and Wetlands Reserve Programs for places meeting the farm definition.

Land in farms is an operating unit concept and includes land owned and operated as well as land rented from others. Land used rent free was to be reported as land rented from others. All grazing land, except land used under government permits on a per-head basis, was included as "land in farms" provided it was part of a farm or ranch. Land under the exclusive use of a grazing association was to be reported by the grazing association and included as land in farms. All land in Indian reservations used for growing crops or grazing livestock was to be included as land in farms. Land in reservations not reported by individual Indians or non-Indians was to be reported in the name of the cooperative group that used the land. In some instances, an entire Indian reservation was reported as one farm.

Percent Change in Number of Farmland Acres Per County Between 1974 & 1992
(Figure 5)



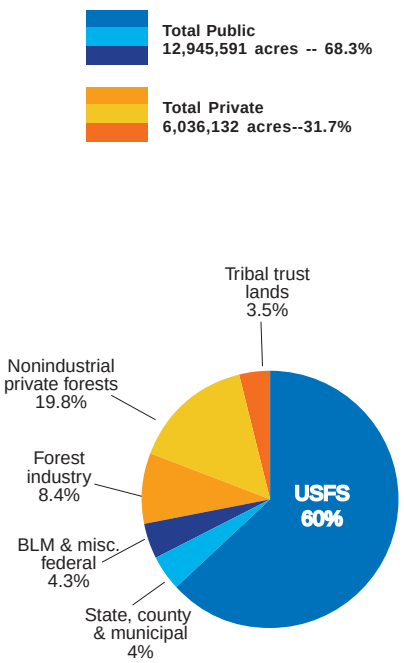
Source: Regional Economic Information System (REIS) CD-ROM, Bureau of Economic Anaylsis (BEA), U.S. Dept. of Commerce, June 1996.

Forests

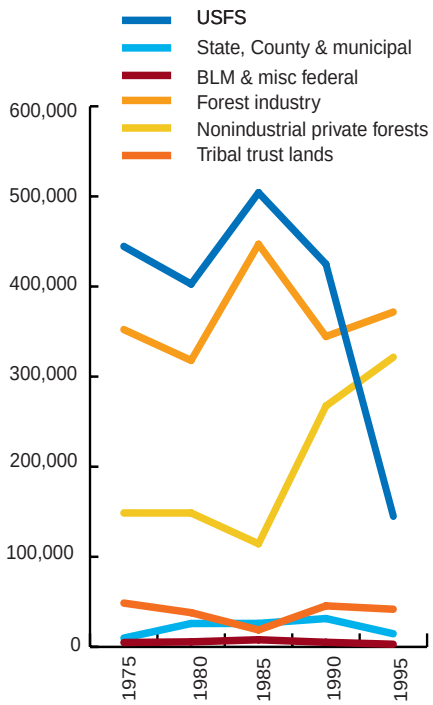
Montana's forests are an important part of what makes Montana unique. And whether one looks at them as sources of timber, habitats for wildlife and livestock, buffers for watersheds, or pleasant environments for people to visit, forests are a key component of our environment, economy, and identity.

Timberland Ownership
(Figure 1)

Harvest by Ownership
(Figure 2)



Source: Montana Forest Resources, Conner, O'Brien, 1993.



Source: An Assessment of Montana's Timber Situation, Montana Forest and Conservation Experiment Station, Sept. 1993.

Excluding forested national parks, wilderness, and other reserved lands, nearly 19 million acres or 85% of Montana's 22.5 million acres of forested land is classified as timberlands available for multiple-use management.

Ownership of Timberlands

Some 12,945,591 timberland acres are publicly owned and managed. The remaining 6,036,132 acres are privately owned timberlands. The Forest Service manages 11,356,442 acres or nearly 60% of the nonreserved timberlands in Montana [figure 1].

Privately owned timberlands are an important component of Montana's forests. Nonindustrial private landowners control over 4.4 million acres or 73% of the total privately owned timberland. Most of this land is owned by individuals, farmers, and ranchers and includes some 671,506 acres of timberlands located on Indian reservations. Forest industry firms own and manage the remaining 1.6 million acres or 8% of the state's nonreserved timberland acreage, primarily used for the production of wood fiber to supply the owners' plants and mills.

Forest Ecology

Forest ecosystem health is a recent concept without scientifically agreed-upon indicators. If healthy forests are defined as those less susceptible to potentially catastrophic mortality from insects, disease, or fire, then some foresters are becoming concerned about the health of Montana's forests. Following years of fire suppression, those forest vegetation species adapted to periodic fires are becoming increasingly replaced by shade-tolerant species. These species are often slower growing and more susceptible to insects and diseases. Conversely, they can also provide forest and ecological diversity. Despite the lack of availability of good indicators for measuring forest health and the data to support them, they may be a significant part of future forest management efforts.

Trends in Timber Harvest

Timber harvest trends can provide an indicator of how forests are being managed, not only for timber but for other environmental components that are influenced by the presence or absence of forests and their age, density, and species configuration. An average of 1.07 billion board feet (one board foot equals a 12" square of wood, 1" thick) of timber has been harvested in Montana between 1975 and 1995. During that time, the harvest has fluctuated from a low of 0.82 billion board feet in 1982 to a record 1.37 billion board feet in 1987. The 1995 harvest of 0.86 billion board feet was about 20% below the 21-year average. A variety of market conditions affect the timber industry, including national housing and construction demands, price, and the availability of timber. The major markets for Montana's wood products are in the north central states, the far west states, and the Rocky Mountain states.

The source of Montana's timber harvest has changed over the past 20 years, most significantly in the past 5 years [figure 2]. Between 1990 and 1995, the timber harvest from national forest lands in Montana has decreased 66%. Conversely, the harvest on nonindustrial private forest (NIPF) lands in Montana increased 133% between 1985 and 1990 and another 20% between 1990 and 1995. The national forest harvest decreased due to a number of regional constraints, including threatened and endangered species protection, appeals and litigation of timber sales, cumulative impacts of past harvesting, and constrained Forest Service budgets. The increase in harvest from the NIPF lands was largely the result of a significant increase in the stumpage price of timber.

A strong market for wood products in the late 1980s encouraged Montana's industrial forest land owners to increase their level of harvesting. Harvest from this source averaged 465 million board feet between 1986 and 1990. Industrial forest harvest levels dropped to an average of about 300 million board feet between 1990 and 1995 and are predicted to remain at this figure or lower over the next 2 decades.

Timber Production

Figure 3 shows growing stock per acre by ownership for the years between 1952 and 1989. Growing stock includes only poletimber and sawtimber-sized tree classes. Between 1952 and 1989, the net volume of growing stock per acre of timberland increased on national forest and other public lands. The net volume of growing stock per acre has decreased overall on private timberlands during the same time period. The contrasts are also significant when using net volume of sawtimber (9" and greater in diameter) rather than growing stock. Between 1952 and 1989, the net sawtimber volume on Montana's industrial forests decreased from 14,274 to 4,780 board feet per acre. These figures for national forest and other public lands show little or no change between 1952 and 1989. Volume of sawtimber per acre only addresses the commercial lumber value of the forest. A young forest can produce more net volume of wood per acre than can a mature old growth forest.

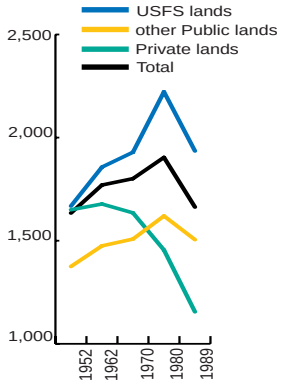
Forest Age

Forests can be classified by tree stand sizes, the stage of a forest's regrowth or succession. Sawtimber-sized trees stocked over 13 million acres or 69% of Montana's total timberland according to a 1989 inventory survey [figure 4]. The acreage of sawtimber-sized stands on national forest lands increased from 61% to 76% between 1980 and 1989, while the acreage of sawtimber-sized stands on industrial forest lands decreased from 60% to 48%. However, the acreage in saplings and seedlings is significantly higher on industrial forests than it is on national forest lands. Industrial forest owners typically have a greater need and opportunity to manage their timberlands for harvest and rapid regeneration than do federal and state forest managers who must consider other public interests.

Forest Practices

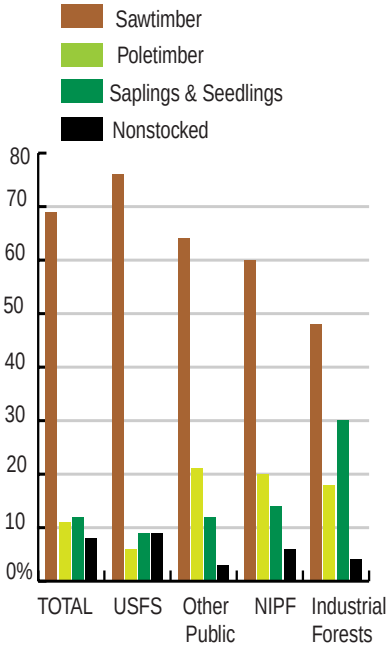
In 1990, Montana implemented a program designed to improve timber harvesting practices through the voluntary use of best management practices (BMPs). Landowners notify the state of their harvest plans, BMP information is provided to landowners, and a state audit team of volunteers evaluates selected postharvest areas for compliance with the BMPs. Timber harvests on private lands have shown the greatest increase in improvement since 1990 [figure 5].

Growing Stock Volume by Ownership
(Figure 3)



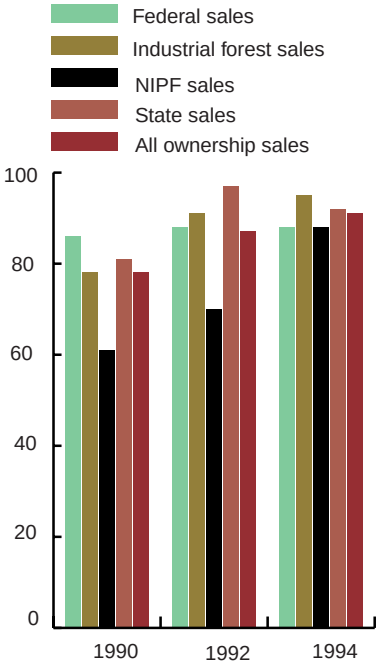
Source: An Assessment of Montana's Timber Situation, Mont. For. Conserv. Exper. Stn. UM, Sept. 1993.

Timberland Stand Sizes by Ownership, 1989
(Figure 4)



Source: Montana's Forest Resources, Conner and O'Brien, 1993.

Application of Best Management Harvest Practices
(Figure 5)



Source: Montana DNRC Final Reports, 1990-94.

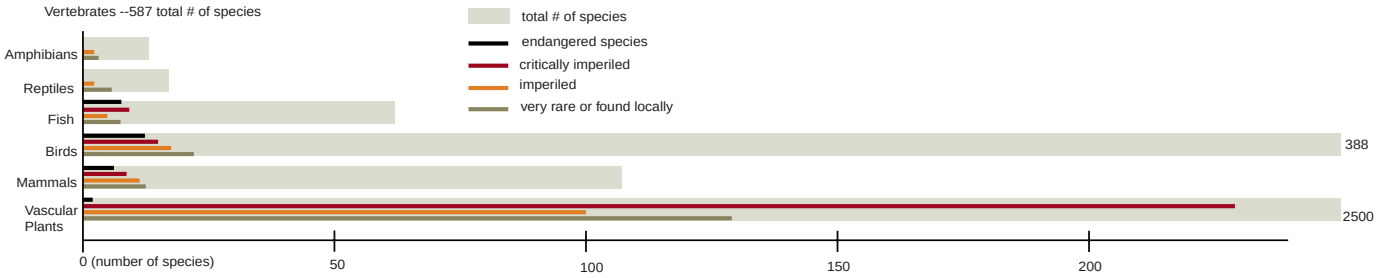
Wildlife

Montana's wildlife is an integral component of our state's environment and heritage. The number and variety of wildlife species able to successfully live in our environment can be an indicator of how successfully we are living in theirs.

Montana's various habitats, geography, and relatively sparse population combine to provide a diversity of wildlife similar to that at the time of settlement. Prior to the enactment of harvest and management controls earlier this century, some wildlife populations were severely over harvested by early settlers. Changes in land use following settlement effectively prohibited some species from re-establishing populations in their former ranges. Despite these changes, Montana is still home to the wolf, grizzly bear, wolverine, lynx, paddlefish, westslope cutthroat, bull trout, and other native species. The Audubon bighorn sheep became extinct around the turn of the century, but since the enactment of wildlife management controls, no known wildlife extinctions have occurred.

Montana supports harvestable populations of many big game species, including antelope, deer, elk, moose, bighorn sheep, Rocky Mountain goat, mountain lion, and black bear. With proper wildlife management, harvest figures can be an indicator of available population numbers. A comparison of 1975 and 1995 harvest statistics shows the following number of animals harvested in 1995 and the percentage change from 1975: 34,103 antelope (+97%); 137,843 deer (+78%); 21,961 elk (+50%); 628 moose (+26%); 250 bighorn sheep (+153%); 237 mountain goat (-10%), 566*mountain lion (+645%), and 588* black bear (-53%) (*1994 data). However, there remains cause for concern. Many other species, although still present, are low in number and are confined to tiny islands of their former range. There are 12 federally listed threatened or endangered species in the state: the bald eagle, piping plover, grizzly bear, black-footed ferret, whooping crane, peregrine falcon, gray wolf, least tern, white sturgeon, pallid sturgeon, water howellia, and Ute ladies' tresses.

Number and Diversity of Rare & Endangered Species &Their Status
(Figure 1)



Source: Montana Natural Heritage Program, 1996

Status of Rare Species

Biological diversity is an indicator of an ecosystem's overall health and vitality. The Montana Natural Heritage Program at the State Library generates information on Montana's native plant and animal species considered to be of special concern. The status of state and federally listed species is determined by ongoing research on population distributions. Figure 1 illustrates the status of plants and animals in Montana. Species shown as endangered include those found in Montana that are federally listed as threatened or endangered. A critically imperiled species is extremely rare (5 or fewer occurrences or very few remaining individuals) or some factor of its biology makes it especially vulnerable to extinction in Montana. A species is imperiled because of its rarity (6 to 20 occurrences), or because other factors demonstrably make it very vulnerable to extinction throughout its range. Other species are either very rare and local throughout their range, are found locally in a restricted range, or are vulnerable to extinction throughout their range because of other factors.

Some of these species are rare only in Montana but are more common elsewhere. The pallid sturgeon, sturgeon chub, whooping crane, and black-footed ferret are examples of species that are critically imperiled both worldwide and in Montana.

Habitat Efforts

Habitat loss and degradation, along with impacts from nonnative species, have been identified as the primary factors of species extinction. A cooperative effort by state, federal, and private entities to map and identify vegetative distribution and trends using satellite images is underway at the University of Montana. This project, ongoing in 28 other states, is referred to as the "Gap Analysis". Only the western half of the state has been mapped thus far. The Montana Natural Heritage Program has identified the Swan River Valley in western Montana as an ecosystem of considerable biodiversity deserving special attention.

A significant statewide effort to preserve fisheries biodiversity is underway with several species, one of which is the westslope cutthroat trout. Within the Upper Missouri River Basin and throughout their historic range west of the Continental Divide, westslope cutthroat have undergone dramatic declines in abundance and distribution. In the Upper Missouri, nonhybridized populations inhabit approximately 545 stream miles or 1% of the westslope cutthroat's historic range of 56,853 miles. According to the Montana Department of Fish, Wildlife, and Parks, of 144 known populations in the Upper Missouri, all are at moderate to very high risk of extinction [figure 2].

Montana has approved several legislative initiatives to improve wildlife habitat. The Department of Fish, Wildlife, and Parks has secured instream flow reservations on rivers and streams and leased water rights to maintain fisheries habitat. Also, a 1995 law authorizes private groups and individuals to lease existing water rights to maintain instream flows. The Future Fisheries Program, initiated in 1995, funds and provides for enhancement of spawning areas and other fish habitats. Also, the state has initiated 67 stream restoration projects under the 1989 River Restoration Program. There are 68 state wildlife management areas in Montana, and conservation easements negotiated by the state have reserved over 80,000 private acres as nondevelopment lands. The Upland Game Bird Habitat Enhancement Program has resulted in over 600 contracts with landowners for the improvement of 206,400 acres of privately owned bird habitat.

Wetlands are considered to be among the most productive habitats. They are capable of supporting a large diversity of plant and animal species. Montana has an ongoing cooperative program with private landowners, conservation organizations, the U.S. Fish and Wildlife Service, and others to enhance wetland and waterfowl areas in the state. Although Montana has retained a significant percentage of its historic wetlands, the extraordinary value and productivity of these ecosystems make them a key part of the state's biodiversity.

Future Direction

The Statewide Habitat Plan, produced by the Montana Department of Fish, Wildlife, and Parks, describes 7 broadly defined habitat types considered important to wildlife resources and focussed attention on the 3 considered most critical. The intermountain grasslands found in mountain foothills are the major sites of current subdivision activity. The shrub-grassland ecosystem has been reduced to a fraction of its original distribution in Montana due to conversions to agricultural use and now comprises only 8% of Montana's land base. The riparian or stream bottom ecosystems were identified as the most productive and diverse habitats and comprise less than 2% of Montana's landscape. The plan intends to focus future state habitat preservation and restoration efforts in these 3 important ecosystems. Montana's ability to maintain the diversity of its wildlife populations depends on our dedication to preserve or enhance the habitats in which they live.

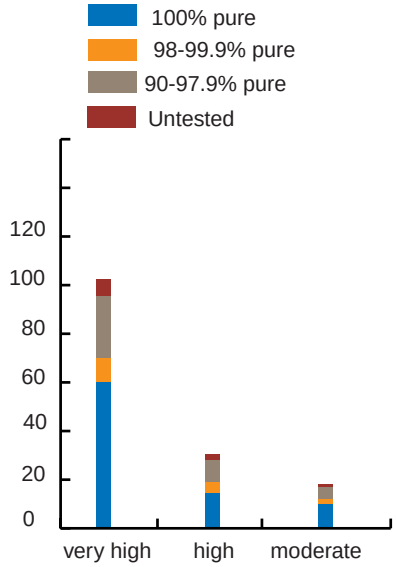
Did You Know?

· **Only 6 states have a greater percentage of their historical wetlands remaining than does Montana.**

· **Nonresident license sales accounted for over 40% of the total state Department of Fish, Wildlife, and Parks budget for 1996.**

· **With only 350 individuals remaining, the black-footed ferret is the rarest mammal in North America.**

Rated Risk of Extinction. Upper Missouri River Basin. Westslope Cuthrout Trout
(Figure 2)



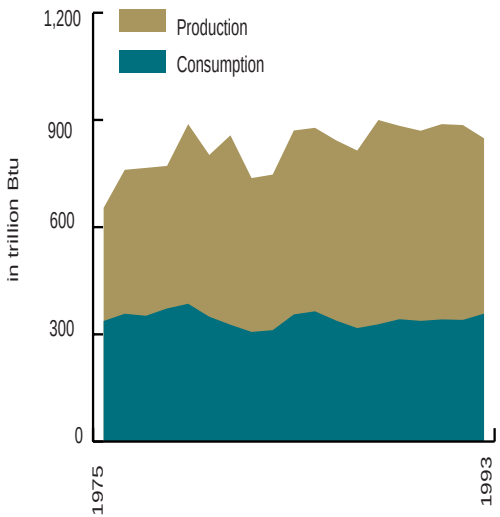
Source: Department of Fish, Wildlife & Parks, 1996.

Energy

Measuring the production and the consumption of energy in the state provides a general picture of Montana's current energy resource demands and needs. It is also an important indicator of general growth and resource extraction activity. When analyzing statewide trends, it is important to remember that the flow of energy both in and out of Montana is an integral part of a complex interstate and international energy system that significantly influences in-state energy use and production.

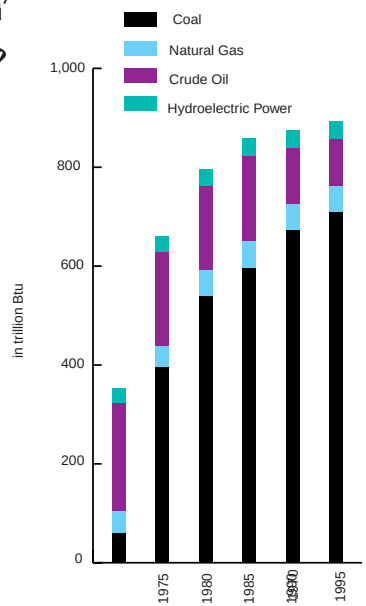
Conversion factors: U.S. Department of Energy, Energy Information Administration, Cost and Quality of Fuels for Electric Utility Plants (1987-93) DOE/EIA-0191 (for subbituminous coal and lignite, average 1987-91).

Montana's Total Energy Production and Consumption
(Figure 1)



Source: U.S. Department of Energy, Energy Information Administration, *State Energy Data Report, Consumption Estimates*; 1960-93 (EIA-0214)

Production of Energy by Type of Fuel
(Figure 2)



Source: U.S. Department of Energy, Energy Information Administration, State *Energy Data Report, Consumption Estimates*; 1960-93 (EIA-0214).

Due to the lack of consistent historical data, statistics exclude wooe, waste, geothermal, wind, photovoltaic, and solar thermal energy (except for small amounts used by electric utilities to generate electricity for distribution).

Montana is an energy rich state. From 1970 through 1995, Montanans have consistently produced more energy than we have consumed [figure 1]. However, most of the energy that we consume is refined fuel that we import from outside our borders. Montanans are dependant on outside sources of energy. We export most of our "Made in Montana" electricity, natural gas, coal, and oil.

While Montana has the potential to develop additional energy sources, such as wind, solar, ethanol, biomass residue, geothermal waters, and cogeneration, there is little information available on how Montanans have capitalized on these resources.

Production

Montana's total energy production has increased 135% since 1970 [figure 2]. Coal production accounts for the majority of energy produced in Montana and has increased from 3.5 million tons in 1970 to a high of 41.5 million tons in 1995. Between 1975 and 1995, coal production has accounted for roughly 50% to 70% of all energy produced in Montana. In 1995, somewhat less than 90% of the coal mined in Montana was exported either in its raw form or by transmission line after conversion to electricity.

In 1995, Montana had an estimated 6,700 oil and gas wells operating in the state. Traditionally, the supply and price of crude oil nationally and internationally has dictated production in Montana. In 1968, production peaked at 48.5 million barrels. Crude oil production reached a 30-year low in 1995 of 16.2 million barrels of production. Natural gas production has been more consistent, averaging 51.1 million cubic feet per year over the last 10 years.

Montana's hydroelectric power supplies are erratic. Everything from drought to floods dictates the fluctuations in hydroelectric production. Hydroelectric dams account for 47% of Montana's electricity generating capacity. Between 1975 and 1990, hydroelectric production has ranged from a low of 8,237 million kilowatt hours (kWh) to a high of 12,406 million kWh in 1976. Hydroelectric production in 1994 was 8,096 kWh.

Consumption

To understand who uses energy in Montana, energy consumption is separated into residential, commercial, industrial, and transportation sectors [figure 3].

The residential sector represents Montana homes that consume primarily natural gas and electricity for space heating, water heating, air conditioning, cooking, and clothes drying. The residential sector accounted for 14% of the energy consumed in 1993. In 1993, Montana residences consumed 6% less energy than they did in 1975 in spite of modest growth in population and economic activity.

Montana's commercial sector represents businesses that include motels, restaurants, wholesale businesses, retail stores, laundries, and other service industries. It also includes health, social, and educational institutions and state, local, and federal governments. Like the residential

sector, the commercial sector uses primarily electricity and natural gas. In 1993, the commercial sector used 9% less energy than it did in 1975 despite an increase in economic activity. The commercial sector accounted for 11% of the energy consumed in Montana in 1993.

Montana's industrial sector has consistently been the largest consumer of energy since 1975. The industrial sector represents Montana manufacturing, construction, mining, agriculture, fishing, and forestry establishments. It generally relies on electricity and petroleum. In 1993, the industrial sector used 40% of the energy consumed in the state. Industrial consumption has fluctuated over the years in response primarily to economic trends. Industrial consumption climbed until the end of the 1970s, when a restructuring of Montana's economy caused consumption to drop. The Anaconda Company's winding down of its operations in Montana played a significant role in that restructuring.

Because of the wide open spaces in Montana, the transportation sector is the 2nd largest user of all forms of energy in the state, accounting for 35% of the energy consumed in 1993. Transportation energy use peaked in 1979, the year of the Iran crisis, then declined and has remained more or less stable in recent years until the mid 1990s when energy use increased. With the "reasonable" and "prudent" speed limits in Montana, transportation energy use is expected to further increase.

Vehicle miles traveled (VMT) in Montana has almost doubled since 1970. Greater than 75% of total VMT in Montana in 1990 were on rural roads and highways, up from 68% in 1980. Compared to other states in the U.S., the average time spent traveling to work in Montana's major cities is low. In 1990, the average travel time to work for Montana urban areas was 12.8 minutes, compared with the U.S. average of 22.4 minutes. The average commute time has increased only slightly from the 1980 average time of 12.6 minutes for the same urban areas.Commuter transportation patterns in Montana's urban areas reflect a general dependence on single occupancy passenger vehicles and trucks [figure 4]. The number of persons per vehicle in Montana has declined from 1.16 in 1980 to 1.11 in 1990. In 1990, more than 85% of the commute trips in Montana cities were in private vehicles. This percentage increased from 76% in 1980.

Conclusion

Montana is a net exporter of energy. We are an energy resource extraction state. In terms of energy efficiency, Montanans consume less energy in their homes and businesses today than they did in 1975.

Did You Know?

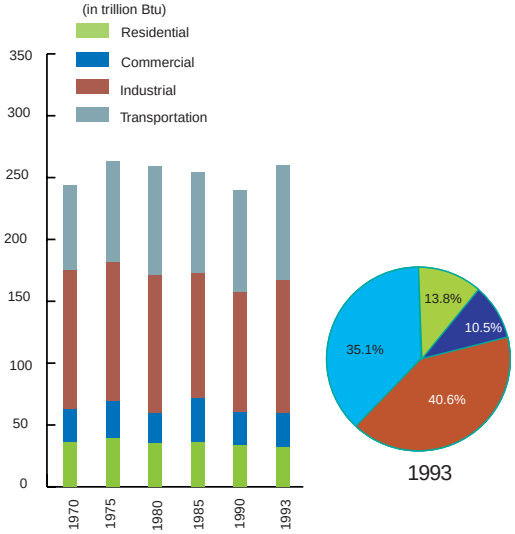
. In 1995, Montana produced approximately 1% of the United State's total consumption of energy in that same year.

In 1990, trucks comprised 41% of total vehicle registrations in Montana, up from 35% in 1970. In the U.S., trucks made up only 17% of total registrations in 1970 and 24% in 1990.

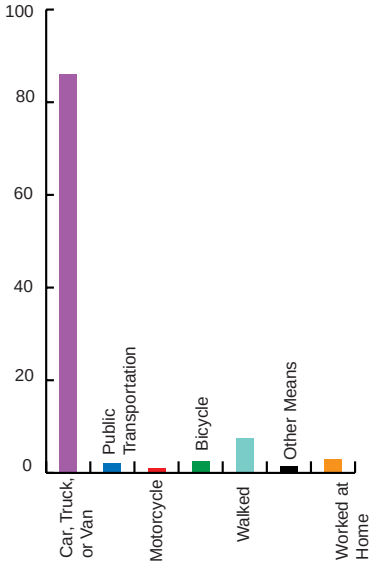
Consumption of Energy by Sector
(Figure3)

Means of Transportation to Work Major Montana Cities Combined, 1990
(Figure 4)

Due to the lack of consistent historical data, statistics exclude wooe, waste, geothermal, wind, photovoltaic, and solar thermal energy (except for small amounts used by electric utilities to generate electricity for distribution).

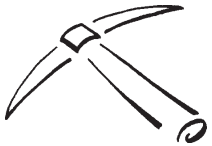


Source: U.S. Department of Energy, Energy Information Administration, *State Energy Data Report, Consumption Estimates*; 1960-93 (EIA-0214)



Source: U.S. Bureau of Census, 1990 Census Population and Housing Summary--Population: Transportation to and from work

Minerals



Montana has a rich abundance of minable resources. Various factors, including availability, capital, markets, environmental regulations, and new technology, have influenced the type, amount, and location of mining production in Montana. In turn, major mining ventures affect local communities and nearby resources.

Some Montana Minerals and Uses

(Figure 1)

Antimony — lead alloy, pigments
Barite — linoleum, rubber, plastics
Clays — tiles, pipes
Coal — fuel
Copper — electrical wires, pipes, coins, pesticides
Gemstones — jewelry, abrasives
Gold — jewelry, electric circuits, dentistry
Gypsum — construction materials
Iron — steel, cement, soil additive
Lime — cement, soil additive, air pollution control
Lead — batteries, pipes, radiation protection
Molybdenum — steel production, mountain bike frames
Palladium — circuity, jewelry, catalytic converters
Peat — soil additive, fuel
Platinum — surgical tools, computer chips, magnets
Pumice — abrasives, landscaping
Sand and Gravel — construction
Silver — mirrors, coins, antiseptics, photography
Stone (crushed) — railroads, roads, landscaping
Stone (dimensioned) — landscaping, walls, rip rap
Talc and Pyrophillite — paper, paints, soap, lubricants
Zinc — iron, steel, batteries, roofing

The U.S. Bureau of Mines has tracked 23 different products mined in Montana since 1975 [figure 1]. Production trends for those products with at least 10 years of data are shown in figure 2.

In 1994, Montana ranked 24th in the nation in nonfuel mineral value produced, with Montana mineral production accounting for 2% of total U.S. mineral value. Montana was the only producer of primary platinum and palladium in the U.S. in 1994 and the top producer of talc and pyrophillite. Montana was the 5th highest producer of copper, gold, zinc, molybdenum, and phosphate rock and one of the 7 highest producers of gemstones.

Montana's mining history has left some scars on the land and its resources. Prior to 1977, most mining was relatively unregulated; miners excavated in many areas, exposing rock to weathering (thereby creating acid mine drainage) and often leaving piles of tailings (waste rock) that leach metals and other harmful substances into Montana's soils and waters.

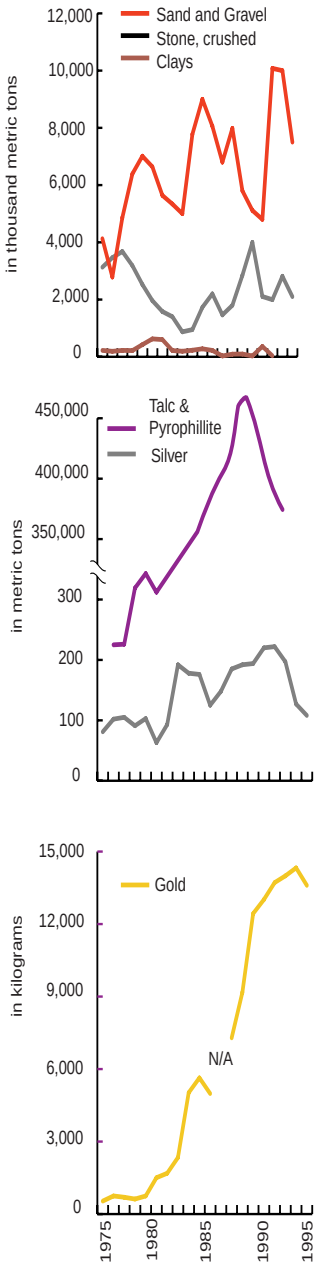
In 1980, the state began identifying and reclaiming abandoned coal and hard-rock mine properties. Those posing the greatest risk to public health and the environment were addressed first. By 1995, 5,985 abandoned mine sites had been identified--429 coal mines and 5,556 hard-rock or other mines. Of the 429 coal mines, all the high priority sites have been reclaimed. Two of the 290 high priority hard-rock sites were reclaimed in 1995 and 6 others are undergoing reclamation in 1996.

There are currently 2,192 permitted mines in Montana—18 coal mines, 89 large hard-rock mines (gold, silver, molybdenum, etc.), and 2,085 opencut mines (clay, gravel, phosphate, etc.). These permits account for about 60,600 acres in coal operations, 38,600 acres in large hard-rock operations, and 30,000 acres in opencut operations. In addition to large hard-rock mines, there are 659 small and/or sporadic hard-rock mining operations, covering about 1,600 total acres.

In addition to current mining activities, the state is reviewing 6 proposed expansions to existing large hard-rock mines, 8 new hard-rock mine proposals, and 30 new opencut mines. If approved, these proposals would add about 12,000 acres to Montana's total permitted acres.

Mineral Production, 1975-1995

(Figure 2)



Source: U.S. Bureau of Mines, 1976-1996

Remediation

The investigation and cleanup of hazardous substance contamination in Montana is the result of relatively new policies. With today's knowledge that waste handling and disposal practices of the past can cause serious harm to people and the environment, policymakers constantly labor to strike a balance between real and potential risks, costs, and benefits.

Investigation and remediation of contaminated sites in Montana is authorized by the 1980 federal superfund program and by the 1989 state superfund program. The federal law, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), addresses the most seriously contaminated sites that are of national concern and ranks them on the National Priority List (NPL).

Federal Superfund Sites; CERCLA

Montana currently has 8 federal superfund sites. They include the following 5 mining or smelting sites: the Anaconda Smelter, Silver Bow Creek/Butte area, Milltown Reservoir, East Helena Smelter, and Mouat Industries. The remaining 3 are wood treating sites: Montana Pole, Idaho Pole, and the Libby ground water site. Remediation efforts are underway at 7 of the 8 federal superfund sites. Due to their size and complexity, sites are usually divided into segments or operable units. At 5 locations, remediation responses for some operable units are complete and in the operation and maintenance stage. Other, more complex segments are currently being assessed for impact, risk, and the feasibility of possible solutions.

State Superfund Sites; CECRA

The Montana superfund program, the Comprehensive Environmental Cleanup and Responsibility Act (CECRA), has identified and investigated additional sites that did not rank as national priorities. State superfund program efforts since 1986 are shown in figure 1.

Montana sites include landfills, refineries or petroleum handling facilities, wood treating facilities, mining or manufacturing sites, and others with contamination from petroleum, heavy metals, chemicals and pesticides, cleaning solvents, sludges, acids, asbestos, and other waste materials. Over 30% of the identified state superfund sites involve the investigation and remediation of contamination from petroleum wastes.

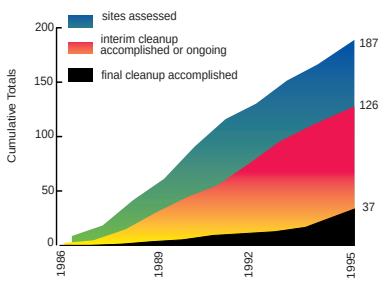
Underground Storage Tanks

The Montana underground storage tank (UST) remediation program specifically addresses petroleum and chemical product releases from storage tanks. State officials have confirmed 2,692 releases in Montana since 1988 [figure 2]. Approximately ½ of these have been resolved or remediated satisfactorily. The remainder are either still under investigation or in need of further remediation.

Summary

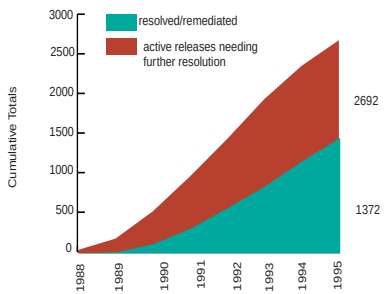
Current mining, solid waste, hazardous waste, underground storage tank, and pesticide management laws and regulations are intended to assure that current waste disposal practices do not result in future superfund sites. Our future remediation efforts will be the indicator of Montana's ability to prevent pollution today.

State Superfund Sites
(Figure 1)



Source: Cleaning up Montana, Superfund Accomplishments 1983-1996, Montana DEQ, 1996.

Underground Storage Tank Releases and Remediation
(Figure 2)



Source: DEQ memo 7-96, and EQC HJR 10 Compliance and Enforcement Study, Draft State Program Review, p. 97.

Did You Know?

· **Four of the 8 federal superfund sites are located in the Clark Fork River Basin between Butte and Missoula.**

· **The median cleanup cost for a state superfund site is over $120,000, 1/4 of which is for the site investigation.**

· **State figures, so far, have shown that nearly 30% of Montana's regulated underground tank facilities have reported leaks.**

· **Only 1/3 of Montana's USTs are located at service stations.**

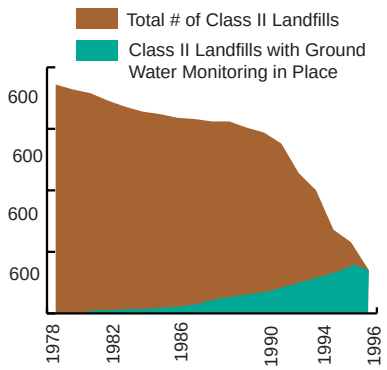
Waste

A society that produces and uses goods also produces waste products. Eventually, the air, the water, or the land will be the recipient of what we throw away. How we choose to manage our wastes can have a direct impact on the health of our environment.

Household Waste

The way we handle our household trash (Group II solid waste) has changed dramatically over the past 20 years. Since 1978, the number of Class II landfills in Montana has decreased from 186 to just 36 in 1996 [figure 1]. The largest number of site closings occurred after 1991. Because solid waste landfills produce methane gases and chemical leachate, states and the federal government enacted more stringent landfill design and operation standards to protect our ground water resources. New requirements became effective in phases, starting in 1991. Ground water monitoring is now in place at all Montana landfills except at 6 locations where soil and ground water conditions do not require it. Montanans landfilled approximately 892,358 tons of household solid waste in 1995. Approximately 41% of that waste was landfilled at 13 sites that are lined or designed to prevent the offsite migration of leachate. This percentage is expected to increase dramatically over the next few years when liners are constructed at several of the larger landfills.

Class II Solid Waste Landfills
(Figure 1)



Source: DEQ Waste Management Program, 1996.

Improper solid waste management can be costly to Montana's citizens. As of 1996, the state superfund program has identified 23 former or currently operating community landfills as having potential problems. Landfill operators have initiated remedial investigations at 8 of these landfills, and a final cleanup plan is proposed at one site where drinking water was contaminated by chlorinated solvents.

The current economics of waste management have resulted in a trend towards a small number of properly designed and operated sites and an increase in the number of innovative ways to get our trash to them. Basically, it has become less costly to collect and transport our solid wastes than it is to dispose of them closer to home. In 1975, there were essentially no waste transfer stations, container systems, composting operations, or recycling processes established in concert with our Class II sites. Today there are 32 composting/yard waste diversion programs, 47 used oil collection centers in 23 cities, 8 waste transfer stations, and a multitude of rural container systems in place.

Recycling

Montana's wide open spaces, low population, and small amount of trash have been a disincentive for economically viable recycling operations. A large city of 800,000 people living within a radius of 50 miles would likely generate as much recyclable material as the entire state of Montana. But, as the cost of landfilling waste increases due to the cost of establishing and operating a landfill, new economic pressures exist that provide incentives to preserve valuable landfill space and recycle our waste products.

Montana recycles less than 5% of its solid waste according to a 1991 estimate. Percentage recycled figures are difficult to obtain, as private firms conduct the majority of commodity, or buy back, recycling and do not make complete tonnage and volume figures public. Also, not all of Montana's disposal sites have weigh scales to provide accurate waste disposal figures. However, between 1993 and 1995, private firms representing a majority of the recycling activities in the state reportedly increased the amount of cardboard recycled by 52%; newsprint and other paper by 88%; brass, copper, and appliances by 73%; and aluminum scrap and cans by 22%. Between 1989 and 1996, the number of different commodities that were accepted at recycling centers increased from 11 to 16 items. There are recycling programs currently available

in 81 Montana communities.

Hazardous Wastes

In addition to household trash, Montanans generate waste considered to be hazardous. Households produced an estimate 3,200 tons of hazardous wastes in l993. Montana's 59 regulated industries and businesses reported to the Environmental Protection Agency (EPA) that they generated 11,271 tons of hazardous wastes in l993 or 0.005% of the national total of 235,473,584 tons.

Businesses produced 15,919 tons of hazardous waste in l995, and 47% of it was shipped out-of-state for treatment and disposal. Montana does not have a permitted commercial hazardous waste disposal site, but some generators are permitted to treat their own wastes on site. Since l99l, the same top 5 generators have accounted for between 70% and 85% of the total hazardous waste produced in Montana.

Recent regulatory changes have ended the land disposal of approximately 6,400 tons of hazardous wastes per year at 6 Montana facilities. Three major waste streams—petroleum refinery sludges, spent aluminum production pot liners, and pesticide wastewaters—were previously managed in facility-owned surface impoundments, land farms, or landfills. Those wastes are now being shipped out-of-state for treatment or disposal at permitted landfills, cement kilns, or injection well facilities.

Toxic Substance Reporting

Another indicator of hazardous material generation in Montana is a review of the Toxic Release Inventory (TRI) figures reported to the EPA under the federal Emergency Planning and Community Right-to-Know Act. Facilities are required to report for a particular chemical only if they meet the manufacture, process, or use thresholds for that chemical. The use threshold is 10,000 pounds. There were approximately 300 chemicals on the reportable toxics list between l987 and l994. Beginning in l995, the list was expanded to include nearly 650 chemicals. The reporting requirement only applies to certain types of manufacturing businesses with 10 or more employees. In l994, 22,744 U.S. facilities reported releases totaling 1.977 billion pounds of reportable toxics. In Montana for l994, 24 facilities reported total releases of 46,428,463 pounds or about 2.3% of the national total [figure 2]. Of Montana's l994 TRI total, 43,615,531 pounds or 94% was the result of reporting of zinc, lead, and other metal slag deposits from one smelting facility in the state. Another Montana facility accounted for approximately 46% of the total l994 reportable toxic air emissions, and the chemical methanol was 85% of that total. The same facility accounted for 71% of the total l994 reportable toxics discharged to surface waters, and methanol made up 96% of that total.

Summary

Waste management in Montana is following national trends resulting from federal regulatory efforts. Waste disposal is being consolidated to fewer locations where stringent design and operation standards are more affordable. Waste minimization and recycling efforts are increasing, in part, to minimize disposal costs and, especially, to postpone the capital costs of replacing a landfill once full. Hazardous waste management, too, is driven by cost avoidance. Minimization of hazardous waste use or generation can increase the disposal options available to businesses and reduces the eventual high cost of either onsite treatment or packaging, shipping, and disposal of wastes.

Pounds of Designated Toxic Substances Released
(Figure 2)

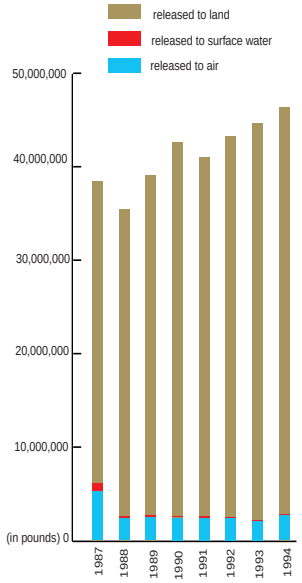
Did You Know?

· **There are 36 landfills in Montana, down from 186 in l978.**

· **Landfills in Billings, Great Falls, Missoula, and Kalispell dispose of nearly 61% of the 892,358 tons of municipal solid waste landfilled in Montana in l995.**

· **Montana does not have a permitted commercial hazardous waste disposal site. Most of Montana's hazardous waste is transported to out-of-state facilities for treatment and disposal.**

· **Most of Montana's hazardous waste is generated by 5 facilities.**

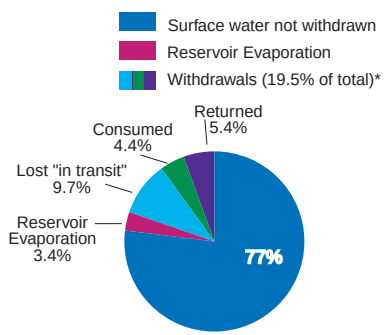


Source: EPA Toxics Release Inventory, 1987, 1991, 1994.

Water Quantity

Water is a necessity of life. It is found both in lakes and flowing streams (surface water), as well as underground (ground water). It fills drinking glasses and carries away wastes; supports crops and livestock and cools industrial plants; and helps create electricity and supports fish, wildlife, plant life, and recreational, ecological, and aesthetic values.

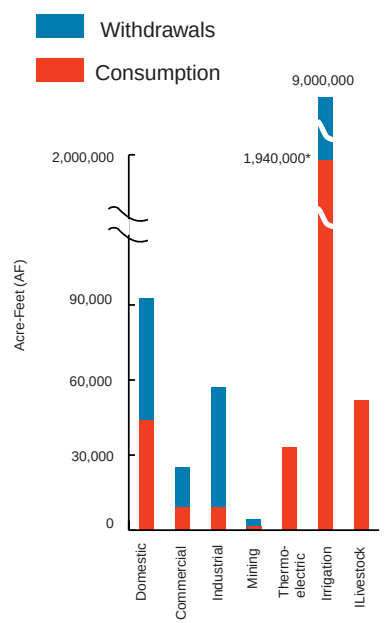
Water Availability and Withdrawls, 1990
(Figure 1)



Total Surface Water Available: 53,391,500 AF/yr.
***Includes 2.2% ground water**

Source: U.S. Geological Survey, 1991: EQC, 1996

Water Consumption, 1990
(Figure 2)



***Excludes irrigation conveyance infiltration (4.6 million AF in 1990).**

Source: U.S. Geological Survey, 1991

In 1990, Montana's total annual supply of surface water was slightly over 53 million acre-feet, enough to cover the entire state to a depth of 7 inches [figure 1]. Reservoir evaporation removed about 1.8 million acre-feet from available surface water.

Water Use

Water withdrawals in l990—2% from ground water—totaled about 10.5 million acre-feet. About 50% of the water withdrawals were absorbed into the ground during transport (i.e., conveyance infiltration). Slightly less that 1/3 of total withdrawals were used and returned to surface or ground water (i.e., return flow). The rest was consumed.

Montana's agricultural water users accounted for 97% of total estimated water withdrawals in l990 and 93% of total estimated water consumption. Towns, cities, and other domestic uses accounted for 1% of total withdrawals and 2% of overall consumption [figure 2].

Water Shortages

Though water availability appears to be high, many water needs occur at similar times in the year or at similar locations on a water body. In some areas, this can create periods of low flows and potential conflicts between water users. The ability to store water in reservoirs adds some flexibility to timing of use. Montana's reservoir storage capacity totaled 34 million acre-feet in l996 and has not changed much since l975.

Because of localized water availability problems and their effects on water users and instream values, several streams in Montana are being closely watched by Montana's resource agencies.

Basins currently identified as having problems related to low stream flows are listed in figure 3. These are streams where the Montana Department of Fish, Wildlife, and Parks (FWP) feels that water withdrawals are threatening important fishery values.

In addition to the FWP list, the Montana Department of Natural Resources and Conservation (DNRC) has so far identified 203 miles of stream

on Mill Creek and the Musselshell River it considers to be "chronically dewatered". Criteria for this classification are provided in state law, and designation triggers mandatory installation of water measuring devices. DNRC continues to evaluate an additional 1,411 miles of river and expects to add streams to its evaluation list in l997. Moreover, FWP will continue to track low flow threats to aquatic resources throughout Montana.

Basin Closures

In addition to general water rights adjudications and decrees, tools available to Montanans to address low flow issues include basin closures and instream flow leases and/or reservations. As of August 1996, 23 water basins were closed to additional applications for water withdrawals [figure 4]. Five of these closures included closures to ground water withdrawals. The area closed totals almost 32,000 square miles or about 20% of Montana's total land area.

Basins With Stream
Flow Concerns
(Figure 3)

BASIN	MILEAGE
Beaverhead/Red Rock	*197.0
Big Hole	*32.5
Bitterroot	60.5
Blackfoot	80.4
Clark Fork	9.0
Dearborn	58.0
Flathead	*109.3
Flint Creek	66.8
Gallatin	*107.0
Jefferson	21.8
Judith	22.0
Kootenai	*126.0
Little Blackfoot	75.2
Lower Clark Fork	6.0
Madison	*28.0
Marias	81.0
Musselshell	*334.0
Rock Creek (Clark)	21.9
Ruby	52.8
Shields	*133.8
Smith	*228.0
Teton	198.0
Upper Clark Fork	224.8
Upper Missouri	*142.0
Yellowstone	*788.5y

*Includes Both Chronic and Periodic Dewatering

Subtotal—Chronic 2,539.9
Subtotal—Periodic 1,237.6

TOTAL MILES THAT ARE FLOW-IMPAIRED = 3,777.5

Total Stream Miles= 176,750

Source: Montana Department of Fish, Wildlife, and Parks, 1991.

Basin Closures
(Figure 4)

BASIN	SQ. MI. CLOSED
South Pine	*178
Milk	283
Larson	*6
Grant	55
Rock	168
Walker Creek	40
Beaverhead/Red Rock	3,779
Upper Clark Fork	2,810
Northern Cheyenne	1,307
Milk River Southern Tribes	152
Towhead Gulch	7
Musselshell	292
Jefferson/Madison	7,739
Upper Missouri	10,520
Teton	1,917
Sharrott Creek	8
Yellowstone	*1,820
Willow Creek	61
Truman Creek	37
Hayes Creek	*0.06
Warm Springs Pond	*5
Six Mile Creek	23
Hayes Creek (temp.)	*4

Subtotal—Controlled Ground Water Area (*) = 2,013 sq. mi.

Subtotal—Surface Water Closures = 29,648 sq. mi.

TOTAL BASIN CLOSURES = 31,661 sq. mi.

Source: Montana Department of Natural Resources and Conservation, l996.

Flow Leases
(Figure 5)

BASIN	FLOW
Yellowstone	51.5 cfs
Blackfoot Basin	3.0 cfs
Bitterroot	4.7 cfs
Jefferson	1.1 cfs

Source: Montana Department of Natural Resources and Conservation, 1996.

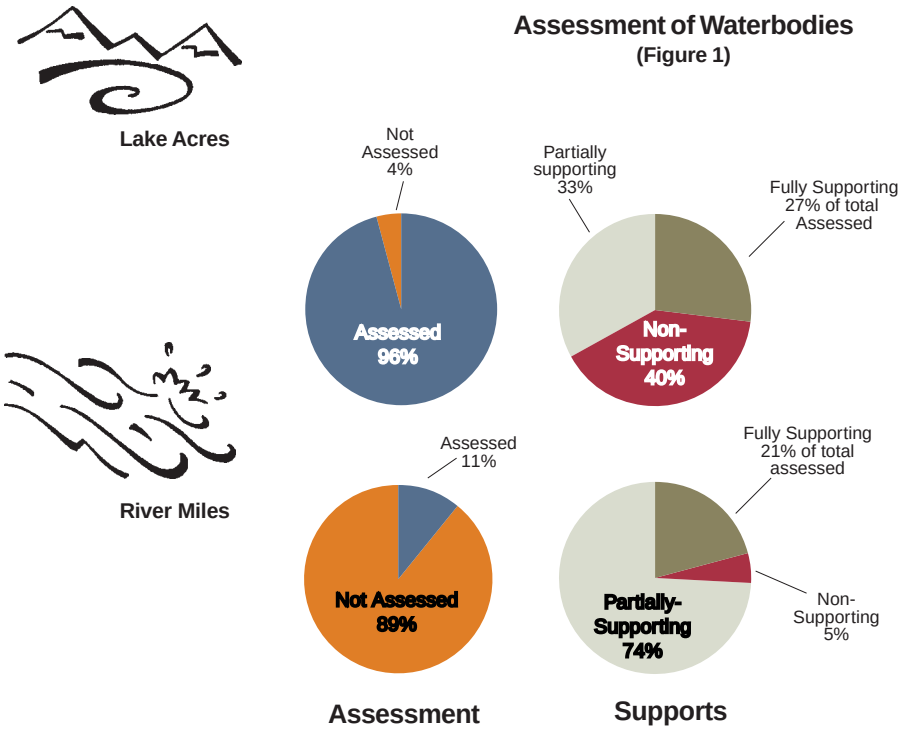
Instream Flow

Water rights in Montana typically specify a diversion point, flow amount, and priority date. Those with the most senior (oldest) priority dates get their water first; those with junior rights have to wait their turn and, in some cases, may not get any water.

There are several mechanisms to protect instream flows in Montana, including reservations, Murphy rights, changes, and leases. On a wide variety of streams, reservations and Murphy rights have been granted to several agencies, but the rights are fairly junior (l970s or later). As of l995, about 60 cubic feet per second of instream flow had been leased for late-season protection of fishery values [figure 5]. All these leased water rights have pre-1915 priority dates, meaning that they have a relatively high likelihood of protecting instream flows, even in dry years.

Water Quality

Nature and humans together determine the quality of Montana's waters, which range from nearly pure rainwater in some of the western mountains to streams more saline than seawater at some eastern locations. Clean water is extremely important to many Montanans and will likely be an integral part of the continuing debate over appropriate development in and adequate environmental protection for Montana.



Assessment of Waterbodies
(Figure 1)

Source: Montana Department of Environmental Quality, 1994

State Water Quality Assessments

Montana's Department of Environmental Quality (DEQ) produces an evaluation of the state's water quality every 2 years. The report includes results of the agency's assessment of the ability of Montana's streams and lakes to support specific uses, including one or more of the following: aquatic life, fisheries (warm-water and/or cold-water), swimming and recreation, drinking water, agriculture, and industrial uses.

The DEQ uses U.S. Environmental Protection Agency (EPA) criteria to assess whether Montana's water bodies are fully supporting, partially supporting, or nonsupporting of their designated uses [figure 1]. According to the DEQ's 1994 assessment, 21% of Montana's assessed stream miles and 27% of Montana's assessed lake acres support all their designated uses. About 5% of these streams and 40% of these lakes, however, exhibit levels of acute toxics, threats to human health, severe degradation, water quality standards violations, etc., and cannot support one or more of their designated uses. The remainder of the streams and lakes that have been assessed fall somewhere in between.

The state's assessments vary in intensity. Some involve direct water quality sampling and/or monitoring; others rely on professional judgment or information from other agencies or from volunteers. In selecting which water bodies to assess, the state emphasizes those that are impaired or threatened and those that have water on a year-round basis. As of 1994, the DEQ had assessed 17,680 river miles (11% of the state total) and 798,583 lake acres (96% of the state total). About 28% of the assessed river miles and 87% of the assessed lake acres received the more intensive type of assessment. As of 1994, the land use contributing to impairment on the broadest scale is agriculture, which contributed to the impairment of 60% of the assessed river miles and 45% of the assessed lake acres [figure 2].

State staff do not expect many changes to these conclusions in 1996 primarily because few additional water bodies have been assessed. However, it is expected that lake impairment will decline—not due to improved water quality, but to relaxed standards for arsenic.

Federal Water Quality Monitoring

In addition to state agencies evaluating water quality, the U.S. Geological Survey (USGS) has operated a water quality monitoring network in Montana for many years. In the 1980s and early 1990s, 16 to 18 stations were included in the network. By 1995, the network was reduced to 3 stations. Now one station represents Montana in the network—on the Yellowstone River near Sidney.

Fecal Coliform and Nitrates

Two surface water concerns in Montana include fecal coliform and nitrates. Fecal coliform bacteria are indicators of

contamination from human or animal wastes; ingestion can transmit disease.

High levels of nitrites/nitrates are associated with blue-baby syndrome and contribute to the growth of algae and reduced oxygen for fish. Small amounts of nitrites/nitrates are introduced naturally to Montana's streams from nitrogen in the atmosphere and water's leaching effects on rocks and soil. Any decaying animal and vegetable matter, fertilizers, and municipal and industrial wastes added to Montana's waters, however, can increase nitrogen levels.

Figure 3 shows the yearly maximum samples for fecal coliform and nitrates collected at the 1995 national water quality monitoring stations in Montana. A 1980-89 USGS summary of water quality monitoring in Montana showed a decrease in fecal coliform concentrations at both the Missouri (at Toston) and Yellowstone (above Billings) stations during that period. The Yellowstone's downward trend was attributed to upstream improvements in community waste treatment and regulatory efforts to control cattle feedlots. The study evaluated 7 water quality parameters at 16 different stations and found no statistically significant upward trends.

Ground Water

Ground water can be contaminated from chemicals or residues applied or leaked on the land and from residential units discharging wastes via septic systems. In 1994, state staff considered Montana's ground water to be plentiful and the quality generally excellent.

Drinking Water

Drinking water, both from surface and ground water sources, contains varying levels of contaminants. In 1995, drinking water for almost 200,000 Montanans violated the federal standards for coliform, nitrate, proper treatment, lead, or copper at some time during the year. The most common problem was total coliform bacteria, with 70 public water supplies exceeding maximum contaminant levels in 1995. Of these systems, 65 drew their supplies from ground water and 11 served populations of 1,000 or more.

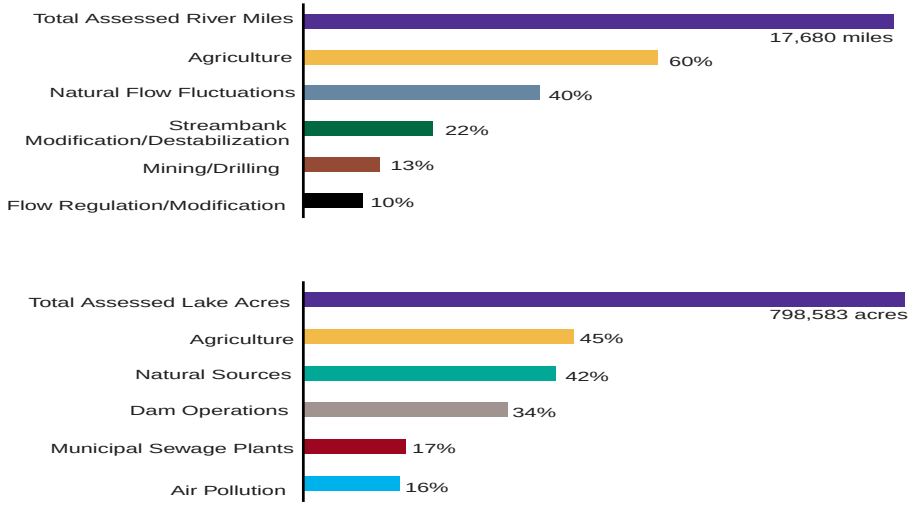
A "boil order" is imposed when fecal coliform levels are too high. Boil orders were issued to 1,569 patrons of 7 Montana public water supply providers at least once in 1995. The DEQ did not compile this type of information prior to 1995.

Discharge Permits

The DEQ manages water quality in Montana in several ways; it sets and enforces water quality standards, monitors and assesses water quality, and reviews and enforces permits for releases into Montana's waters (discharge permits).

Over the last 5 years, about 400 discharge permits have been active, most for cities/towns and industrial companies. During that time period, about 81% of the permitholders in a given year had no documented effluent violations. Data are not available on the severity of the violations.

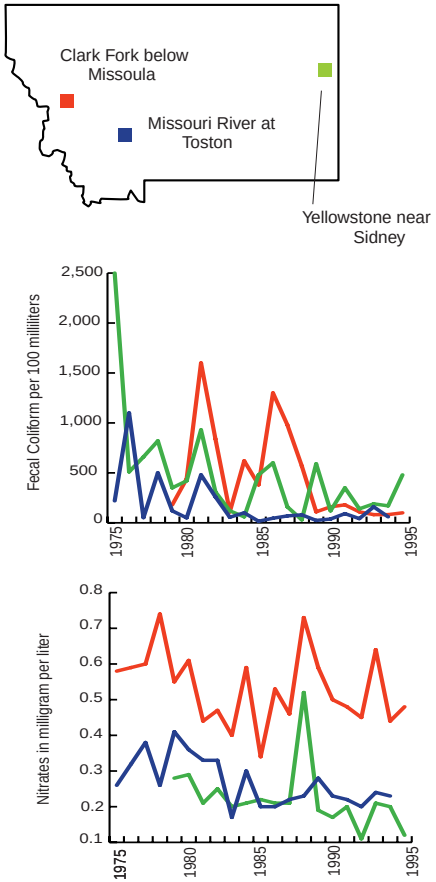
Top Five Sources of Water Quality Impairment
(Figure 2)



Source: Montnaa Department of Environmental Quality, 1994.

Note: Percentages do not add up to 100% because many streams and lakes are impacted by more than 1 source.

Fecal Coliform and Nitrate Levels
(Figure 3)

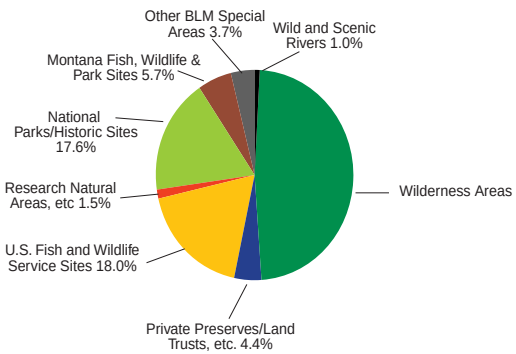


Note: The 3 stations displayed were Montana's representation in the National Stream Quality Accounting Network in 1995.

U.S.Geological Survey, 1976-1996

Outdoor Recreation

Montana provides a rich variety of recreational, historical, and aesthetic amenities for both residents and visitors. This richness is based on the diversity of the state's landscapes, as well as on the ability of agencies and groups to provide a variety of facilities and services—from local ball fields to wilderness treks, fishing access sites, and historic preservation.



Acres of Protected Areas
(Figure 1)

Source: Montana Department of Fish, Wildlife & Parks, 1975-1995.

About 7 million acres or 7.6% of Montana is specially managed for resource protection [figure 1]. Over 25 million additional acres are open to the public for various recreational opportunities.

In addition to public lands available for recreation, some privately held lands are also open to public recreational use. For several years, the Montana Department of Fish, Wildlife, and Parks has been working with state landowners to negotiate public access to hunt and fish on private lands. As of 1995, there were almost 500 landowners participating in the program, allowing official public recreational access to almost 4 million acres or 7% of total private holdings in Montana.

Recreational Facilities

A 1978 statewide review of developed recreational facilities found that of the 1,022 nonurban recreation sites in Montana, 42% were managed by federal agencies, 29% by state agencies, 3% by local agencies, and 26% by private and nonprofit groups. According to a 1994 statewide trail inventory, Montana has over 14,600 miles of trails, over 99% on federal lands.

There is no statewide inventory of urban recreational facilities. However, in 1992, 27 of Montana's cities and counties concluded that the 5 most-needed facilities for these jurisdictions were (in order of need): outdoor sports/games areas, day use/picnic areas, trails, water access, and natural areas.

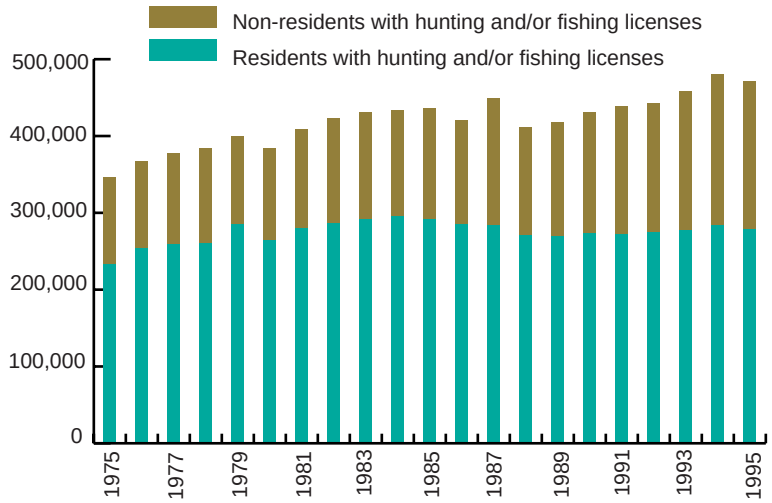
Hunting and Fishing

Much of Montana's recreational opportunities and issues relate to resident and nonresident pursuit of hunting and fishing opportunities. As shown in figure 2, the total number of persons holding some type of fishing and/or hunting license has fluctuated since 1975. The proportion of nonresident licenses has steadily increased over the last 20 years.

Tourism

Montana's outdoor recreational opportunities draw many visitors to the state. In 1994, an estimated 7.7 million persons visited Montana—about 9 visitors for every state resident. These visitors spent a total of about $1.2 billion while they were here, which supported 59,000 jobs and ultimately generated $2.5 billion in goods and services in the state.

Total Persons With Hunting and/or Fishing Licenses
(Figure 2)



Source: Montana Department of Fish, Wildlife & Parks, 1975-1995

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COVER

mourning dove *n*: a wild dove *(Zenaidura macroura carolinensis)* of the United States with a plaintive call.

The mourning dove is common along Montana roadsides. Because of its extreme sensitivity to chemical contaminants, it is a useful indicator of environmental quality. The mourning dove is one of many environmental indicators presented in this report. The cover drawing is in pen and ink by Jack Jasper.

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LETTER OF TRANSMITTAL

Honorable Thomas L. Judge
Governor
State of Montana

Members of the Legislative Assembly

The People of Montana

The Environmental Quality Council herewith submits its *Fourth Annual Report* for the fiscal year ending June 30, 1975, in accordance with Sec. 69-6514 of the Montana Environmental Policy Act.

Rep. Thomas O. Hager
Chairman

John W. Reuss
Executive Director

THIS REPORT PRINTED ON RECYCLED PAPER.

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Preface

This past year and the 1975 session of the Legislature were times of testing and review of the Environmental Quality Council. Two bills were introduced which allowed the Legislature to assess the role of the EQC and modify its membership to reflect more accurately the interests of the Legislature — the branch of government the Council was designed to serve. One bill, SB 332, would have repealed the Montana Environmental Policy Act. This was rejected by the House, which passed HB 401, generally revising the composition of the Council, removing the Governor's vote on the Council and having the legislative leadership appoint the four citizen members. These revisions (Ch. 492, L. 1975) helped clarify the status of the EQC as a legislative agency. Retention of the citizen members also reinforced the belief that the Council's work is strengthened and given added credibility by their active participation and assistance.

Another important environmental issue considered by the 1975 Legislature was whether state agencies preparing environmental impact statements required by the Montana Environmental Policy Act could assess fees from applicants reflecting EIS costs (HB 340). It is noteworthy that the legislative debate focused on the size of the fee rather than on the usefulness of the EIS process. The Legislature feels that the EIS process is a valuable agency decision-making tool.

One important MEPA action occurred outside the Legislature. The District Court (Helena) decision in *Montana Wilderness Association vs. The Board of Land Commissioners* declared that state agencies should adopt rules for preparing environmental impact statements and incorporate those into the Montana Administrative Code. In response to this, Governor Judge established the Commission on Environmental Quality and directed it to draft model EIS rules. It is important to note that the EQC staff advised and worked very closely with the Commission.

As the Legislature took steps to make the EQC more responsive to its needs, the Council and EQC staff acted to implement a program that contained several projects designed to aid the Legislature in its consideration of complex environmental-agricultural-natural resource issues. One important element of this is the environmental indicators program, presented here as the EQC *Fourth Annual Report* (1975). Others now underway that will be available for legislators when they convene in 1977 are a study reviewing the agricultural and wood products sectors of Montana's economy and outlining an ecologically sound legislative program to strengthen these vital renewable resource sectors. Another EQC program is reviewing Montana environmental-natural resource statutes and agency programs. The product here will be a state environmental index, a convenient reference to important laws that will facilitate legislative examination of state agency operations in these program areas.

I believe all these developments — modifications of Council membership, strengthening of EIS procedures, and new EQC programs — move the Council closer to fulfilling its charter in the Montana Environmental Policy Act and will enable the Council to provide the Legislature with the information and technical assistance it needs to act decisively and effectively to maintain and enhance Montana's environment and way of life.

Representative Thomas O. Hager
Chairman
Environmental Quality Council

Introduction

Publication of the EQC *Fourth Annual Report* (1975) marks the return of an effort to assemble and report information on the conditions and trends of the Montana environment initiated in the EQC *First Annual Report* (1972). The 1975 report adopts the reporting framework of Montana environmental regions developed by Professor John M. Crowley for the 1972 report, updates the biophysical data it presented, and incorporates social-economic-demographic data for the first time.

Two main reasons account for the selection of the environmental indicators theme for this annual report. First, a major task of the Environmental Quality Council, as required by the Montana Environmental Policy Act, is "to gather timely and authoritative information concerning the conditions and trends in the quality of the environment. . ." (Sec. 69-6514(a)). The *Fourth Annual Report* (1975) attempts to do exactly that. Secondly, it appears to us that Montana will be subject to enormous forces of change in the coming years. To the extent Montanans can or want to guide these forces, they need accurate information on the state of the state's environment. These forces — the demand for Montana coal, growing materials shortages which will increase the demand for Montana minerals, the likely increase in demand for Montana agricultural products, the redistribution to more rural areas of people from large cities, and the ever increasing demand for high quality recreation — have significant implications for all Montanans, regardless of individual value judgments as to whether the changes coming are "good" or "bad".

The major premise upon which this report is based is that maintenance of a high quality environment and fostering those conditions that allow man and nature to live in "productive harmony" require more than simple caring. Action is necessary and that action must be informed if it is to be effective.

Since its creation in 1971, and throughout all of its reports, the EQC has maintained that no greater challenge confronts the citizens and leaders of Montana than identifying what it is about the state that makes Montana a good place to live and establishing policies and designing programs to maintain and protect those characteristics through democratic processes. Forces are at work that unchallenged and unmanaged will destroy those things most citizens associate with why they are here and why they choose to remain.

Sensitively used, the EQC *Fourth Annual Report* (1975) can be of considerable assistance in the difficult and complex process of finding out where we are, discovering where we want to go, and doing what is required to enhance and protect those things we cherish.

Responsibility for coordinating the EQC environmental indicators program, the results of which are published here, fell to Loren L. Bahls, EQC staff ecologist. The *Fourth Annual Report* is testimony to his skill and determination in reviewing other indicator efforts, collecting current state indicator data, assembling state agency and University System review committees, assigning research and writing tasks to other EQC staffers, and the other hundred chores that go into producing such a report.

John W. Reuss
Executive Director
Environmental Quality Council

Montana Environmental

Quality Council

FOURTH ANNUAL REPORT

MONTANA ENVIRONMENTAL INDICATORS: 1975
A GUIDE TO READERS

The EQC **Fourth Annual Report** *(1975) is a handbook containing data on the state of the state's environment. The usefulness of the report to citizens and decision makers will be enhanced if the following limitations and guidelines are understood and kept in mind:*

—the report contains little new or original data. An objective of the report is to assemble, integrate, and report existing and periodically collected or monitored data on conditions and trends of the Montana environment. If the report highlights inadequate or faulty data or identifies areas where new data are needed, the report has been successful.

—the report organizes indicator data using Montana's seven major environmental regions. The purpose of this is not to promote yet another set of state districts or suggest a new scheme to redraw political boundaries. The system used here does not prevent getting "the big picture" — a straightforward statewide summary begins the report; the system does not preclude finding data about where you live — ample maps precede each section of the report and a large state map is inserted. Organizing the report around the state's environmental regions is the EQC's way of stimulating more systematic thinking about man-nature relationships and interactions in the state.

—the report does not attempt to interpret whether the conditions and trends contained here are "good" or "bad". Likewise, it is not organized around any preconceived notions of what Montana should be or do to protect and enhance the "quality of life" of its citizens. The effort here is to present the data required to make these choices in an informed, as opposed to intuitive, manner.

—the report is partial and tentative. The data contained here represent the EQC staff's judgment about the full-range of currently available, statistically reliable, and periodically monitored data on the Montana environment, broadly defined. As readers review the contents of this report, they should note the gaps and identify conditions for which no data are reported and send their comments to the EQC on the page provided in the back. Readers are urged to assist the EQC in recommending improvement in and/or additions to state agency monitoring activities.

—the report places heavy demands on its readers. The report was carefully designed and edited to present the data in a clear and understandable fashion. Nonetheless, the amount of material it contains appears awesome. Some readers will come across unfamiliar terms and wonder why certain variables were selected for inclusion in the report. To assist readers we have provided, as separate chapters, a comprehensive **Glossary** *which explains how certain terms are used and a discussion of* **The EQC Indicators Program** *which analyzes the indicators used here. Frequent reference to both will improve the usefulness of this report.*

—the report asks readers to evaluate the report and help the EQC increase the utility of the environmental indicators project. The EQC believes that critical choices confront the citizens of Montana and that for action to be effective it must, among other things, be informed. A page at the back of this report allows you to evaluate the report and make recommendations for changes that will assist the EQC in preparing subsequent summaries. You are urged to help in this effort.

MONTANA ENVIRONMENTAL INDICATORS: 1975

Research Coordinated
by
Loren L. Bahls

INTRODUCTION

Passage of the Montana Environmental Policy Act in 1971 established a state policy for the environment "to use all practicable means and measures . . . to create and maintain conditions under which man and nature can coexist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Montanans." This policy was strengthened when Montanans ratified the new state Constitution in 1972. Article IX — Environment and Natural Resources — declares that "the state and each person shall maintain and improve a clean and healthful environment in Montana for present and future generations."

Important responsibilities were assigned the Montana Environmental Quality Council for monitoring, documenting, and reporting changes in environmental conditions in the state. The tasks given the Montana Environmental Quality Council were important and difficult: How to get environmental issues out of the realm of heated emotions and into the cold light of objective science? How to determine realistically the conditions of human existence in Montana and the prospects for the future? How to assure that the public has a chance to speak out and be heard on environmental issues?

This *Fourth Annual Report* (1975) represents another step toward answering those difficult and elusive questions. Adapting and expanding the reporting framework of the EQC's *First Annual Report* (1972), this report offers a list of environmental indicators representing individual factors believed to be attributes of "a clean and healthy environment." In an attempt to portray objectively and clearly environmental conditions in Montana, some 30 indicators are used on a tentative basis. If some of the indicators prove not to be useful, they will be dropped and new ones examined. Table 1 lists the indicators selected for inclusion in this report. The critical prerequisite for selecting the indicators for this year's report was the availability of monitored data.

The EQC's *Fourth Annual Report* (1975) represents a major effort to assemble comprehensive baseline data, reported in a systematic format, on the current state of the Montana environment. The EQC intends a long-term commitment of refining the indicators and of issuing updated and revised summaries periodically (30).* A detailed explanation and analysis of the indicators presented here is contained in the section of this report entitled *The EQC Indicators Program*. A complete listing of the data sources indicative of environmental conditions in Montana is presented in *Environmental Monitoring in Montana*, inserted in this report as a supplement. A section of this report examines in depth the origin and purpose of the monitoring directory.

To provide a coherent and ecologically sound system for reporting environmental conditions, the Environmental Quality Council commissioned Dr. John M. Crowley, a University of Montana geographer, to classify Montana into environmental regions. This system was used in the EQC's *First Annual Report* (1972) and it has been revised for inclusion in this report.

*Throughout, all numbers within parentheses refer to materials cited in the Bibliography section of this report.

Russell W. Peterson, Chairman of the President's Council on Environmental Quality, noted not long ago, that "Because the public is exposed to so much emotion and so little compensatory science, 'ecology,' I'm afraid, is in danger of becoming synonomous with a soft-headed desire to repeal technology and re-invent the Garden of Eden" (167). In the belief that Mr. Peterson is correct, the EQC's *Fourth Annual Report* (1975) seeks to begin a new effort of assessing the dynamic interplay of social, economic, and environmental systems within a broad ecological approach to help assure the maintenance and improvement of the potential for achieving the "good life" in Montana.

Specifically, the indicators program has a two-fold function. First, it will make possible a review and appraisal of various programs and activities of state government as required by the Montana Environmental Policy Act. Second, with the benefit of the trends reflected by the indicators, this program will make it possible for government to make appropriate decisions on environmental issues.

This first function will culminate in recommendations for new environmental legislation and repeal or alteration of old laws. Such results are at the core of EQC's role as the legislature's environmental watchdog. The second function will clarify environmental conflicts so that decision makers can operate on the basis of scientifically derived knowledge, rather than on ill-founded advice based on misinformation or poorly-founded data.

Members of the public may contribute to the program by suggesting new indicators to reflect environmental concerns of particular relevance to them, or otherwise comment on the indicators program. A form provided at the end of this report is designed to make it easy for members of the public to comment. Readers are urged to assist the Environmental Quality Council in strengthening the accuracy and usefulness of the indicators program.

Table 1. Montana Environmental Indicators: 1975.

Indicator	Unit of Measurement
Population Size	Number
Population Density	Number Per Square Mile
Population Distribution	Percent Distribution by Sector
Population Change	Percent Change
Energy Production	Variable
Energy Reserves	Variable
Agricultural, Forest, and Wild Lands	Acres
Water Withdrawals and Consumption	Acre-Feet Per Year
Minerals Production	Variable
Wildlife Health	Breeding Bird Diversity
Air Quality	Variable
Water Quality	Population Served Substandard Drinking Water
	Stream Miles Degraded
Agricultural Land Quality	Acres Needing Conservation Treatment
Forestland Quality	Acres Adequately Stocked
Health	Perinatal Death Rate
	County Health Status Index
Crime	Offenses Known to Police
Employment	Employment By Sector
	Employment Ratio/ Unemployment Rate
Income	Per Capita Income
	Earnings Per Employee
	Low Income Families
Library Access	Circulation Per Capita
Social Welfare	Additions to Child Welfare Services Case Load
Rural Road System	Area and Population Served Per Mile

ACKNOWLEDGMENTS

This *Fourth Annual Report* (1975) expands and continues the indicators theme established in the *First Annual Report* (1972) by former EQC director Fletcher E. Newby, now deputy director of the Montana Department of Fish and Game.

Professor John M. Crowley, Department of Geography, University of Montana, Missoula, reassessed his Montana environmental regions, which appeared originally in the *First Annual Report.* This effort resulted in adjusting some boundaries and in updating the descriptions of the regions. Professor Crowley's contribution to this report is gratefully acknowledged.

State Librarian Alma S. Jacobs reviewed material concerning library circulation and provided substantial assistance in interpreting the significance of that indicator.

Members of the EQC staff were assigned responsibility for collecting major portions of the data reported here. Richard L. Bourke, EQC staff economist, assembled data on energy, lands in forest, farms, and range, employment and income, and other areas. Steven J. Perlmutter, EQC staff attorney, contributed data on population size and distribution, and transportation. Charles E. Brandes, former land use analyst now with the California Governor's Office of Planning and Research, collected data on population changes, library circulation, and social services.

In order to provide a critical review of EQC staff efforts to develop a statewide environmental indicators system and other techniques for interpreting environmental monitoring data, an academic advisory committee was established. The committee consisted of three faculty members from each of the Bozeman, Butte, and Missoula campuses of the University System, representing a wide range of scientific disciplines:

Montana College of Mineral Science and Technology

Charles Herndon, Engineering
Thomas Lester, Humanities
Paul Sawyer, Biology

Montana State University

Charles Bradley, Earth Sciences
Richard McBee, Microbiology
Gene Payne, Range Science

University of Montana

Robert McKelvey, Mathematics
Malinda Schaill, Economics
Wayne Van Meter, Chemistry

A state interagency advisory committee, consisting of representatives from 14 environmental agencies, was also established:

George A. Algard, Department of Agriculture
Charles Brown, Department of Livestock
Ted Clack, Montana Energy Advisory Council
Steve Colberg, Office of the Superintendent of Public Instruction
C. R. Draper, Department of Community Affairs
Dave Johnson, Department of Highways
Gerhard Knudsen, Department of Natural Resources and Conservation
Laury Lewis, Department of Revenue
James A. Posewitz, Department of Fish and Game
Frank Smoyer, Department of Social and Rehabilitation Services
Sharon Solomon, Department of State Lands (now with the Lt. Governor's office)
Ben Wake, Department of Health and Environmental Sciences
Curt Warner, Department of Labor and Industry
Wallace White, Department of Justice

The task of editing earlier drafts fell to Ronald J. Schleyer. Daniel Vichorek assisted in assembling a final version. Members of the Environmental Quality Council commented on earlier drafts and made many helpful suggestions that have been incorporated into the final draft. Responsibility for the contents of this report, however, rests with the EQC staff.

INDICATORS STATEWIDE: A SUMMARY OF DATA

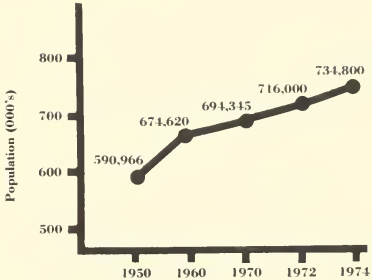
POPULATION SIZE AND DENSITY

Montana is a sparsely populated state with one half the population density of the Rocky Mountain West and less than a tenth the national average (2).

Until recently the state's population was growing very slowly, recording an increase of 17.5 percent from 1950 to 1970. However, from 1970 until July, 1974 Montana's population increased by over 40,000 people, or 5.3 percent. This is almost twice the rate of the previous 20 years (Figure 1).

An optimum level of population density has not been defined. There are certainly difficulties inherent in trying to provide public services in sparsely populated rural counties; however, increases in population in already urbanized areas may at some point result in net costs to the community and a lower overall quality of life. Figure 2 provides data on population density in the state.

Figure 1. Montana Population, 1950-1974.

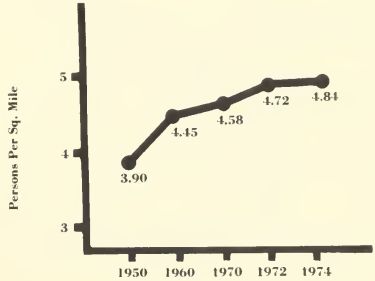


Sources: References 198, 216, and 217.

POPULATION DISTRIBUTION

In 1930, Montana's population was almost evenly distributed among urban centers, farms and rural non-farm localities. Almost two-thirds of the people lived in rural settings. While the rural non-farm population has maintained a fairly steady share of the total, the cities and towns have been growing steadily, and the farm population has experienced a drastic decline in absolute as well as relative size. In 1970, over half of Montana's population lived in urban areas, while scarcely more than one in 10 lived on farms. Between 1960 and 1970, however, Montana's rural non-farm population rose only 5 percent, as compared with a 25 percent rise during the preceding decade. The farm population fell 18 percent between 1960 and 1970, after decreasing 21 percent during the 1950s (119). Montana's total population increased from 694,409 in 1970 to about 735,000 in 1974 (9). Montana's population growth has not been distributed evenly; the urban areas and adjacent counties account for most of the increase. These trends are reflected in Figure 3 and Figure 4.

Figure 2. Montana Population Density, 1950-1974.

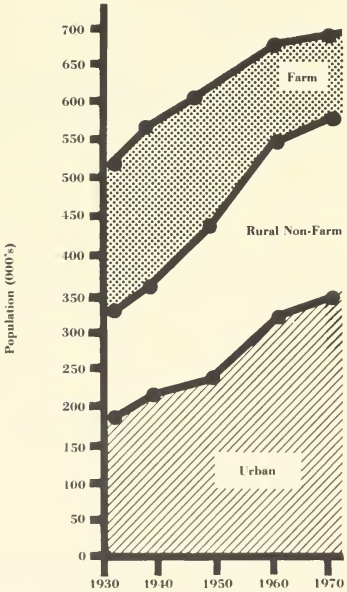


Sources: References 198, 216, and 217.

POPULATION CHANGE

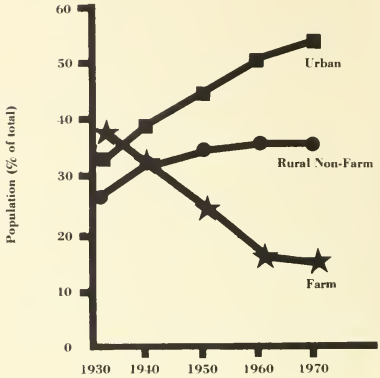
Population change has been divided into two categories: the percentage resulting from births minus deaths and the percentage resulting from net migration. Figure 5 presents the percentage change from 1950 to 1960, and for each of the two subsequent decades through 1974. From 1950 to 1970, more people left the state than entered it (168). However, the net population change (△) was positive due to births exceeding deaths. From 1970 to 1974, the population increased by about 6 percent, half of which was attributable to births exceeding deaths and the other half from a net in-migration of 20,000 people, reversing the trend of net out-migration characterized by the 1950-1970 period.

Figure 3. Size of Montana's Urban, Farm, and Rural Non-Farm Population, 1930-1970.



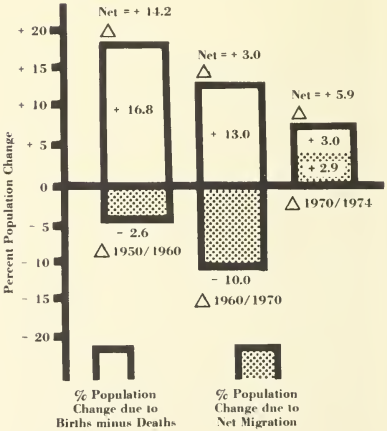
Source: Reference 119.

Figure 4. Percent of Montana's Urban, Farm, and Rural Non-Farm Population, 1930-1970.



Source: Reference 119.

Figure 5. Montana Population Changes (△) Reflected by Births minus Deaths and Net Migration, 1950-1974.



Sources: References 198 and 217.

ENERGY RESOURCES

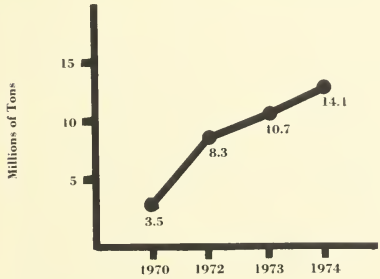
Statewide, Montana has continually produced much more energy from coal, oil, natural gas and hydroelectric dams than it has consumed (81). With the projected substantial increases in coal production, the state's net exports of energy will continue and increase greatly for the foreseeable future (140). Obviously, energy resources are among Montana's most valuable assets; however, unlike Montana's agricultural land and forest resources, its fossil fuels (coal, oil, natural gas) are finite and eventually will be exhausted.

Any discussion of Montana's energy resources would be incomplete without mention of uranium. Although there is no current production of uranium in the state, the Department of State Lands has issued 28 permits for uranium prospecting in 17 counties and over 150,000 acres in Montana have been leased for uranium exploration (140) (165). This activity suggests a high potential for uranium extraction in Montana; however, no mineable reserves have been publicly identified.

Coal production has increased 400 percent since 1970 (Figure 6). Current contracts indicate that there will be another four-fold increase by 1980 (140). Montana's economically recoverable coal reserves are large enough to supply current production rates well into the future as the resource index, the ratio of reserves to production, presented in Table 2 illustrates. Table 3 provides data on the state's potentially recoverable coal reserves.

Annual oil production fell 10 percent between 1970 and 1972 and has remained steady since then (Figure 7). Montana's recoverable oil reserves apparently are very small and will last only nine years at present rates of production (Table 4). However, removal of the price ceiling on "old" oil combined with estimates of upwards of 2 billion barrels of potential new oil may eventually increase the proven oil reserves in Montana. This would produce a higher resource index.

Figure 6. Montana Coal Production, 1970-1974.



Source: Reference 140.

Table 2. Economically Recoverable Montana Coal Reserves, 1973.

Coal Type	Millions of Tons	Resource Index
Surface		
Lignite	8,469	
Subbituminous	6,818	
Total	15,287	1,084

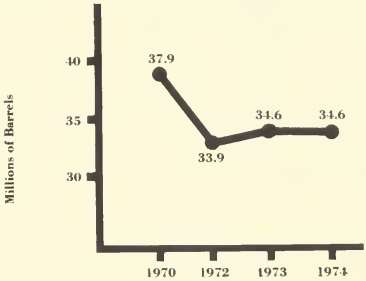
Source: Reference 163.

Table 3. Potentially Recoverable Montana Coal Reserves, 1973.

Coal Type	Millions of Tons	Resource Index
Surface		
Lignite	14,134	
Subbituminous	11,491	
Underground		
Lignite	26,122	
Subbituminous	32,166	
Bituminous	672	
Total	84,585	5,999

Sources: References 163, 208 and 213.

Figure 7. Montana Oil Production, 1970-1974.



Source: Reference 143.

Table 4. Proven Recoverable Montana Oil Reserves, 1974.

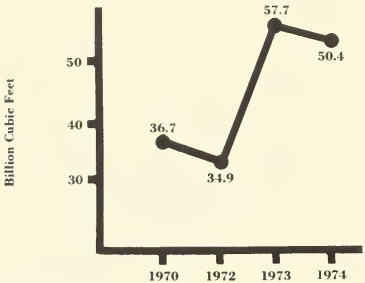
Millions of Barrels	Resource Index
310.0	9.0

Sources: References 143 and 185. Final recovery is 25-30 percent of original oil in place. Recent conservative estimates place potential new reserves at "upwards of 2 billion barrels" (185).

Montana's annual natural gas production has increased 37 percent since 1970, due to addition of production from the Tiger Ridge Field in 1973 (Figure 8). The resource index for natural gas found in Table 5 indicates that at present rates of production proven reserves in the state have an expected life of 20 years, twice as long as that for oil. The expected increase in natural gas well head prices combined with potential new reserves of 4 to 6 trillion cubic feet may eventually result in a net addition to the proven reserves figure.

Installed hydroelectric capacity in Montana has remained constant since 1972 (Table 6). This will increase in the next few years with the completion of the facilities at Libby. Figure 9 presents data on hydroelectric power generation from Montana facilities. The drop in 1973 net generation is attributed to the low runoff from lack of precipitation.

Figure 8. Montana Natural Gas Production, 1970-1974.



Source: Reference 143.

Table 5. Proven Recoverable Montana Natural Gas, 1974.

Billion Cubic Feet	Resource Index
1,054	20.9

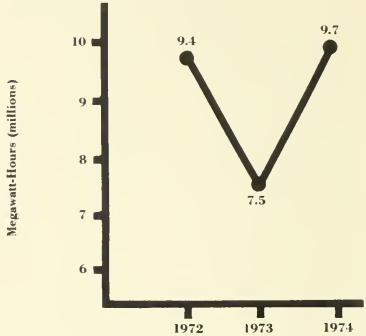
Sources: References 42, 58, 61, 62, 91, and 141. Recent estimates put potential new reserves (unexplored extensions of proven and possible resources based on geologic evidence and production) at 4 to 6 trillion cubic feet. As of December 1974, there were 207 billion cubic feet of reserves in underground storage. All measurements made at 14.73 pounds per square inch.

Table 6. Montana Installed Hydroelectric Generating Capacity, 1973.

Maximum Nameplate Rating (Kw-Hours)
1,511,830

Source: Reference 164.

Figure 9. Montana Hydroelectric Generation, 1972-1974.



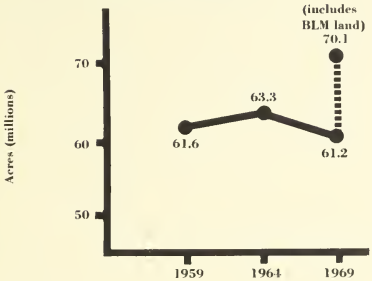
Sources: References 45, 64, 65, 77, 144, and 218. Figures represent net hydroelectric power generation, exclusive of plant use.

LAND RESOURCES

It is difficult to get accurate data on Montana land in agriculture. This report relied upon two measures to reflect agricultural land trends in the state. Figure 10 shows a decrease in total acreage of nearly 500,000 acres between the 1959-1969 period. Figure 12 records an increase of about 2 million acres for the period 1958-1967.

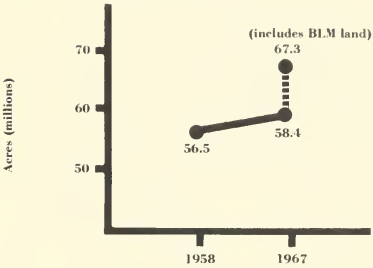
These differences can be traced to the nature of the two surveys. "Agricultural Land in Farms" (Figure 10) is broader in its interpretation of agricultural land. It includes farmland not under direct cultivation. The reported decrease could be caused by private farmland changing ownership and going to other uses. Included in this particular census is federal land leased on a per acre basis. A change in land leasing practices by the Bureau of Land Management (BLM) in the mid-1960s from a per acre basis to a per head basis contributed significantly to the decrease in acreage between the years 1964-1969.

Figure 10. Montana Agricultural Land in Farms, 1959, 1964 and 1969.



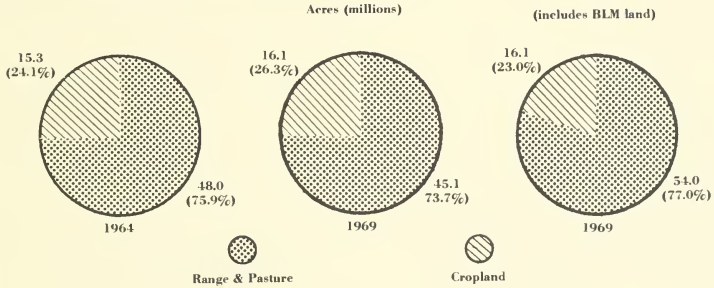
Sources: References 150 and 195.

Figure 12. Montana Cropland, Pasture and Range, 1958 and 1967.



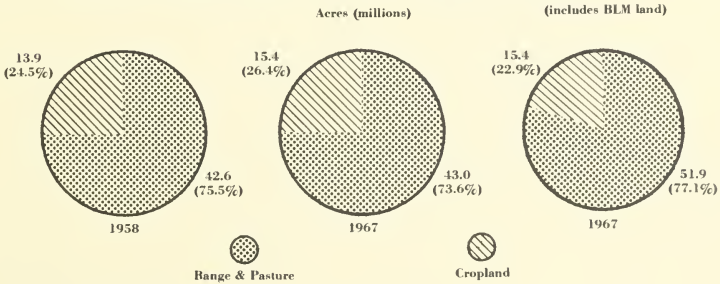
Sources: References 150, 151, and 152.

Figure 11. Distribution of Montana Agricultural Land by Type, 1964 and 1969.



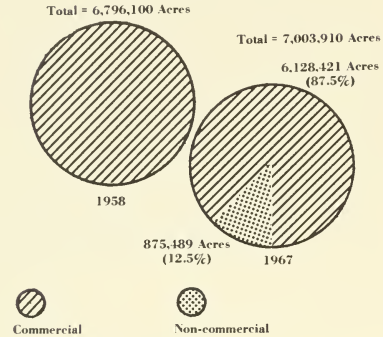
Sources: References 150 and 195. Cropland component includes cropland used for pasture. Farmland not under direct cultivation is included in range and pasture category.

Figure 13. Distribution of Montana Cropland, Pasture, and Range, 1958 and 1967.



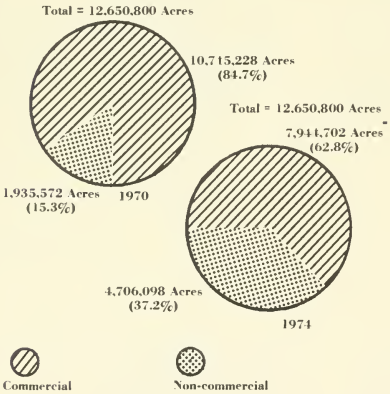
Sources: References 150, 151, and 152.

Figure 14. Private and State Forestland in Montana, 1958 and 1967.



Sources: References 151, 152, and 153.

Figure 15. Federal Forestland in Montana, 1970 and 1974.



Sources: References 41 and 50. Figures exclude lands under reserved or wildland classifications.

The "Cropland, Range, and Pasture" data (Figure 12) were taken directly from an inventory which was limited to land used specifically for these purposes. The acreage increase reported may simply mean farmland previously not in agricultural use has been converted. Another contributing factor is that the definition of cropland was liberalized in 1967 to include wild hay and mountain meadows being cut for hay.

Figure 11 and Figure 13 show the distribution of agricultural lands by certain categories. In both measures that portion of agricultural land in cropland rose from 24 percent to over 26 percent of the total (excluding BLM land) to between 15.5 and 16 million acres as of 1969. The range and pasture component exhibited different trends, decreasing by 3 million acres during 1964-1969 according to measures used in Figure 11 and increasing by 400,000 acres between 1958 and 1967 by the standards applied in Figure 13. In the former case the change may be attributed to the shift in BLM leasing practices. Figure 11 indicates a total of 45 million acres in range and pasture in 1969, while Figure 13 yields 43 million acres in 1967. The differences may be traced to the changes in definitions discussed above.

Montana's 20 million acres of forestland has remained stable except for a small increase in private acreage in the period 1958-1967. The almost 13 million acres of non-reserved federal forestland comprises about 65 percent of the total acreage. Data on forestlands in Montana are presented in Figure 14 and Figure 15.

There has been a significant drop in the amount of the federal forestland classified as commercial in the last four years, from 85 percent in 1970 to 63 percent in 1974, a net loss of almost 3 million acres. This was partly due to the removal from commercial classification of relatively high elevation forestlands which were inaccessible and of marginal commercial use. In 1967, about 87 percent of the private and state forestland was classified as commercial.

The federal government owns about 56 percent of the total commercial forestland in the state with the remainder being controlled by the state (3 percent) and private owners (41 percent).

Montana has about 10 million acres of wildlands (76) (Table 7). Of these lands, only a little more than 2 million acres (or 20 percent) are presently classified and protected under the National Wilderness Preservation System. The bulk of the remaining wildlands in Montana — about 6 million acres — are roadless areas under the management of the U.S. Forest Service and the Bureau of Land Management. Many of these areas are being studied for possible changes to primitive or wilderness status.

Table 7. Wildlands in Montana, 1975.

Classification	Acres
Wilderness	1,801,988
Proposed Wilderness	2,152,736
Primitive	355,456
Proposed Primitive	102,850
New Study Areas	1,643,044
Proposed New Study Areas	971,000
Roadless Areas (USFS)	3,709,466
Roadless Areas (BLM)	207,017

Source: Reference 76. Proposed wilderness does not include Montana portion of Yellowstone National Park Wilderness and includes 344,776 acres currently classed primitive. New study areas include 100,000 contiguous acres in Idaho in the Hoodoo and Scotchman Peak areas.

WATER

Recent calculations put the average total annual supply of surface water in Montana at 43,899,580 acre-feet (134).

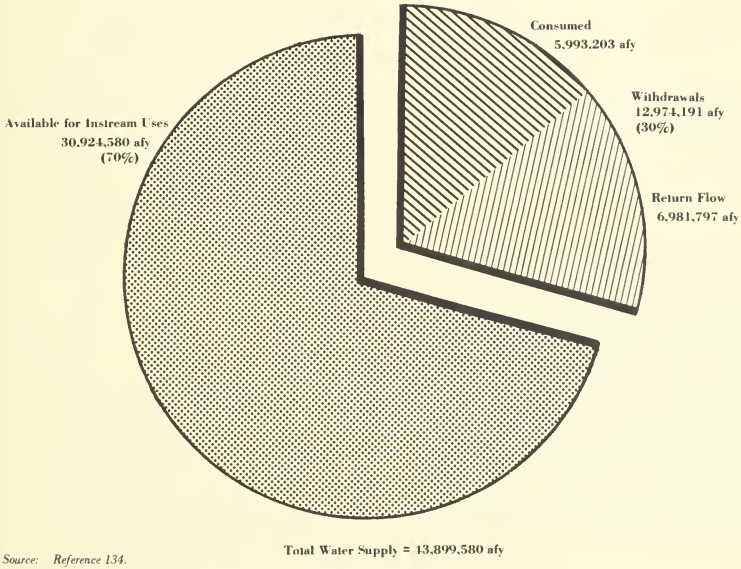
This resource is depleted by evaporation and by withdrawals for consumptive purposes, including irrigation, municipal and industrial, livestock, rural domestic and thermoelectric. Total depletion amounts to 7,105,376 acre-feet per year (afy); irrigation alone consumes 5,851,827 afy, which, together with reservoir evaporation, accounts for 98 percent of all water consumption in Montana. All other uses account for the remaining 2 percent (134).

Surface waters yield 99 percent of the water used for irrigation in the state. While supplies are generally adequate, locally intense irrigation activity may cause locally severe depletions, stream dewatering and impacts on aquatic life and recreation. These impacts are most apparent in the Broad Valley Rockies where irrigated agriculture has reached greatest development.

In 1967 over 1.6 million acres were irrigated in Montana (153). Current estimates range between 2.5 million acres (134) and 3.4 million acres with expectations of reaching 6.5 million irrigated acres by the year 2020 (155). As more acres come under irrigation the amount of additional water consumed will depend in part on irrigation efficiency. Although heavy energy users, sprinkler systems deliver a greater percentage (70 percent) of withdrawn water to the crop than do gravity ditch and lateral systems (50 percent). Increased efficiency will result in less withdrawal per acre, less water consumed unproductively (through ditch seepage and evaporation), and in less salt laden water returned to rivers and streams.

Figure 16 illustrates the two water indicators used in this report. One measures dewatering — the amount of water withdrawn and, at least temporarily, denied for instream uses such as hydroelectricity, recreation, fish and wildlife and waste dilution. The other measures consumption — the percentage of water withdrawn that is consumed and not returned. Although figures for net irrigation depletion are available on a county basis, figures for nonirrigation consumption are not. In this report nonirrigation consumption by environmental region must be estimated by multiplying total state nonirrigation consumption by percentage of state nonirrigation water withdrawals for the environmental region.

Figure 16. Montana Water Withdrawals and Consumption of Withdrawals, 1970.



Source: Reference 134.

The most recent estimate puts total water withdrawals at nearly 13 million afy or almost 30 percent of total annual supply (134) (Figure 16). Excluding reservoir evaporation (which is water "consumed" but not withdrawn), 5,993,203 afy or 46 percent of the water withdrawn in Montana is consumed. Besides increasing irrigation efficiency, national and international water experts are encouraging wastewater recycling in order to avoid serious water shortages in the future (4) (159) (186) (200).

Groundwater diversion in Montana amounts to 250,000 afy, with about 163,000 afy of that consumed (134). A proposed coal slurry pipeline from Wyoming to Arkansas would eventually draw 75,000 afy from the Madison groundwater formation, a portion of which underlies eastern Montana (14) (21).

MINERALS

In 1974, the minerals produced in Montana were valued at over one-half billion dollars.

The two most important groups of minerals — metals and mineral fuels — accounted for 90 percent of the total value of minerals produced in 1974 (207). The remaining minerals, including sand and gravel, clays and stone, tend to be more widely distributed and of more local importance. Reserves and production of mineral fuels, including coal, natural gas, and petroleum, are presented separately as indicators of the state's energy resources. This section is concerned only with indicators of metallic production.

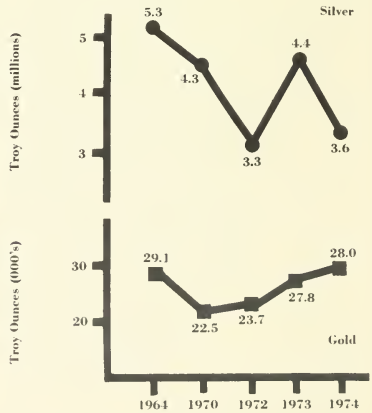
Prior to 1935 and the development of Montana's petroleum industry, gold, silver, copper, lead and zinc accounted for practically all of Montana's mineral production value (213). Since 1964 these metals have contributed about 45 percent of the state's total mineral wealth (202) (203) (204) (206) (207). Production of these metals is confined to the Broad Valley Rockies, except for a limited amount in Lincoln and Mineral counties in the Columbia Rockies.

Photo 1. Old Northern Pacific stripmine spoils at Colstrip, Rocky Mountain Foreland.

Photo 2. The Anaconda Company copper smelter at Anaconda, Broad Valley Rockies.

Because of the diffuse nature of ore bodies and because of confidentiality agreements between regulatory agencies and mining companies, accurate reserve figures for metals are not available. Also withheld are the quantity and value of certain minerals where only a single company is involved in production.

Figure 17. Montana Gold and Silver Production, 1964-1974.

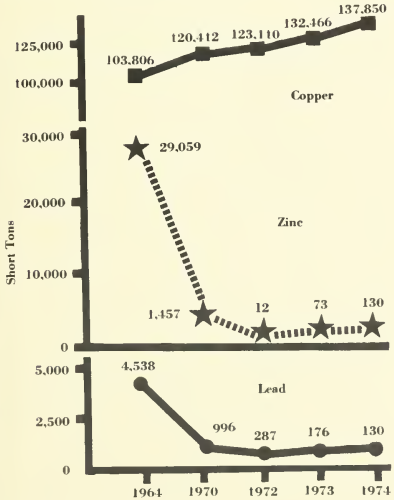


Sources: References 202, 203, 204, 206, and 207.

The quantity of gold, silver, copper, lead and zinc historically produced in the Broad Valley Rockies of Montana is presented in Figure 17 and Figure 18 as an indicator of Montana's contribution of these important metals. The minerals produced in Montana are consumed almost entirely outside the state and therefore the future production and prosperity of the mineral industry within the state will depend in part on the national economy and on demands by industry elsewhere for mineral products (213). Because reserves of mineral resources are becoming increasingly difficult to extract — requiring a greater energy subsidy — future production of minerals will also depend in part on the price of fossil fuels (79).

Mineral extraction is frequently accompanied by severe social and ecological disruption, as a history of the old mining camps in Montana will testify. New or proposed mines near Troy (copper and silver) (3) (189), Dillon (iron) (187), and Nye (platinum and palladium) (181) need to be watched closely so that the same mistakes are not repeated in these relatively unspoiled areas. Uranium mining threatens the scenic and resource-rich Long Pines area of extreme southeastern Montana (215), and new interest has been expressed in phosphate deposits in the Gold Creek area of the Broad Valley Rockies (199) and in potassium in the Two Rivers Region (28).

Figure 18. Montana Copper, Lead, and Zinc Production, 1964-1974.

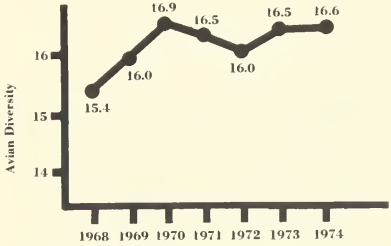


Sources: References 202, 203, 204, 206, and 207.

WILDLIFE DIVERSITY

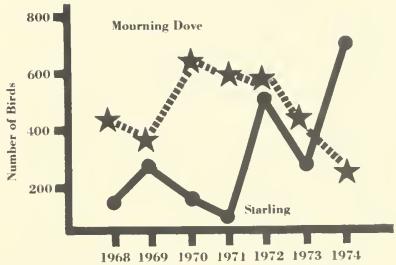
Figure 19 shows the statewide avian diversity trend from 1968 to 1974. It has remained relatively stable, increasing slightly in this period. This increase may be due more to increasing familiarity with Montana's bird fauna on the part of amateur ornithologists than to an actual increase in the number of bird species. Figure 20 provides population trends for two species: the mourning dove, which is an indicator of chemical contamination, recreation and wildlife management effectiveness, and the starling, which is an indicator of garbage and filth contamination, crop damage, and urban degradation (183). The starling, an introduced species, appears to be strengthening its foothold in Montana, while the mourning dove is declining for reasons unknown.

Figure 19. Avian Diversity in Montana, 1968-1974.



Source: Reference 212. Avian diversity = (m − 1)/1nN where m is the number of species and N is the number of individual birds observed.

Figure 20. Montana Mourning Dove and Starling Populations, 1968-1974.



Source: Reference 212.

AIR QUALITY

Most serious air pollution problems are in Rocky Mountain Montana. Indeed, death rates for asthma, emphysema and bronchitis — diseases aggravated by air contaminants — are 51 percent higher in the mountainous portion of Montana as compared to the plains portion (55) (142).

A 1970 status report on air pollution in Montana identifies six problem areas: Columbia Falls, Flathead Valley, Missoula, Billings, Anaconda and the Helena Valley (128). All but the Billings area are located in the Broad Valley Rockies. Additional problem areas include Great Falls, Philipsburg, Libby and Garrison, all but Great Falls in Rocky Mountain Montana.

The major source of air pollution in each of these areas has its own unique mix of emissions, with certain pollutants predominating. Thus in Anaconda, sulfur dioxide might be the principal pollutant; whereas in Columbia Falls, fluoride might be most critical. For this reason only certain parameters are measured in each locality and composite indexes of air quality cannot be applied. Individual air pollution parameters, namely particulates, sulfation rates, and fluoride, are used as prime indicators of air quality at selected localities for the purpose of this report.

Stimulated by passage of the federal Clean Air Act Amendments of 1970, the country's air pollution cleanup campaign has made significant strides although operating slightly behind schedule. The Act set May 31, 1974 as the deadline date for states to meet the national ambient air quality standards. Although national compliance status on that date is not known, the end of 1974 saw 134 out of 247 Air Quality Control Regions meeting federal standards for sulfur dioxide and all but a few areas within federal standards for particulates (94). Montana has five Air Quality Control Regions surrounding the towns of Billings, Great Falls, Missoula, Helena and Miles City. Only one of the five regions — Billings — achieved federal ambient standards by the May 31 deadline (43).

Montana has approximately 100 industrial plants classed as major sources, i.e., that emit 100 tons per day or more of airborne byproducts. It is now thought that roughly three-quarters of these emitters are currently in compliance with the stationary source regulations of the state's air pollution control implementation plan. Of the 20 or so that are out of compliance, about half are on schedule for compliance by a definite date (43).

National air quality monitoring shows average concentrations of particulates and sulfur dioxide on a predominantly downward trend across the country (211). The trend for Montana is similar, and with the possible exception of fluoride at Garrison, the levels of all pollutants reported here are either stable or declining at all stations. (124).

Nevertheless, there is room for continued improvement at both new and existing installations. In addition, these trends may produce a deceptive sense of well being since vast areas of Montana potentially susceptible to excessive particulate and dust pollution are not now being monitored. For the most part, as with water pollution, the easier large industrial point source problems have been or will be solved shortly. The real challenges are the control of more elusive sources such as motor vehicles, slash burning, dusty roads and streets, open burning dumps, and large parking lots, and the prevention of significant deterioration. The Department of Health and Environmental Sciences is currently developing a system for preventing further air quality degradation over much of the state (8).

WATER QUALITY

The importance of Montana's water was aptly described in a recent Montana Department of Natural Resources and Conservation report (134):

> Perhaps the most valuable natural resource a region can possess is an ample supply of clean, fresh water. Montana, being a headwaters state, is so favored. Her water supply is in most cases adequate and, except in a few troubled areas, still reasonably unpolluted. Keeping it so under the pressures of an increasing population and a growing industrial development presents a challenging opportunity as well as an important responsibility to all Montanans.

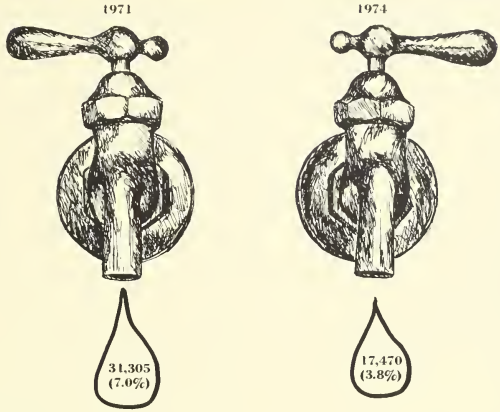
Drinking Water. Quality drinking water, too often taken for granted, is of fundamental importance to Montanans. Water may contain disease organisms, nuisance elements, and other constituents that affect human health.

Monitoring and assuring an adequate supply of safe public drinking water is the responsibility of the Department of Health and Environmental Sciences. About 240 locally operated public water supplies are inspected annually for bacterial contamination. Passage of the Federal Safe Drinking Water Act of 1974 and issuance of federal regulations may require expansion of the state monitoring program to include 2,000 public water sources along with expanded analysis to detect more waterborne impurities than are now examined.

Montana has generally good drinking water, although certain supplies are chronically beset with salinity, color and/or taste and odor problems. Natural phenomena such as eutrophication, floods and drought, and human activities such as rapid urbanization, agriculture and mining, may jeopardize water supplies. The quality of the delivered water may be a function also of the diligence of the local water plant operator.

The Department of Health and Environmental Sciences has established standards for fecal coliform bacteria, which indicate the presence of pathogenic bacteria in drinking water. The population served by public water

Figure 21. Montana Population Delivered Unsatisfactory Drinking Water, 1971 and 1974.



Source: Reference 47.

supplies not meeting bacteriological standards is the indicator of drinking water quality used in this report (Figure 21). Statewide, this indicator decreased by almost half from 1971 to 1974 (74).

The microbes responsible for diseases like typhoid, cholera and dysentery are usually carried by water. Most public drinking water in Montana is routinely treated with chlorine to keep it safe from these pathogens. Ironically, the Environmental Protection Agency has discovered through recent studies that chlorine may combine with organic chemicals in the water to form volatile organic compounds, some of which are suspected to be cancer-causing (20). At present, however, the benefits of chlorination appear to outweigh these newly suspected risks, although alternative water treatment processes are being investigated.

Lake and Stream Pollution. Clean water from the lakes and streams of Montana is used for domestic purposes, recreation, fish and wildlife, agriculture, and industry. Montana has some of the best quality surface waters in the country, including several pristine lakes and nationally recognized trout streams.

The most obvious cause of stream degradation is the point source — an effluent or discharge by a municipal or industrial polluter. Progress in controlling point sources has been dramatic in recent years (129):

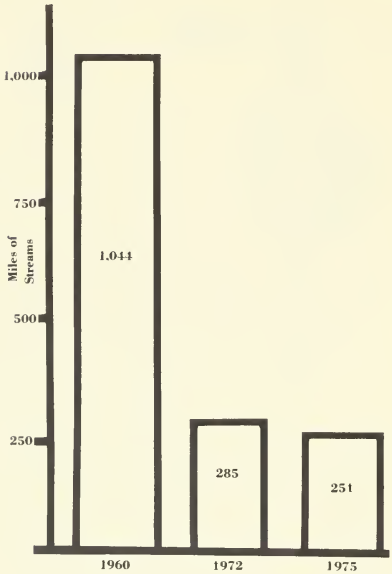
> In 1960, over 1,000 miles of Montana streams were receiving raw sewage or industrial wastes which seriously affected beneficial uses. Since that time, state efforts have lowered the mileage affected to less than 250 miles in 1975 and will lower the total to less than 50 miles by 1977. Through the permit program, point discharges will be controlled so that stream degradation from this source will be avoided in the future.

A more insidious and far reaching cause of stream degradation is the non-point source. Pollution from non-point sources is currently Montana's greatest water quality problem; approximately 3,500 miles of streams are affected (129). Non-point source pollution results primarily from manipulating the land to produce crops, livestock, timber and minerals. It commonly takes the form of sediment, elevated salinity and temperature, flow changes from dewatering, and toxic agents such as pesticides, herbicides and heavy metals.

An indicator of the extent of point and non-point source pollution is the number of stream miles degraded (Figure 22). The effects of point and non-point sources sometime overlap because the same reach of stream may be degraded by both. Monitoring this indicator over time will give a clear picture of how well the state is accomplishing the objectives of the Federal Water Pollution Control Act Amendments of 1972.

Montana has approximately 2,000 publicly owned freshwater lakes. Of these, an estimated 500 are significant, i.e., identified as having fisheries potential. As lakes age and are subject to human pressures, water quality deteriorates, algae flourish and game fish are replaced by rough fish. This process is called eutrophication. It was reported in 1975 that 27 significant Montana lakes exhibited signs of eutrophication, 5 were found not to be eutrophic, and the status of the remaining 468 lakes was unknown (126).

Figure 22. Point Source Degradation of Montana Streams, 1960, 1972, and 1975.



Sources: References 54 and 129.

LAND QUALITY

A recent report of the Committee on Agriculture of the U.S. House of Representatives sounded an important warning about the risks of overestimating our ability to increase agricultural production (214):

> Efforts to expand the food supply, either by expanding the area under cultivation or intensifying cultivation through the use of the agricultural chemicals and irrigation, bring with them troublesome and disturbing ecological consequences. Accelerating soil loss, problems caused by irrigation and eutrophication of streams and lakes due to increased use of chemical fertilizers are pressing ecological dangers associated with efforts to increase food production. Enlarging livestock herds for food and draft power has caused overgrazing and the inevitable erosion that follows. Nature requires centuries to create topsoil and man can destroy it in only a few years. Deforestation has been followed by erosion in many parts of the world.

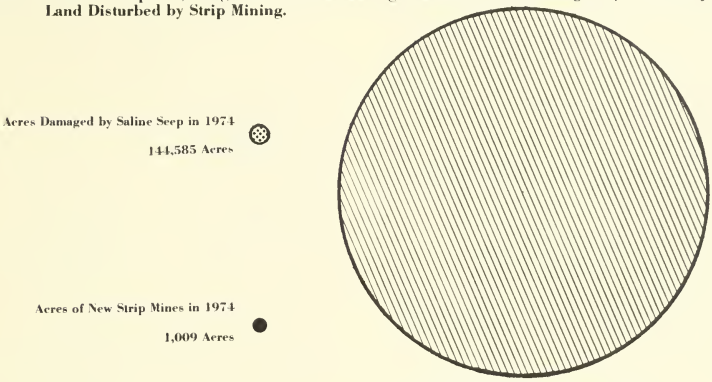
Cropland, Rangeland, and Woodland — The Private Sector. As world population grows, so does the demand for food and forest products, often to the point of surpassing the land's ability to sustain production without severe environmental consequences. For example, the Soil Conservation Service estimates that nearly nine million acres of previously unfarmed land was plowed during 1974, about four million acres of which was "marginally productive, ecolgically fragile wilderness" (170). The shallowness and dryness of much of Montana's soil make it extremely susceptible to abuse from grazing, logging, mining and other activities.

The latest comprehensive inventory of conservation treatment needs on private and state-owned lands in Montana was conducted by county conservation needs committees in 1967 and published in 1970 (153). The findings of this inventory form the basis for evaluating the quality of soil, grass and timber on private lands in Montana. Although a previous inventory was undertaken in 1958 (152), the treatment needs data are not comparable with those from 1967 because of different and overlapping treatments prescribed in the 1964 supplement (151) to the 1958 report. Tentative plans call for updating the inventory every five years (56).

Montana has about 58 million acres of cropland, pasture and range in private or state ownership. Over 32 million acres of this land — approximately one-third of the total land area in the state — were in need of conservation treatment in 1967 (153), ranging from alternative land use for some dry cropland to protection from grazing for much

Photo 3. Refuse along the Bitterroot River, Broad Valley Rockies.

Figure 23. Montana Cropland, Range and Pasture Needing Treatment; Land Damaged by Saline Seep; and Land Disturbed by Strip Mining.



Sources: References 132, 138, and 153.

of the range and pasture. On a national level, about 60 percent of the farmland requires conservation treatment, according to the Soil Conservation Service (161). The additional Montana soil problems of saline seep and strip-mined land reclamation are put in perspective by comparing the acres affected on the same scale in Figure 23.

Over four million acres (61 percent) of private woodlands in Montana were in need of establishment and reinforcement (i.e., tree planting) and/or timber stand improvement (i.e., tree thinning) in 1967. The situation was most critical in the Columbia Rockies where nearly two million acres (93 percent) of private woodland were in need of improvement. It has been estimated recently that of the approximately 5,707,000 acres of non-state private commercial forestland in Montana, 485,000 acres or 8.5 percent need replanting only (71).* Of the 421,000 acres of state-owned commercial forestland in Montana, 15,000 acres (3.6 percent) require planting and 76,000 acres (18.1 percent) require thinning (71). About two million acres (47 percent) of Montana's private forest used for grazing were in need of improved forage and grazing reduction or elimination in 1967 (153).

* Conditions on small private and large industrial forestlands should be segregated in the future. Communications with the three large industrial timber companies in Montana have indicated that the situation is not so severe on lands under their management (51) (59) (68). For example, Burlington Northern reports that only about 10,000 acres or 1.3 percent of its 750,000 acres of commercial forestlands are inadequately stocked and require treatment (68), St. Regis reports that only 1,000 acres or 0.5 percent of its 200,000 commercial forest acres are not properly stocked (59), and U.S. Plywood indicates that 42,500 acres or 6.6 percent of its 640,000 acres of commercial timberlands in Montana are in a poorly stocked or a non-stocked status (48).

A significant correlation exists between agricultural and forestland treatment and the quantity and quality of Montana's surface water resource. In 1967, one and one-third million acres (80 percent) of the state's irrigated cropland needed either improved systems or proper water management (153). As a result of irrigation withdrawals in excess of need, stream dewatering is a chronic problem in western Montana. About half of the 3,500 stream miles affected by non-point sources of pollution are degraded by sediment derived from soil erosion on unprotected lands, although it is not known how much of this sediment results from unreasonable conservation practices and how much from natural wasting (129).

Photo 4. A heavily used pasture near Missoula, Broad Valley Rockies.

Four local planning agencies in the Yellowstone, Flathead and upper Missouri basins have received a total of $2.2 million from the Environmental Protection Agency under Section 208 of the Federal Water Pollution Control Act Amendments, largely to plan for mitigating non-point source pollution through prescriptive land use measures (108). To control soil loss and sediment pollution outside these special planning areas, the state Department of Health and Environmental Sciences and Department of Natural Resources and Conservation are proposing a statewide sediment control project (127). A proposal has been made to the Environmental Protection Agency and $145,000 have been earmarked for this purpose (69).

Forests and Rangeland — The Public Sector. About 30 percent of the land area of Montana is in federal ownership, most of it in forest and rangeland. A study of soil erosion and sedimentation on federal lands, analogous to the conservation needs inventories on private and state lands, was completed in 1968 (194). Although this study was made in response to a Congressional request and will probably not be repeated, treatment needs are presented here for comparison with the private sector analysis conducted in 1967 (153).

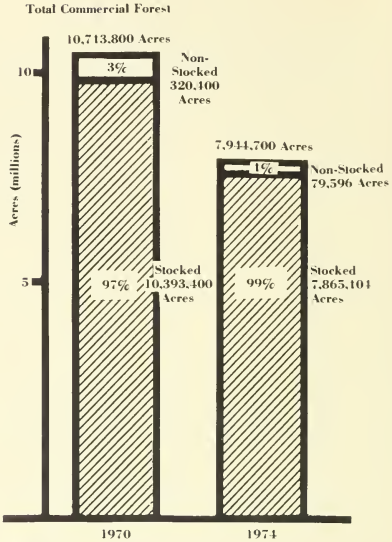
The federal government manages over 11 million acres of cropland, pasture and range in Montana, of which cropland (about 30,000 acres) is a relatively minor portion. Sixty-two percent of federal range and pasture (about 6,800,000 acres) was in need of treatment to alleviate soil erosion, while 20 percent of federal cropland (about 6,300 acres) required treatment at the time of the report. Only 6 percent of the 14 million acres of federal woodland, primarily under the management of the U.S. Forest Service, was in need of treatment in 1968 (194).

As an indicator of forest quality, consideration might be given to the number of forest acres or number of trees visibly defoliated by insects and diseases on a year to year basis. For example, the acres defoliated by western spruce budworm in Montana were: 2,856,760 in 1972; 1,666,900 in 1973; and 2,161,309 in 1974 (90) (115). However, data on damage by other forest pests are not reported in so uniform a manner, making it extremely difficult if not impossible to extract appropriate figures for indicator purposes.

In 1970, on 11 national forests in Montana, 320,400 acres (3 percent) of commercial forestland required stocking (66). On the same forests in 1974*, about 79,600 acres (1 percent) needed reforestation (41) (Figure 24). During this period, however, the non-reserved commercial forest inventory in Montana decreased by 2,769,100 acres or 26 percent of the 1970 inventory. This was primarily the result of a change in classification causing the removal from commercial status of substantial forest acreages in high elevation areas having fragile soils, inaccessible terrain, and relatively low growing volume (50).

* With incorporation of the Montana portion of the Kaniksu into the Kootenai, there were only 10 national forests in Montana in 1974.

Figure 24. Stocked and Non-Stocked Commercial Forest in Montana Managed by USFS, 1970 and 1974.



Sources: References 41 and 66.

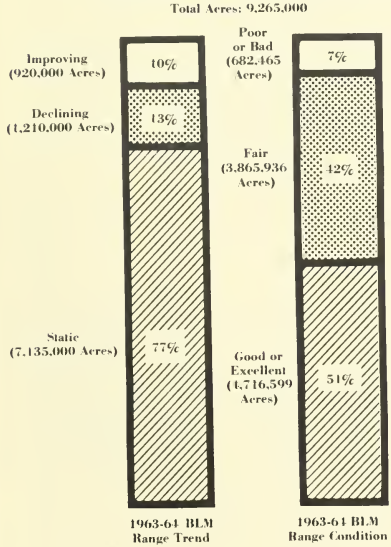
Photo 5. A clearcut in the West Fork drainage of the Bitterroot River, Columbia Rockies.

The most recent BLM range condition classification was conducted in 1963-64 (205). Acreages were classified as being in "excellent," "good," "fair," "poor," and "bad" condition, based on plant species composition and soil surface factors. An updated classification is now in progress, but range condition categories are being limited to three: good, fair and poor. (A fair rating means the land has unsatisfactory top soil and plant coverage, while poor and bad reflect heavy loss of topsoil, poor forage conditions and varying degrees of erosion.)

The 1963-64 range condition and trend survey found that 51 percent of Montana's BLM land was in good or excellent condition, 42 percent was in fair condition and 7 percent was in poor or bad condition (49). Ten percent of the land was improving, 77 percent static and 13 percent declining (Figure 25).

However serious the range situation might be in Montana, on the remaining BLM lands in the West it is even worse: only 16 percent of the 150 million acres of BLM grazing land is in good or excellent condition, while 84 percent is in fair, poor or bad condition (12). Consequently, as the result of a suit initiated by the Natural Resources Defense Council, the BLM will be required to draft specific environmental impact statements for each of its grazing districts before issuing any further grazing permits (22).

Figure 25. Range Condition and Trend for Montana Land under BLM Management, 1963-1964.

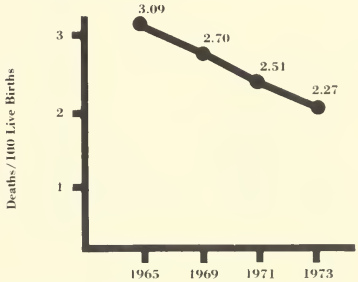


Source: Reference 49.

HEALTH STATUS

The perinatal death rate steadily decreased for the period 1965-1973. This was due to both improved health services statewide as well as a general increase in public awareness of the need for improved personal health care habits (Figure 26).

Figure 26. Montana Perinatal Death Rate, 1965-1973.

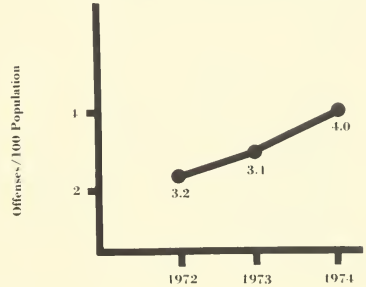


Sources: References 118 and 125.

CRIME

The crime rate in Montana has steadily increased in the last two years. Generally, aggregate crime rates vary directly with population densities and Montana appears to be experiencing that trend (Figure 27).

Figure 27. Offenses Known to Police in Montana, 1972-1974.



Source: Reference 52.

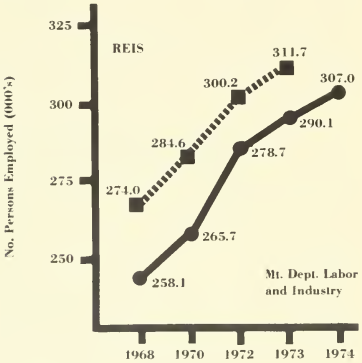
EMPLOYMENT

Based on data provided by the Regional Economic Information Service (REIS) of the U.S. Department of Commerce, Montana's employment grew by almost 14 percent between 1968 and 1973 when 37,700 jobs were added to the state's economy (Figure 28). Over 34,000 of these were added to the private non-farm sector, with the government contributing over 4,000. The farm sector lost about 1,200, declining from 14.5 percent of the total in 1968 to 12.4 percent in 1973 (Figure 29).

The most recent information available from the Montana Department of Labor and Industry shows this tend continuing with 17,000 jobs added in 1974 and 4,500 more through the first 8 months of 1975. According to this source, about 41,000 jobs were added during the period 1970-1974. To put this in perspective, it is almost double the natural population increase (births minus deaths) that occurred in Montana during this period (217). While more jobs have been added in Montana, the unemployment rate has also increased, from 5.6 percent in 1970 to 6.7 percent in 1974, indicating that people have been entering the labor force faster than jobs have been created. This also holds true for the nation as a whole. Nationally, the unemployment rate has also risen over the same period of time from 4.9 percent to 5.6 percent. For a number of years Montana's rate has remained above the national average, although lately the gap has narrowed; in fact, for most of 1975, Montana's rate has been below the national average (131).

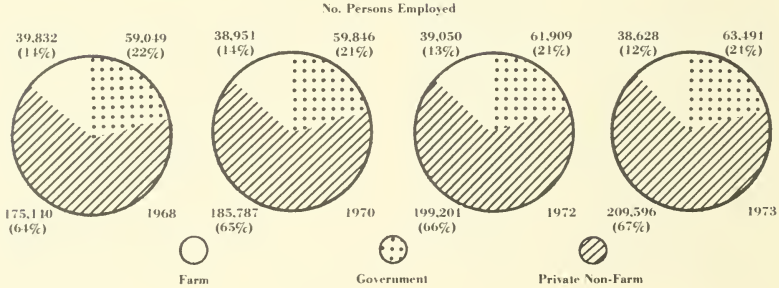
It is interesting to note that while the unemployment rate increased between 1970 and 1973 the employment ratio also increased, from 76.4 percent to 79.6 percent (Figure 30). This may be attributable to intercensal population estimates which are understating true population growth, hence inflating the employment ratio. It could also be a result of conceptual differences in the two measures; the unemployment rate being very dependent on people's decisions to enter or withdraw from the "civilian labor force" and the employment ratio being based only on the size of population aged 18-64. What this apparent data contradiction implies is that as the employment picture improved (the percent employed of the population aged 18-64 increased), more people have been added to Montana's labor force than were able to find suitable employment. Another factor may be that liberalized unemployment benefits have induced an increase in relative demand for unemployment benefits over time.

Figure 28. Total Employment in Montana, 1968-1974.



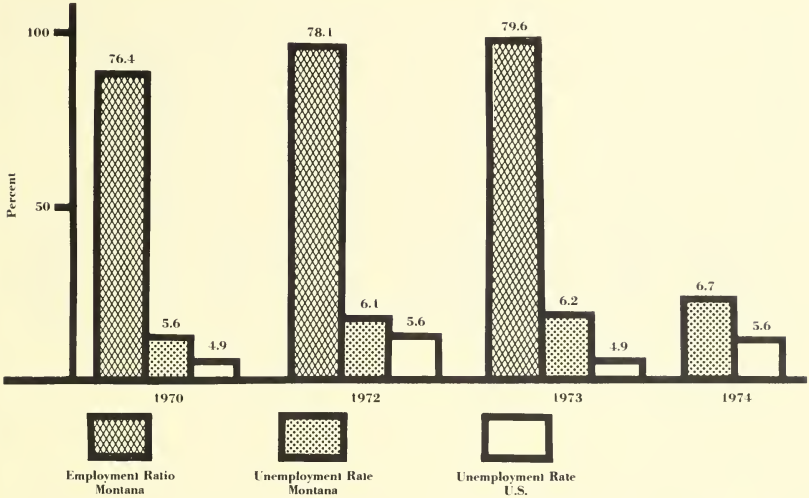
Sources: References 131 and 196.

Figure 29. Montana Employment by Sector, 1968-1973.



Source Reference 196.

Figure 30. Montana Unemployment Rate and Employment Ratio, 1970-1974.



Sources: References 53, 196, 216, and 217.

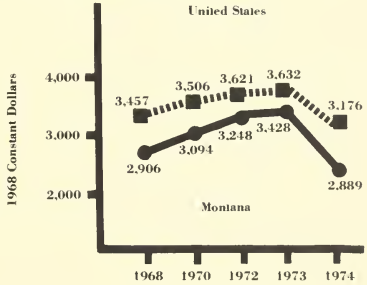
INCOME

Figure 31 shows that real per capita income in Montana increased almost 12 percent between 1968-1973, more than double the national increase of almost 5 percent. In the two years since 1972, however, Montana's real per capita income declined 11 percent, slightly less than the national figure of over 12 percent. Still, Montana's real per capita income has shown an increase relative to the national average, from 16 percent below in 1968 to 9 percent below in 1974.

These income figures can be better understood by examining earnings in the three major employment sectors, because earnings generally comprise about three-fourths of income (Figure 32). Unfortunately, comparable employee data for 1974 are unavailable so only earnings and employee figures for the period 1968-1973 will be presented. The recent increase in real per capita income has been led by the strong advance in real earnings per employee in the farm sector, from $5,000 in 1968 to over $12,000 in 1973. This has occurred during a period of declining employment in the sector; the return to labor has increased substantially while the sector has become less labor intensive.

Over this same period, the real earnings per employee increase was 5 percent in the government sector, or $400 per year. The private non-farm sector had an absolute decrease in real earnings per employee of $600 per year.

Figure 31. Per Capita Income: U.S. and Montana, 1968-1974.

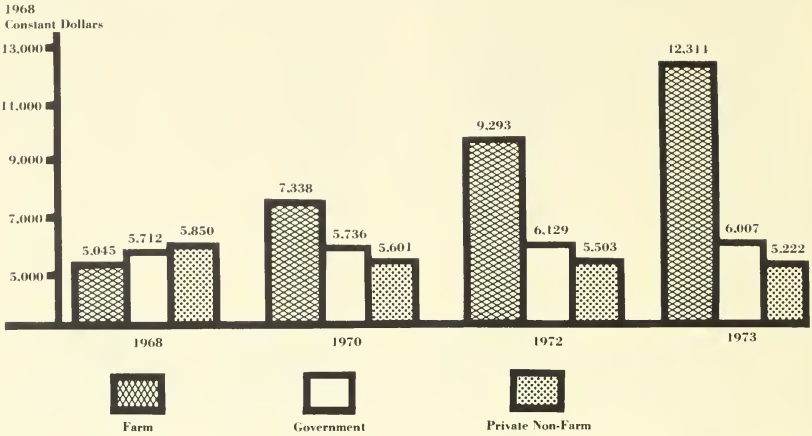


Source: Reference 197.

This may be due to both the relative increase in lower paid service workers and the increase in part-time employees.

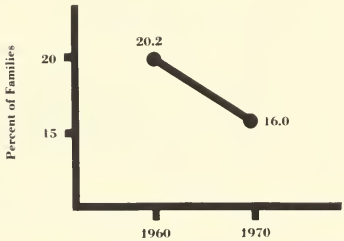
In the period 1959-1969, there was a net improvement in income distribution, computed as a decrease of about 20 percent in the number of low income families, those earning less than a minimal yearly income. However, in 1969 nearly 1 in 6 families could be classified as low income (Figure 33).

Figure 32. Montana Per Employee Earnings by Sector, 1968-1973.



Source: Reference 196.

Figure 33. Montana Families Earning Less than $3,000/Year in 1960 and Less than $4,000/Year in 1970.



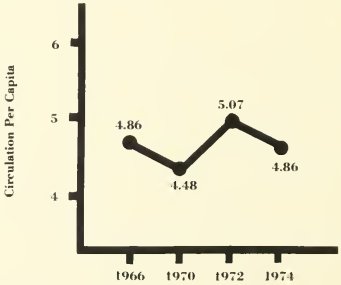
Source: Reference 198.

LIBRARY CIRCULATION

The Montana public library system has grown tremendously in the last 15 years as the result of the establishment of a number of library federations. Each federation includes a strong central library and provides extensive sharing of resources and services among member libraries.

The statewide trend in circulation of library holdings per capita over the past eight years is shown in Figure 34. The per capita circulation is the same as it was in 1966 with an interim peak in 1972 and a low in 1970 (146) (147) (148) (149). Average regional circulation rates vary considerably. Several factors account for this variation — federation participation, non-compulsory reporting of statistics and the differences in the areas included in federations and the areas included in the environmental regions.

Figure 34. Library Circulation in Montana, 1966-1974.

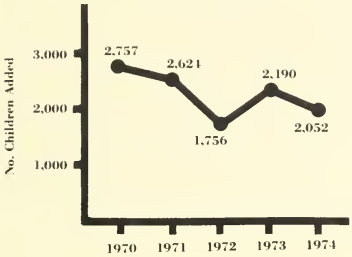


Sources: References 146, 147, 148, and 149.

CHILD WELFARE

Annual additions to the Child Welfare Services case load statewide from 1970 through 1974 are shown in Figure 35. Child welfare cases have generally decreased since 1970, with a resurgence of cases in 1973 (137).

Figure 35. Children Added to Child Welfare Services in Montana, 1970-1974.

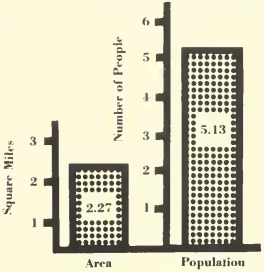


Source: Reference 137.

RURAL ROAD SYSTEM

The rural area and rural population served per mile of rural road in Montana are shown in Figure 36.

Figure 36. Rural Area and Population Served per Mile of Rural Road in Montana, 1970.



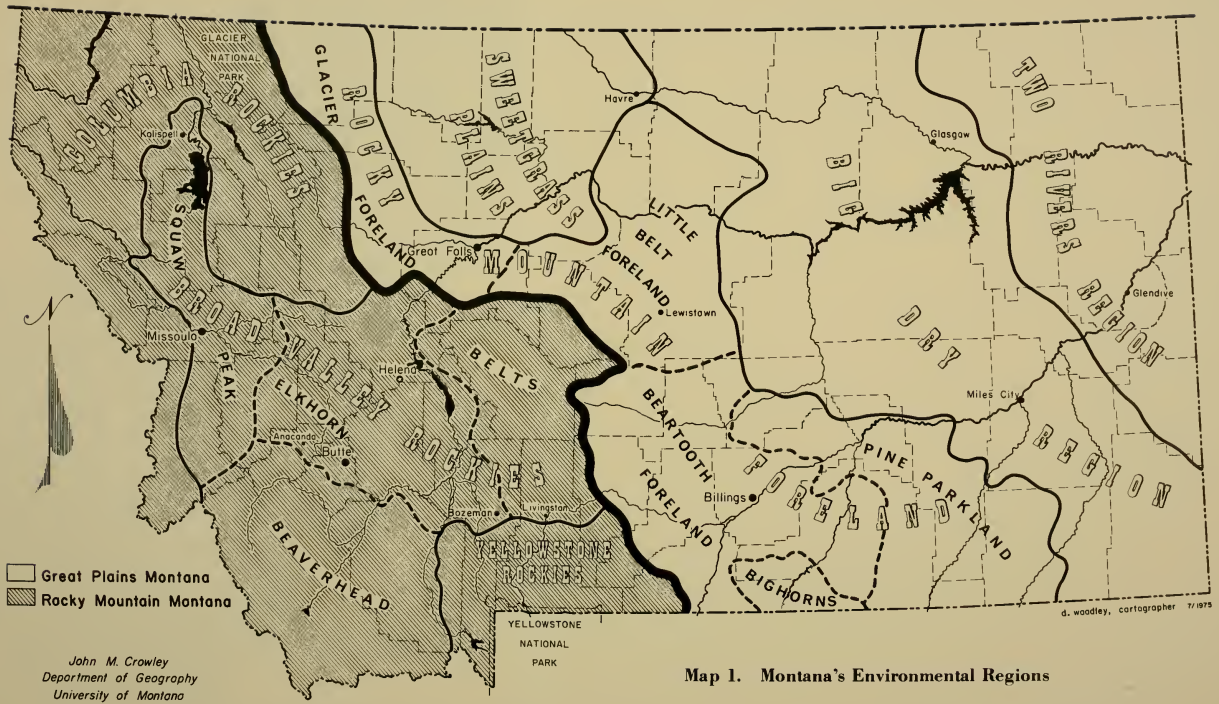
Sources: References 119, 130, and 153.

MONTANA'S ENVIRONMENTAL REGIONS

Geographically, Montana is a diverse and complex state. There actually are two Montanas: Rocky Mountain Montana and Great Plains Montana, with little in common except long term economic activities based on a renewable resource base and a common state government centered in Helena.

The environmental regions used as the reporting format in this report combine areas on the basis of natural and man-made similarities which, in the aggregate, delineate the regions into recognizable environmental units.

The environmental regions of Montana as developed by Professor John M. Crowley for EQC's *First Annual Report* (1972) and revised by him for presentation in this report are shown in Map 1. The indicators material for each region is preceded by a map and environmental perspective for that region. Each region is designed to stand alone as a study unit in this report.



John M. Crowley
Department of Geography
University of Montana

Map 1. Montana's Environmental Regions

ROCKY MOUNTAIN MONTANA

ENVIRONMENTAL PERSPECTIVE

The southwestern two-fifths of Montana lies within the Rocky Mountains. This is a land of high mountains and deep valleys, green forests and sparkling waters, dams and powerlines, sawmills, mines and smelters, irrigated farms and mountain ranches, spectacular scenery and outdoor recreation, heavily populated pockets and virtually uninhabited wildlands.

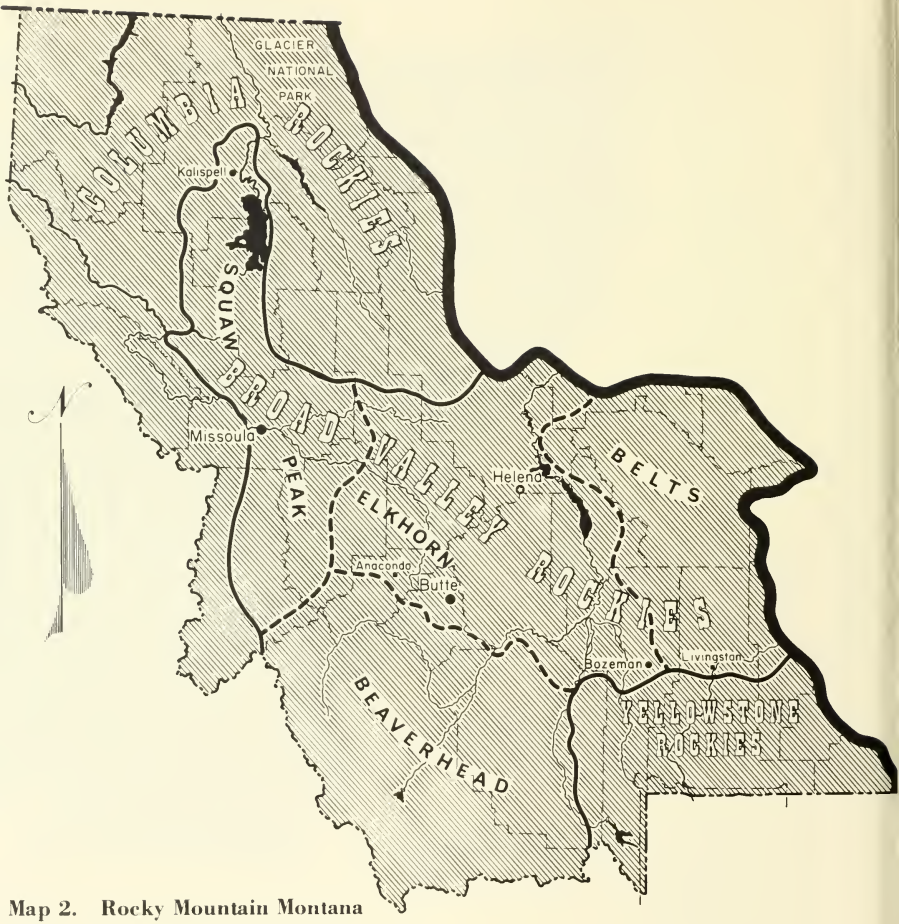
The widths of the valleys, amounts of precipitation, and resulting differences in settlement and economic activities in this sector delineate three environmental regions.

The northwestern and southeastern portions of the Rocky Mountain sector have narrow, humid valleys and generally humid mountainsides. These are the Columbia Rockies and Yellowstone Rockies environmental regions. Both are sparsely populated. Basically they are regions of outdoor recreation, timber supply, and water supply. The Columbia Rockies also have an important wood-processing industry and major hydroelectric power facilities.

The rest of Rocky Mountain Montana has broad, dry valleys. This is the heavily populated Broad Valley Rockies Region. In addition to the economic activities carried on in the other two mountain regions, this region embraces widespread agriculture, major mining, and important mineral processing.

Photo 6. Undisturbed subalpine habitat in Jewel Basin, Columbia Rockies.

Photo 7. Rhoda Lake, Little Belt Mountains, Broad Valley Rockies.



Map 2. Rocky Mountain Montana

ROCKY MOUNTAIN MONTANA

ENVIRONMENTAL PERSPECTIVE

The southwestern two-fifths of Montana lies within the Rocky Mountains. This is a land of high mountains and deep valleys, green forests and sparkling waters, dams and powerlines, sawmills, mines and smelters, irrigated farms and mountain ranches, spectacular scenery and outdoor recreation, heavily populated pockets and virtually uninhabited wildlands.

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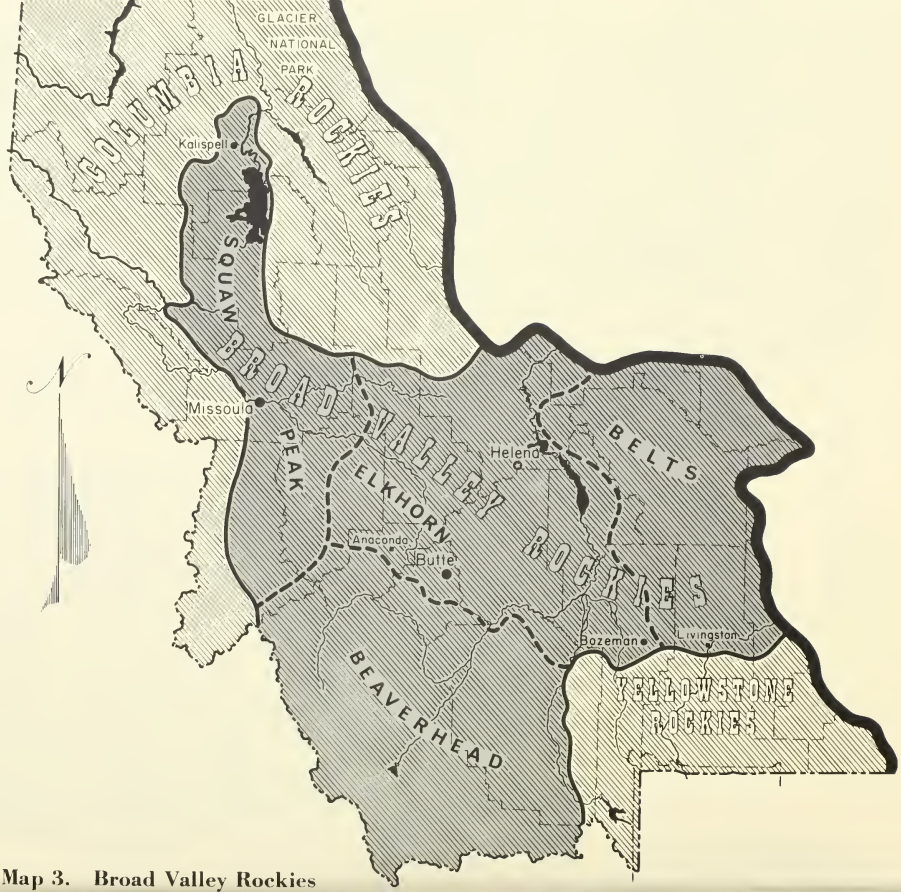


Map 3. Broad Valley Rockies

BROAD VALLEY ROCKIES

ENVIRONMENTAL PERSPECTIVE

The Broad Valley Rockies is a region of high mountain ranges separated by broad valleys. It is a heavily populated region and has a rather complex economy that revolves around farming and ranching, logging and sawmilling, mining and metallurgy, water supply and hydroelectric power, scenery and recreation, and transportation and services.

The Broad Valley Rockies constitute the most densely populated region both of Rocky Mountain Montana and the entire Rocky Mountain system. Montana is the only Rocky Mountain state or province having its capital, its major universities, several of its principal cities and towns, and much of its manufacturing industry in the Rockies rather than on the Great Plains or in the Intermountain Region. Missoula is the largest city within the Rocky Mountains. (Denver is at the foot of the Rockies.) The second and third largest cities in the Rocky Mountains are Butte and Helena, and Bozeman may be the fourth largest. All these cities are in the Broad Valley Region which also encompasses Kalispell, another of the dozen regional trade centers of the state, and several other large towns of Montana: Anaconda, Livingston, Dillon, Deer Lodge, Hamilton, Whitefish, Columbia Falls, and Polson.

The region is bisected by the Yellowstone-Clark Fork corridor and traversed by the two main north-south routes crossing Montana. The Yellowstone-Clark Fork axis is the "Main Street" of Montana and one of the country's principal transcontinental routes. It is followed by Interstate 90-94, U.S. 10, the southern mainline of the Burlington Northern Railroad, and multiple utility lines, both aerial and underground. For long distances it is also followed by the main line of the Milwaukee Road. The north-south arteries are U.S. 93 along the Bitterroot-Flathead route — the more important of the two in the amount of traffic — and Interstate 15 through Dillon, Butte, and Helena. In terms of traffic and communications the Broad Valley Rockies possess a great deal of internal cohesion; that is, there is considerable "pull" from nearly all parts of the region towards the Butte-Helena core.

Photo 9. Central business district, Butte.

Photo 8. Eighteenmile Peak and the Beaverhead Mountains in the Bitterroot Range south of Dillon.

The major corridors and rather dense network of communication lines make nearly all parts of the region quite accessible. Wilderness areas exist but are small. Although the forested mountainsides and rocky crestlines are enclosed in national forests, the broad valley bottoms and grassy foothills are almost entirely in private ownership and, hence, available for development with few controls. The proliferation of country homes occupied by urban (usually white-collar) workers is rampant. The rather dense rural settlement, large urban centers, busy transportation corridors, and intensive economic activities have greatly modified the natural environment and are themselves integral components of the present human environment.

Three factors underlie the region's dense population and complex economy. First is the spacing of the mountain ranges. The region is characterized by mountains with broad valleys, in contrast to (a) mountains with narrow valleys, as in the Columbia and Yellowstone Rockies, and (b) widely spaced mountain ranges separated by broad

basins, as in Nevada. The second factor is the amount of precipitation, which is less than in the other two regions of Rocky Mountain Montana but more than in the basin-and-range country of Nevada. The third is the presence of mineralized rocks.

The mountain ranges are humid and the valley bottoms dry. The climate of the valley bottoms, where most of the people live, is semiarid with a cold winter, a warm summer, and scant precipitation the year around. This climatic belt is called the steppe zone. It is similar to the semiarid climate of Great Plains Montana, although summers are not quite so warm and winters not quite so cold (except in the higher valleys) as in eastern Montana. The scant precipitation, compared to that of more humid valleys, greatly reduces winter snow removal problems but makes irrigation necessary for hay and most other crops. The dryness of the air mitigates the impact of severe cold or intense heat.

The broad valley bottoms provide much space for farming and the humid mountain ranges supply plenty of water for irrigation. The nonirrigated portions of the valley bottoms, the prairie foothills, and the forested mountain slopes provide considerable grazing. Agriculture, both irrigated farming and livestock ranching, is of major importance in the region. The prairie, or foothill, zone is subhumid. Its rough fescue prairie is better for grazing than the bluebunch wheatgrass community of the steppe zone. The irrigated farms, and the hay meadows of the livestock ranches, are mainly on the floodplains and on the terraces of the steppe zone.

The Broad Valley Rockies and the Yellowstone Rockies fall within the Rocky Mountain Douglas-fir Forest Region. In this vegetational region, the principal climax types are Douglas-fir forest in the montane zone and subalpine fir-Engelmann spruce forest in the subalpine zone. As a result of fires and logging, much of the timberland is today covered with seral forests of lodgepole pine and ponderosa pine. The forests of the Broad Valley Rockies are somewhat less dense and luxuriant, due to less humid conditions, than those of the Yellowstone Rockies. This makes them better for grazing but less productive for timber supply. Nevertheless, the Broad Valley Rockies have a significant logging industry. The logs cut in the region, together with those hauled in from adjacent mountain regions, are the basis of the major wood-processing industry of the region. Within the Rocky Mountains, Missoula is not only the largest city but also the most important wood-products center. Other important wood-processing towns receiving most of their logs from the Columbia Rockies are Kalispell, Columbia Falls, Polson, and Darby. Those obtaining most of their logs from the Yellowstone Rockies are Livingston, Bozeman, and Belgrade. And those supplied mainly with logs from the Broad Valley Region itself are Dillon, Deer Lodge, Philipsburg, Townsend, and White Sulphur Springs.

Much of Montana's hard-rock mining has been based on the mineralized rocks of the Boulder Batholith. Today the lion's share of the metals mining is at Butte, near the center of the batholith. The Berkeley and Continental East

Photo 10. Cherry orchard in bloom, Flathead Valley.

pits, ore concentrator, extensive mine dumps, and "gallows frames" of the numerous shaft mines underlying the city are as much a part of the Butte environment as are "The Hill," "The Flat," and the deteriorated condition of much of the Mining City. Ore from Butte and some from Nevada is smelted in the giant metallurgical complex at Anaconda. Man-made land consisting of the solid refuse from nearly a century of smelting extends from Anaconda to beyond Warm Springs in the Deer Lodge Valley. The smelted copper goes to the copper refinery at Great Falls. The aluminum mill at Columbia Falls, based on cheap hydroelectricity from the Columbia Rockies, and the lead-zinc smelter at East Helena complete the metallurgical picture in the Broad Valley Rockies. Minor mining and mineral processing involving non-metals include phosphate mining near Garrison, phosphate processing at Garrison, phosphorus processing near Butte, talc mining in the Beaverhead subregion, and talc processing at Dillon and Three Forks.

The forested mountainsides of the Broad Valley Rockies supply considerable water, although much less than those of the other two regions of Rocky Mountain Montana. There is substantial withdrawal of stream water for irrigation. Total outflow from the region is not very impressive. Water development in the region has resulted in the creation or increase in size of three of the more significant lakes in the state — Flathead, Canyon Ferry, and Georgetown. Kerr and Canyon Ferry dams are important power producers.

The mountains of the Broad Valley Rockies vary from low, rounded, grassy, unimpressive ones to high, rugged, forested, spectacular ranges. The width of the broad valleys permits sweeping, panoramic views of the mountain ranges. The beautiful scenery, pleasant lakes, and easy accessibility are the basis of a major outdoor recreation industry, including 12 of Montana's 27 skiing centers. Missoula and Kalispell are the most important tourist service centers, but virtually every town and village in the region serves some

recreational function. Those near the Columbia and Yellowstone regions serve the recreation industry of those regions as well as that of the Broad Valley Rockies.

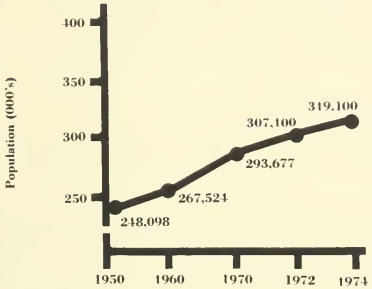
This region is unique in terms of the spacing of the mountain ranges, dense population and large towns, and balanced combination of economic activities. There is none other like it in the world. The land has been rather drastically modified by human action. And the Squaw Peak and Elkhorn subregions, the most urbanized and industrialized of the subregions, are plagued by frequent smog, polluted water, industrial refuse dumps, and scarred mountainsides.

POPULATION SIZE AND DENSITY

The Broad Valley Rockies had a population increase of over 71,000 persons in the period 1950 to 1974, or about 50 percent of the state's total. The region also had the greatest population increase among the regions during the past four years, over 25,000 persons (Figure 37). This growth can be attributed largely to four counties: Missoula, Flathead, Gallatin, and Lewis and Clark.

The Broad Valley Rockies have the highest population density among the regions: almost eight persons per square mile (Figure 38).

Figure 37. Broad Valley Rockies Population, 1950-1974.

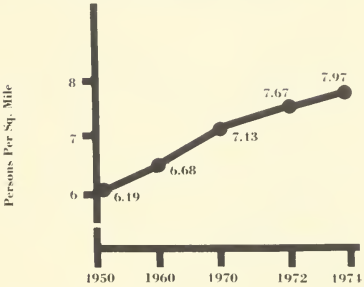


Sources: References 198, 216, and 217.

POPULATION DISTRIBUTION

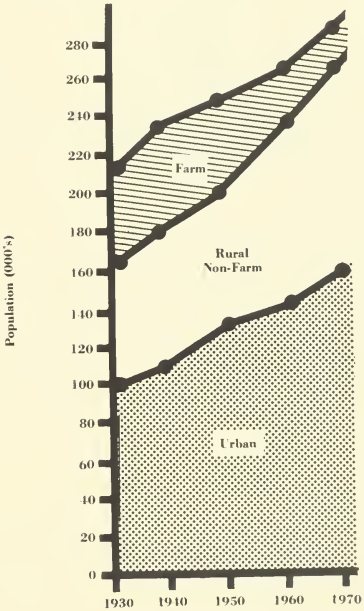
The Broad Valley Rockies have long been one of the more heavily urbanized areas of the state. As far back as 1930, nearly half the population of the region lived in urban areas, and the farming population was even then the smallest segment. The numbers of people in the region classified as urban, farm, and rural non-farm as shown in Figure 39 and Figure 40 have generally followed the state-

Figure 38. Broad Valley Rockies Population Density, 1950-1974.



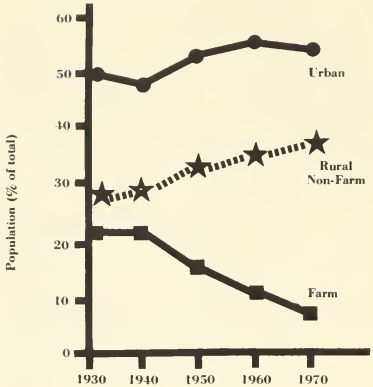
Sources: References 198, 216, and 217.

Figure 39. Broad Valley Rockies Urban, Farm, and Rural Non-Farm Population, 1930-1970.



Source: Reference 119.

Figure 40. Broad Valley Rockies Urban, Farm, and Rural Non-Farm Population by Percent, 1930-1970.



Source: Reference 119.

wide trend, though the urban percentage has held relatively steady, while the rural non-farm population has had the largest growth in relative size (119).

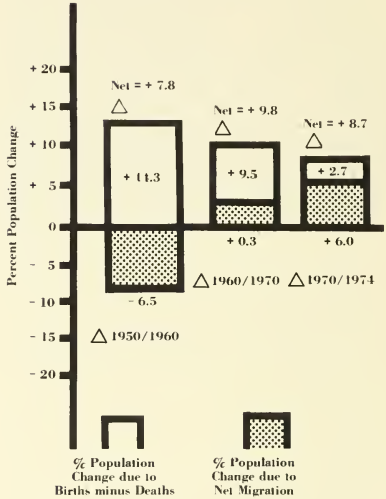
POPULATION CHANGE

The population of the Broad Valley Rockies has been growing at about 8 percent each decade over the last 24 years. From 1950 to 1960 this increase was due entirely to births; however, since 1960 there also has been a net migration into the region which has been increasing in recent years. On the other hand, the net increase of births over deaths has been decreasing since 1950. The Broad Valley Rockies was the fastest growing region in Montana from 1970 to 1974 (Figure 41).

ENERGY

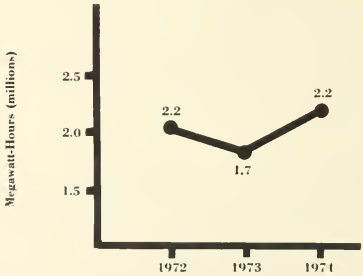
The Broad Valley Rockies' primary energy resource is hydroelectric power. The region contains 18.3 percent of Montana's installed capacity (Table 8) and in 1974 accounted for 22.4 percent of Montana's net hydroelectric generation (Figure 42). The region also has a very minor amount of potentially recoverable coal, 37 million tons (Table 9).

Figure 41. Broad Valley Rockies Population Changes (△) Reflected by Births minus Deaths and Net Migration, 1950-1974.



Sources: References 198 and 217.

Figure 42. Broad Valley Rockies Hydroelectric Generation, 1972-1974.



Sources: References 64, 144, and 218. Figures represent net hydroelectric power generation, exclusive of plant use.

Table 8. Broad Valley Rockies Installed Hydroelectric Generating Capacity, 1973.

Maximum Nameplate Rating (Kw-Hours)
277,900

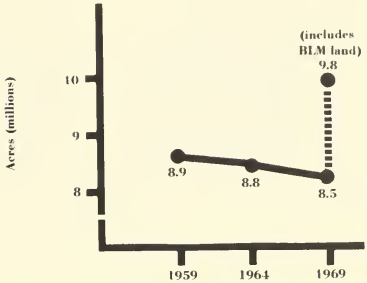
Source: Reference 164.

Table 9. Broad Valley Rockies Potentially Recoverable Coal Reserves, 1973.

Coal Type	Millions of Tons
Surface	
Lignite	34
Underground	
Bituminous	3
Total	37

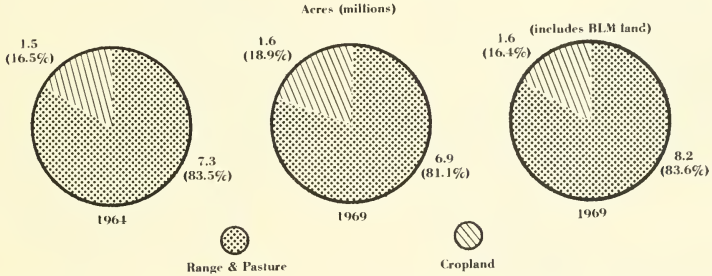
Source: Reference 213.

Figure 43. Broad Valley Rockies Agricultural Land in Farms, 1959, 1964, and 1969.



Sources: References 150 and 195.

Figure 44. Broad Valley Rockies Distribution of Agricultural Land, 1964 and 1969.



Sources: References 150 and 195.

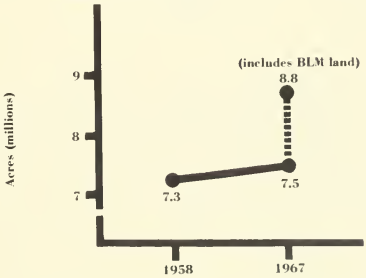
LAND RESOURCES

In 1969 the Broad Valley Rockies contained about 10 percent of the cropland in the state and about 15 percent of the range and pastureland, or about 1.5 and 8 million acres respectively, including BLM land, depending upon which data are used. There was about a 150,000 acre increase in cropland in the last 5 to 10 years (Figures 43, 44, 45, and 46).

The Broad Valley Rockies contain over 5 million acres of commercial forestland, about 37 percent of the state's total, split almost evenly between private and state, and federal control. The region contains about 7.5 million acres of forestland, 38 percent of the state's total (Figure 47).

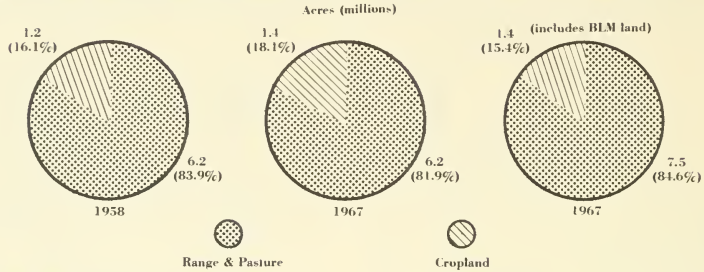
Commercial federal forestland showed a decrease of 1.2 million acres in the period 1970-74 (Figure 48). About 32 percent of the federal commercial forestland is in the

Figure 45. Broad Valley Rockies Cropland, Range and Pasture, 1958 and 1967.



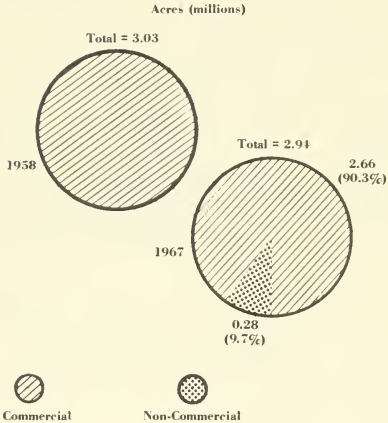
Sources: References 150, 151, and 152. The Dillon and Missoula BLM Districts are included in the Broad Valley Rockies.

Figure 46. Broad Valley Rockies Distribution of Cropland, Pasture and Range, 1958 and 1967.



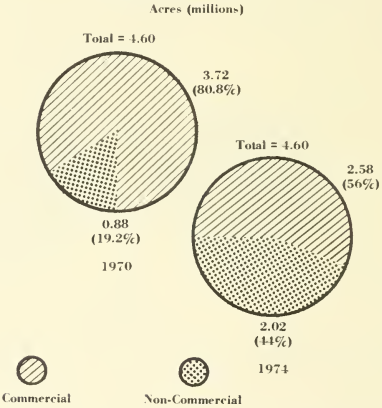
Sources: References 150, 151, and 152.

Figure 47. Broad Valley Rockies Private and State Forestland, 1958 and 1967.



Sources: References 151, 152, and 153.

Figure 48. Broad Valley Rockies Federal Forestland, 1970 and 1974.



Sources: References 41 and 50. Figures exclude lands under reserved or wildland classifications and include Beaverhead, Deer Lodge, and Lewis and Clark National Forests.

Broad Valley Rockies. The region contains about 43 percent of Montana's private and state commercial forestland.

The Broad Valley Rockies contain about one-quarter of all wildlands in Montana (76). These include many roadless areas and areas under study for inclusion in the National Wilderness Preservation System as well as three areas already included in the system: the Anaconda-Pintlar and Gates of the Mountains wildernesses and the Humbug Spires Primitive Area. The Red Rock Lakes are being proposed for Wilderness status by the U.S. Fish and Wildlife Service and the Centennial Mountains are proposed for Primitive status by the Bureau of Land Management (Table 10).

Table 10. Broad Valley Rockies Wildlands, 1975.

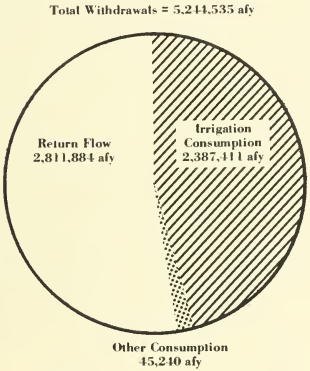
Classification	Acres
Wilderness	187,648
Proposed Wilderness	32,350
Primitive	7,041
Proposed Primitive	102,850
New Study Areas	185,682
Proposed New Study Areas	402,000
Roadless Areas (USFS)	1,657,026
Roadless Areas (BLM)	?

Source: Reference 76.

WATER RESOURCES

The Broad Valley Rockies is the region of greatest water diversion and consumption in Montana, accounting for fully 40 percent of the water diverted and consumed in the state (134). The region is relatively well watered, although peaks in demand and seasonal low flows often coincide to produce chronic dewatering (Figure 49). According to the Department of Health and Environmental Sciences, about 200 miles of the Beaverhead, Bitterroot, West Gallatin, Big Hole and Jefferson rivers suffer from dewatering, elevated temperatures and attendant deterioration of instream values as a result of agricultural diversion (129). These rivers total about 484 miles in length. Short sections of 20 additional rivers and streams are also affected by dewatering in the region (129).

Figure 49. Broad Valley Rockies Water Withdrawals and Consumption of Withdrawals, 1970.



Source: Reference 134.

MINERAL RESOURCES

Except for gold, almost all of Montana's strategic metals (copper, lead, zinc, manganese and silver) are produced in the Butte mining district, an area approximately three miles wide by five miles long. Montana has 53 gold mining districts in 17 counties, most of which are in the Broad Valley Rockies.

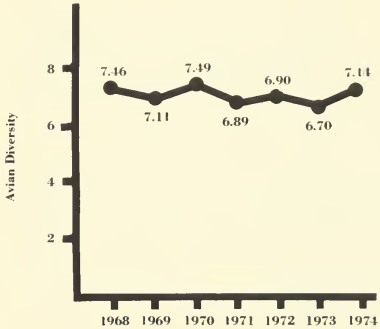
Production of lead, silver and zinc has declined appreciably in recent years. Gold production has declined since 1964 but now appears to be on the rise again. (See Figures 17 and 18 in Statewide Summary.)

Copper appears to be the only strategic Montana metal experiencing a significant increase in production (Figure 18). Even with the current energy crunch and recent emphasis on mineral fuels production, copper in 1974 remained the single most valuable mineral commodity produced in Montana (207).

WILDLIFE DIVERSITY

The average avian diversity computed for the 11 survey routes in the Broad Valley Rockies has remained relatively stable over the last seven years (212) (Figure 50). Aside from the Yellowstone Rockies, which has only one survey route (shared jointly with the Broad Valley Rockies), this region has the highest average breeding bird diversity of all the environmental regions in the state. A perennial problem for wildlife in the Broad Valley Rockies is the loss of habitat to rural subdivision and recreational real estate development (85) (178). Although no one knows exactly how much deer and elk range has been lost in recent years, a study just completed by a University of Montana graduate student documents the typical changes in animal movements and behavior coincident with the rapid suburbanization of a western Montana valley (93).

Figure 50. Broad Valley Rockies Avian Diversity, 1968-1974.



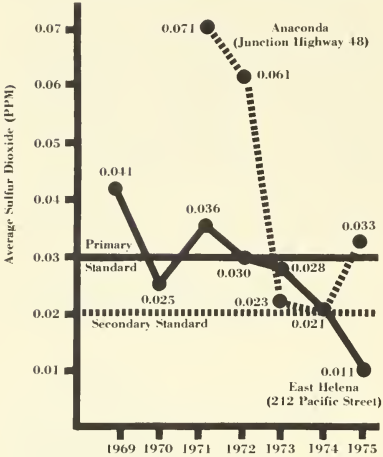
Source: Reference 212.

AIR QUALITY

The climate and topography of the Broad Valley Rockies lend themselves to frequent episodes of inversion, a situation where masses of still air are trapped in pockets for hours or even days at a time. This relatively poor ventilation combines with heavy population and industry to make the Broad Valley Rockies one of the most problem ridden regions in terms of air pollution. Six of the nine state air pollution "hot spots" are located in this region:

Anaconda. Between 1969 and 1973 some of the highest death rates in the state for a number of respiratory and circulatory diseases were recorded in Deer Lodge and Silver Bow counties, presumably caused by a combination of mining and smelting operations, dusty roads and streets and

Figure 51. Annual Average Sulfur Dioxide Levels Recorded at East Helena and Anaconda, 1969-1975.



Sources: References 88 and 124. Sulfur dioxide levels derived from sulfation plate readings, applying a factor of 0.035.

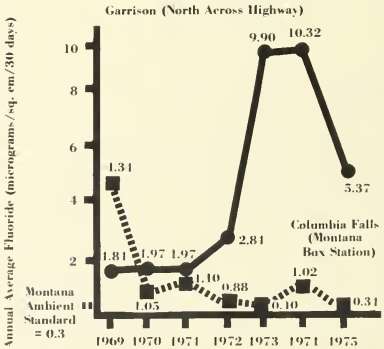
poor atmospheric conditions (55) (106). However, sulfur dioxide, as measured by the sulfation plate technique, has declined abruptly in recent years at the Highway 48 Junction (Figure 51), the station normally recording the greatest amount of pollution from the Anaconda Company's copper reduction works. For 1973 and 1974, the last complete data years, sulfur dioxide levels were below the federal ambient primary standard and almost below the more strict secondary standard (124). The company is presently operating under a variance negotiated in 1974 with the Department of Health and Environmental Sciences. Also in the area, the Stauffer Chemical Company plant near Butte has been served notice by the State Board of Health to reduce its fluoride emissions, which exceed state standards (100).

Columbia Falls. The major polluter here is the Anaconda Aluminum Company and the pollutant of most concern is fluoride. Fluoride levels have declined in recent years, even approaching the Montana ambient standard (Figure 52), but much remains to be done. Late in 1974, following negotiation with the Department of Health and Environmental Sciences for a five-year compliance schedule, the plant emitted between 1,800 and 2,000 pounds of fluorides a day compared with the state standard of 864 pounds (95). In addition to killing many trees near the plant, fluoride emissions have caused timber growth losses amounting to 404,695 board feet during the period 1968-1973 (38).

East Helena. In 1969 and 1970, ambient concentrations of sulfur dioxide in the Helena Valley exceeded levels considered to have deleterious effects on human health, vegetation and materials (210). For the last three years, average levels of sulfur dioxide near the American Smelting and Refining Company's (ASARCO) smelter have been at or below the federal primary standard but above the secondary standard (Figure 51). However, on January 31 and February 1, 1975, sulfur dioxide in the Helena Valley rose to above the "warning" level of 0.6 parts per million over a 24-hour period as the result of a strong inversion episode. This was the highest reading ever recorded in the area (10). Chronic exposure to sulfur compounds in the air has been linked to the incidence of respiratory problems in three Utah communities (109). ASARCO is the third of Montana's big three air polluters to have negotiated a long-term variance agreement with the Department of Health and Environmental Sciences.

Garrison. The Rocky Mountain Phosphate Company has had problems recently in controlling fluoride emissions from its cooling ponds (123). Average annual fluoride concentrations at a representative station nearby were on the order of 30 times greater than the Montana ambient standard in 1973 and 1974 (Figure 52). Early 1975 fluoride levels were appreciably lower, but still well above the ambient standard. This was likely the result of a 50 percent cut in plant production last winter due to a depressed market for calcium phosphate cattle feed supplement. Rocky Mountain Phosphate is now working with the Department of Health and Environmental Sciences on a pollution control plan to bring the plant into compliance with state clean air standards (20).

Figure 52. Annual Average Fluoride Concentrations Recorded at Garrison and Columbia Falls, 1969-1975.



Source: Reference 124. Fluoride concentrations determined by calcium formate paper method.

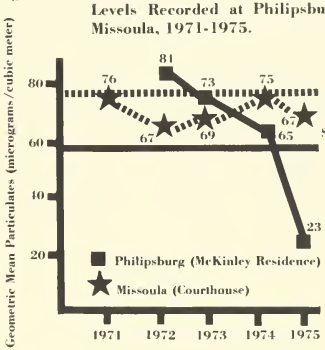
Missoula. Particulate levels at the Missoula County Courthouse, derived in part from the wood products industries in the area and in part from dusty streets and other sources, have been fluctuating on either side of the federal ambient primary standard since 1971 (Figure 53). A study released in 1972 found a positive correlation between the monthly hospital admission rate for acute upper respiratory infection and the average monthly particulate level in Missoula (114). A more recent student study, however, found no correlation between total particulate in the air and hospital respiratory admissions, but did conclude these admissions rise and fall along with soluble sulfate concentrations in the air (27). Efforts by a group of concerned Missoula citizens to fund additional health-oriented pollution studies have been thwarted, even though the Hoerner Waldorf company is proposing a major plant expansion (23). Violations of state clean air standards are now occurring at the U.S. Plywood mill in Bonner and the Evans Products particle board factory in Missoula (99).

Philipsburg. This little town on the west slope of the Flint Creek Range has long experienced particulate pollution from two saw mills and dusty roads and streets. Recently, however, one of the mills announced its closure (24) and with the teepee burner of the other mill inoperable (43), particulate levels in Philipsburg have been dropping since 1972 (Figure 53).

Flathead Valley. The Flathead Valley has historically recorded some of the highest particulate levels in the state, the consequence of slash and open burning, teepee burners, road dust and poor ventilation (145). It is perhaps no coincidence, then, that Lake County had the state's highest death rate from asthma, emphysema and bronchitis during the period 1969 to 1973 (55) (107). The C & C Plywood Company of Kalispell is currently violating state clean air standards (99).

Overall, air pollution from major sources is declining in the Broad Valley Rockies. This is primarily the result of two factors: a depressed economy and pollution control efforts by industry mandated by Clean Air Act deadlines and variances negotiated with the Department of Health and Environmental Sciences.

Figure 53. Annual Geometric Mean Particulate Levels Recorded at Philipsburg and Missoula, 1971-1975.

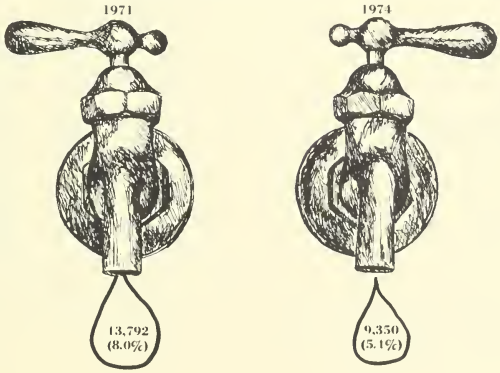


Source: Reference 124. Measurement method was gravimetric using a high volume sampler.

WATER QUALITY

In spite of a sizeable increase in the population served by public water supplies from 1971 to 1974, (173,000 to 184,000) the number of people delivered unsatisfactory water in the Broad Valley Rockies decreased by over 4,000 (Figure 54). Nevertheless, over 5 percent of the region's

Figure 54. Broad Valley Rockies Population Delivered Unsatisfactory Drinking Water, 1971 and 1974.

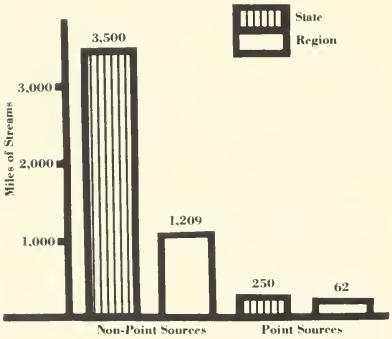


Source: Reference 47.

population was delivered unsatisfactory water (by bacteriological standards) in 1974 (47).

The Broad Valley Rockies have the greatest number of stream miles in the state known to be degraded by either point or non-point pollution sources (Figure 55). The region has several major municipal dischargers plus three of the state's prinicpal industrial water polluters: American Smelting and Refining Company, Anaconda Company, and Hoerner Waldorf Corporation. Much of the non-point source pollution in the region comes from sediment, dewatering and elevated water temperatures, and nutrients derived from agriculture, logging, mineral exploration and extraction (36) (129). In addition to the extensive non-point source pollution there is a loss of fish habitat in many of the region's streams: a 1973 Department of Fish and Game study of 160 miles of six quality fishing streams in the Broad Valley Rockies revealed that 24 miles of streambed were recently altered with dragline or bulldozer and artificial shoreline alterations were accomplished on 44 additional miles (116). Water quality degradation in the Bitterroot drainage recently was reported to be primarily "the result of activities in the valley and not in the (upper) watershed" (182).

Figure 55. Broad Valley Rockies Point and Non-Point Source Stream Degradation, 1975.

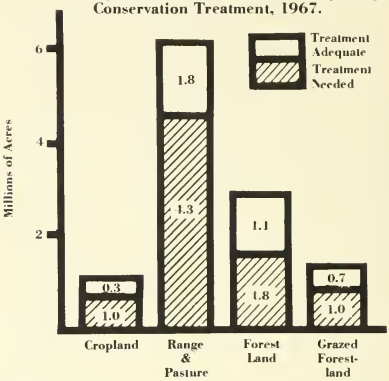


Source: Reference 129.

LAND QUALITY

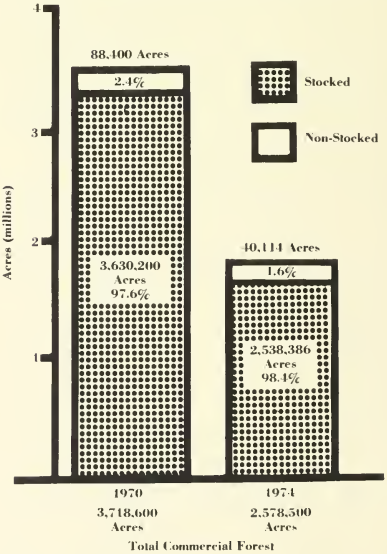
Range and pasture represent the largest agricultural land use in the Broad Valley Rockies. Over 50 percent of all agricultural land in the region was in need of conservation treatment in 1967 (153) (Figure 56). Many streams in the

Figure 56. Broad Valley Rockies Private and State Agricultural and Forestland Requiring Conservation Treatment, 1967.



Source: Reference 153.

Figure 57. Broad Valley Rockies Stocked and Non-Stocked Commercial Forest under USFS Management, 1970 and 1974.



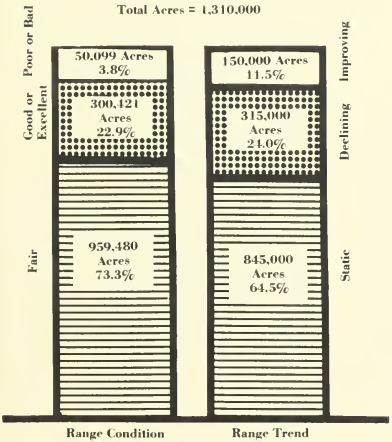
Sources: References 41 and 66.

region suffer from excessive sediment but little is known of the current status of conservation measures being conducted in these drainages (129).

The major portions of four national forests are included within the Broad Valley Rockies: Lewis and Clark, Deer Lodge, Helena, and Beaverhead. As in all other forests in Montana, these forests experienced a decline in commercial acreage (both stocked and non-stocked) between 1970 and 1974, apparently due to a change in classification which removed from commercial consideration many fragile and relatively inaccessible high elevation areas (41) (50) (66) (Figure 57). Forest insects and disease are also a serious problem in the Broad Valley Rockies (115).

Most of the Bureau of Land Management (BLM) lands in the Dillon and Missoula districts of western Montana are found in the Broad Valley Rockies. These lands amount to about 14 percent of all BLM lands in Montana. Range conditions in the Broad Valley Rockies appeared to be inferior overall in 1963-1964 when compared to conditions in the Big Dry and Rocky Mountain Foreland, with a substantial percentage of the land — 73.3 percent — rating only a "fair" appraisal. For the same period, while most of the range land condition remained static, the amount of land worsening was double that of the land improving (49) (Figure 58).

Figure 58. Broad Valley Rockies Range Condition and Trend for Land under BLM Management, 1963-1964.

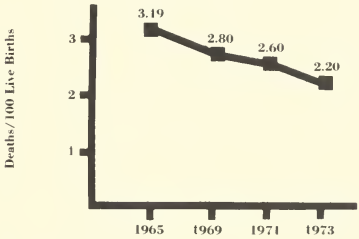


Source: Reference 49.

HEALTH STATUS

The Broad Valley Rockies have witnessed the most improvement in the perinatal death rate during the period 1965-73 and now have the second best rate in the state (Figure 59). However, the region also has the second worst health status index (compiled by county) in the state (Table 11). As indicators of health status, however, the two measures are mutually inconsistent.

Figure 59. Broad Valley Rockies Perinatal Death Rate, 1965-1973.



Sources: References 118 and 125.

Table 11. Broad Valley Rockies Health Status Index, 1968-1972.

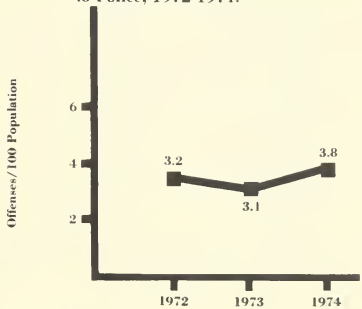
379.4

Source: Reference 78.

CRIME

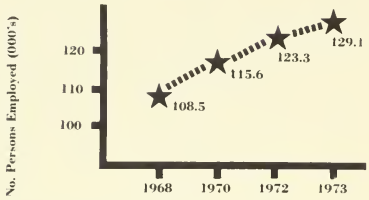
The incidence of crime in the Broad Valley Rockies has not changed appreciably over the last two years and has remained close to the state average (Figure 60).

Figure 60. Broad Valley Rockies Offenses Known to Police, 1972-1974.



Source: Reference 52.

Figure 61. Broad Valley Rockies Total Employment, 1968-1973.



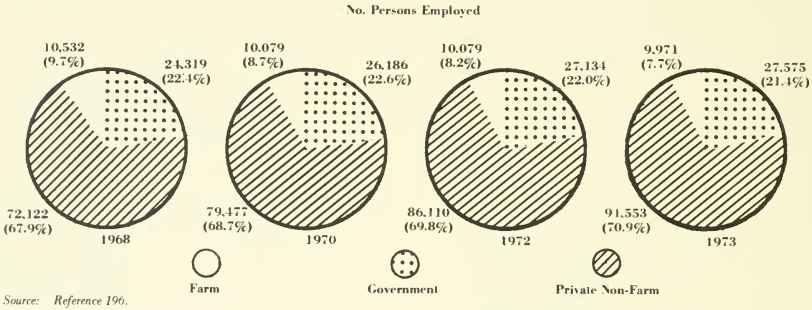
Source: Reference 196.

EMPLOYMENT

The Broad Valley Rockies added over 20,000 jobs during the period 1968-1973 or almost a 20 percent increase, the highest in the state (Figure 61). This employment growth was led by the private non-farm sector which contributed over 19,000 of the new jobs. The government sector's percent of total jobs remained fairly stable and contributed the remainder of the new positions. The farm sector had a decrease in employment of over 500 jobs contributing to its continued decrease in importance relative to the other sectors (Figure 62).

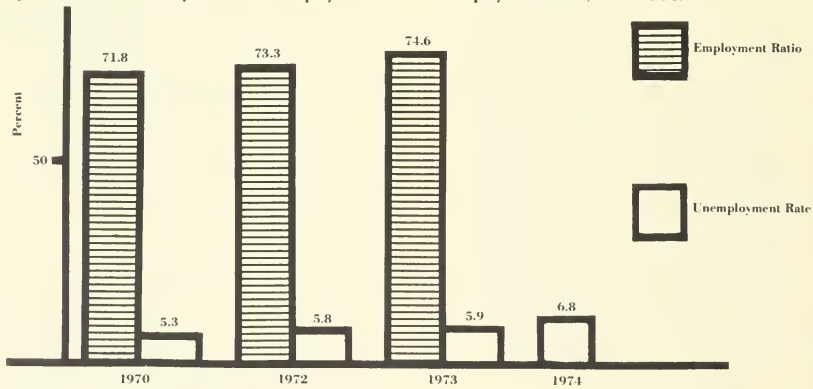
In 1973 the Broad Valley Rockies had the lowest employment ratio of any region in the state and in 1974

Figure 62. Broad Valley Rockies Employment by Sector, 1968-1973.



Source: Reference 196.

Figure 63. Broad Valley Rockies Unemployment Rate and Employment Ratio, 1970-1974.



Sources: References 131 and 196. Unemployment rate computed using state Department of Labor and Industry Montana Labor Market Area data for Bozeman, Butte, Helena, and Missoula.

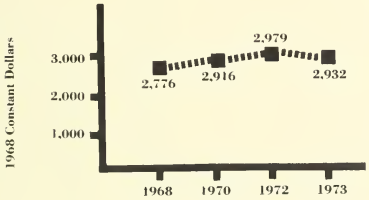
recorded an unemployment rate second only to the Columbia Rockies. While jobs were being added through 1973, the unemployment rate increased 1.5 percent during the period 1970-1974, mirroring the general statewide trend of a civilian labor force increasing in size faster than new jobs are being formed (Figure 63).

INCOME

The Broad Valley Rockies had an increase in real per capita personal income (PCPI) of between 5 and 6 percent over the five-year period with both the rate of increase and income figures remaining below the state average. In fact, 1973 showed a decline in real per capita income contrary to the statewide increase in that year (Figure 64). There was a strong five-year increase in real earnings per employee (EPE) in the farm sector, about 15 percent per year. The government sector had a slight increase while the private non-farm sector showed a decrease in real EPE (Figure 65).

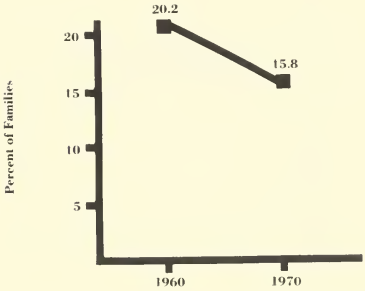
The percentage of families earning subsistence incomes fell from about one in five, to one in six, consistent with the statewide trend (Figure 66).

Figure 64. Broad Valley Rockies Per Capita Income, 1968-1973.



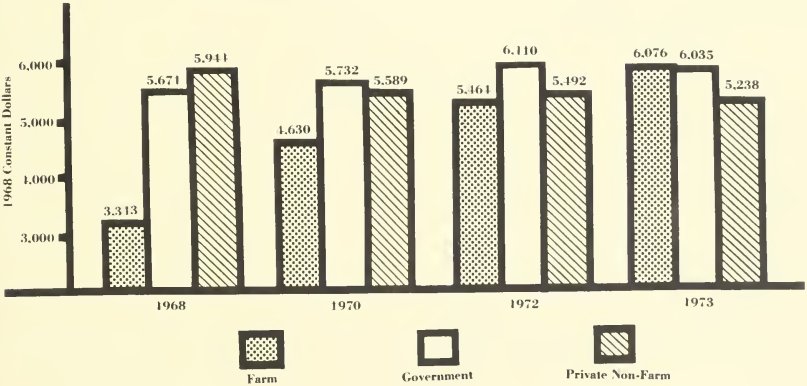
Sources: References 196 and 197.

Figure 66. Broad Valley Rockies Families Earning Less than $3,000/Year in 1960 and $4,000/Year in 1970.



Source: Reference 198.

Figure 65. Broad Valley Rockies Earnings Per Employee, 1968-1973.

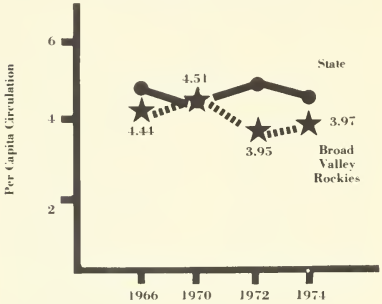


Source: Reference 196.

LIBRARY CIRCULATION

The Broad Valley Rockies Region includes Lewis and Clark, Beaverhead, Broadwater, Jefferson, and Madison counties, which participated in the Big Sky Federation of Libraries from 1966-1970. The additional services provided by the library system — access to more books, bookmobile service, etc. — contributed to increased circulation for the area, decreasing after the federation demonstration project was ended (Figure 67).

Figure 67. Broad Valley Rockies Library Circulation, 1966-1974.

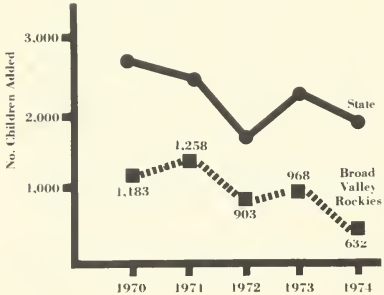


Sources: References 146, 147, 148, and 149.

CHILD WELFARE

The number of children added to the Child Welfare Services case load in the Broad Valley Rockies has generally declined since 1970 (Figure 68).

Figure 68. Broad Valley Rockies Children Added to Child Welfare Services, 1970-1974.

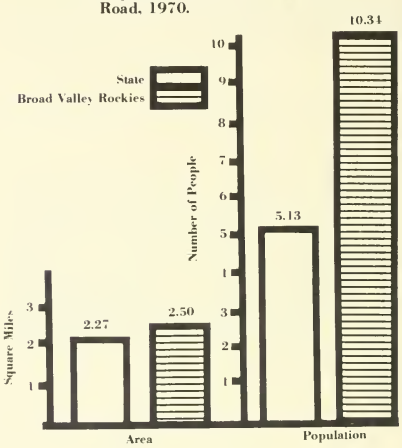


Source: Reference 137.

RURAL ROAD SYSTEM

The Broad Valley Rockies Region is the most populous in the state and a large portion of that population is rural. It is no surprise that each mile of rural road serves a relatively large number of people. The area served is slightly more than the state average, reflecting the large areas of sparse population and few roads in the ranching regions of Beaverhead and Madison counties (119) (130) (153) (Figure 69).

Figure 69. Broad Valley Rockies Rural Area and Population Served per Mile of Rural Road, 1970.



Sources. References 119, 130, and 153.

Map 4. Columbia Rockies

COLUMBIA ROCKIES

ENVIRONMENTAL PERSPECTIVE

Northwestern Montana is the most humid and heavily forested region of the Treasure State. It is the most important region in timber supply, water supply, and hydropower. It remains the most wild and unspoiled area of Montana. In terms of attractions for outdoor recreation, particularly wilderness experience, it is unsurpassed by any region in the world.

This is a land of majestic mountains and outdoor recreation. The mountains are high and rugged, the valleys narrow and humid. Ice Age glaciation was more widespread and severe here than elsewhere in Rocky Mountain Montana. The severe glaciation carved the mountain range topography with graceful curves, sharp peaks, and sawtooth crestlines. Most of Montana's present-day glaciers are in this region. The glaciers, persistent snow, tumbling streams, shining lakes, and barren rock account for much of the region's splendor, which reaches the spectacular in Glacier National Park. The majestic scenery combined with pleasant climatic conditions make the region priceless as a recreation source. Summers are refreshingly cool, even though it may get quite hot occasionally, and winters in the valley bottoms are the mildest in Montana, being rivaled only by those in the Squaw Peak Subregion of the Broad Valley Rockies.

Recreation in the region as a whole is probably less intense than in the Yellowstone Rockies. Most of the region's villages have considerable tourist trade and some, such as West Glacier, are primarily recreation service centers. Many of the recreation services are provided by tourist centers outside the region.

Photo 12. Mission Canyon in the Mission Mountains.

Photo 11. Glacier National Park viewed through a haze generated by the Anaconda aluminum smelter, Columbia Falls.

With regard to water supply and hydroelectric power production, the Columbia Rockies are preeminent in Montana. This is a wet, drippy, snowy, foggy region. The heavy precipitation, voluminous rivers, and excellent dam sites in the narrow valleys are the basis for tremendous hydroelectric production. The power stations at Libby, Hungry Horse, Noxon Rapids, and Cabinet Gorge dams are among the giants of Montana's electric power industry. And all the water that turns the turbines at Kerr Dam, in the Flathead arm of the Broad Valley Rockies, comes from the Columbia Rockies. The "hydroelectric landscape" is very much a part of the environment, and Hungry Horse is a "hydroelectric village" which also serves tourists. In addition, the region supplies the water for irrigation in the Flathead Valley and the Glacier Foreland Subregion and much of the water that flows in the Columbia and Missouri rivers.

Forests, logging, and sawmills are an integral part of the environment of the Columbia Rockies. The vegetation, named the Columbia Forest, is one of the most luxuriant coniferous forests in the world. The deep green of the seemingly endless forest contributes much to the region. In addition to all of the species mentioned in the Rocky Mountain Douglas-fir Forest, the Columbia Forest contains western red cedar, western hemlock, grand fir, western white pine, and western larch — all forest giants — in the montane zone and mountain hemlock and alpine larch in the subalpine zone. The tall trees of the Columbia Forest are the basis of the important logging and wood processing industries of the region.

The piercing whine of chain saws, roar of logging trucks, clatter of sawmills, and smell of sawdust are a characteristic overlay to the environment. Many logs are hauled out of this region for processing in the Broad Valley Rockies or in Idaho. But wood processing is the major — and virtually the only — manufacturing industry in the Columbia Rockies. Libby, largest town in the region, is the principal wood products center. Other sawmill towns include Eureka, Thompson Falls, Plains, Troy, and Superior.

Photo 13. Sawmill at Thompson Falls.

The only noteworthy mineral extraction in the Columbia Rockies is vermiculite mining near Libby. This activity nevertheless makes Lincoln County the second most important in Rocky Mountain Montana in dollar value of mineral production.

Inhabitants are few, towns small, and communications corridors widely spaced in the Columbia Rockies. None of the economic activities of the region — logging, sawmilling, recreation, hydroelectric power production, and water supply — supports much population. The valleys are too narrow to afford much space for farming, and the forests are too dense to offer much grazing. As a result, agriculture is unimportant. The region as a whole remains sparsely populated. It is accessible in the sense that it is traversed by three main rail lines, Interstate 90, and three other important highways. Virtually all of the inhabitants, towns, and transportation corridors are concentrated in linear strips in the narrow valley bottoms. Consequently, population is rather dense in the settled areas, where the whine of freightliner tires, whistle of trains, smell of diesel exhaust and the hum of power lines are a part of everyday life. One does not have the impression of living in, or travelling through, a largely empty land.

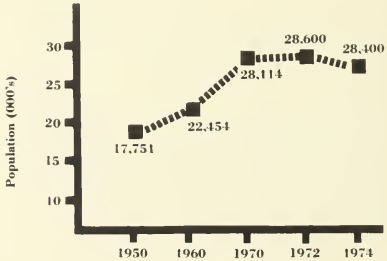
Nevertheless, the immense mountain ranges separating these bands of settlement are areas of emptiness almost entirely enclosed in national forests. And they encompass most of Montana's wilderness and other wildlands. As a result, the Columbia Rockies Region constitutes one of the cleanest and least spoiled environments in Montana. Only logging, lakeshore cabins, and mining cause much modification of the natural environment. Progressive elimination of teepee burners and control of erosion from logging have probably reduced the impact of the wood processing industry on air and water quality. The result is generally clean air, relatively clear water, and a largely unscarred land.

POPULATION SIZE AND DENSITY

The Columbia Rockies had the greatest percentage increase in population of any region during the 1950-1974 period — 60 percent — most of which occurred prior to 1970. Since 1970 the region's population has remained stable but recent indications are it is declining (9) (Figure 70).

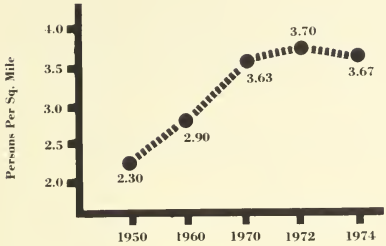
Most of the pre-1970 population spurt occurred in Lincoln County, which was caused by the construction force and derivative personnel at Libby Dam. Between 1970 and 1974, Lincoln County lost more residents than any other county in the state — 1,500 or 5.9 percent (9). Figure 71 provides data on population density in the Columbia Rockies.

Figure 70. Columbia Rockies Population, 1950-1974.



Sources: References 198, 216, and 217.

Figure 71. Columbia Rockies Population Density, 1950-1974.

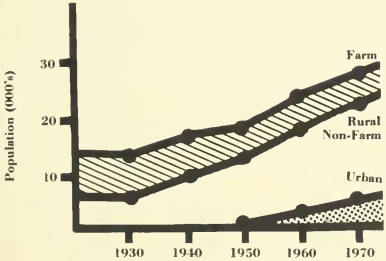


Sources: References 198, 216, and 217.

POPULATION DISTRIBUTION

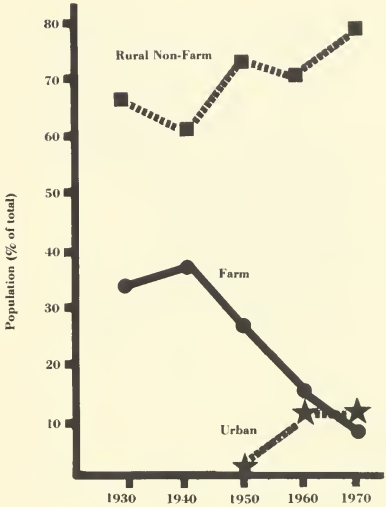
The rugged Columbia Rockies Region has a small total population with relatively little farming. The urban population was non-existent prior to 1960, when the town of Libby reached 2,500 persons. By far the largest segment of the population has been rural and non-farm, engaged primarily in logging and hydroelectric power production (119) (Figure 72 and Figure 73).

Figure 72. Columbia Rockies Urban, Farm, and Rural Non-Farm Populations, 1930-1970.



Source: Reference 119.

Figure 73. Columbia Rockies Urban, Farm, and Rural Non-Farm Population by Percent, 1930-1970.



Source: Reference 119.

POPULATION CHANGE

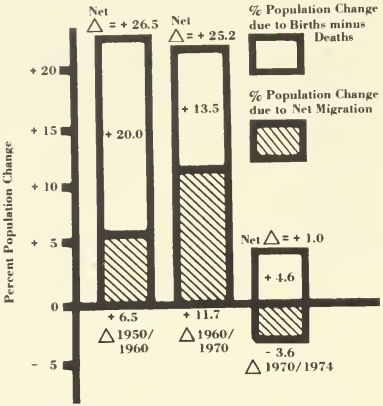
The Columbia Rockies was the fastest growing region in the state from 1950 to 1960 and again from 1960 to 1970. Most of this increase from 1960 to 1970 was undoubtedly due to the large influx of construction workers for the Libby Dam project. However, from 1970 to 1974 more people left the region than entered and the net increase due to births also decreased resulting in an overall net population gain of only 1.0 percent (Figure 74). This decline may be explained in part by the declining level of construction activity of Libby Dam.

ENERGY

Over 40 percent of Montana's hydroelectric capacity is located in the Columbia Rockies, making it the principal site for this type of power in Montana. In 1974 the region generated over 36 percent of the state's total hydroelectric generation. Considering power generated by streamflows originating in the Columbia Rockies sytem, the Columbia Producing Area has 66 percent of the hydroelectric generating capacity of the state and 58 percent of the total capacity (81) (Figure 75) (Table 12).

No economically recoverable fossil fuel resources have been identified in the Columbia Rockies.

Figure 74. Columbia Rockies Population Changes (△) Reflected by Births minus Deaths and Net Migration, 1950-1974.



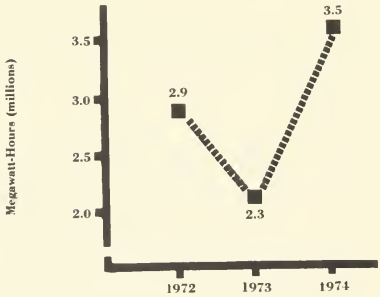
Sources: References 198 and 217.

Table 12. Columbia Rockies Installed Hydroelectric Generating Capacity, 1973.

Maximum Nameplate Rating (Kw-Hours)
606,530

Source: Reference 164.

Figure 75. Columbia Rockies Hydroelectric Generation, 1972-1974.

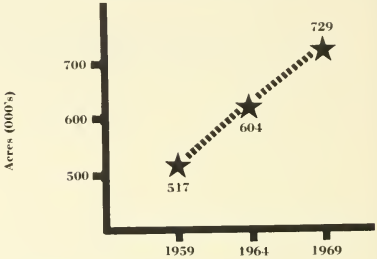


Sources: References 45, 64, 65, 77, 144 and 218. Figures represent net hydroelectric power generation, exclusive of plant use.

LAND RESOURCES

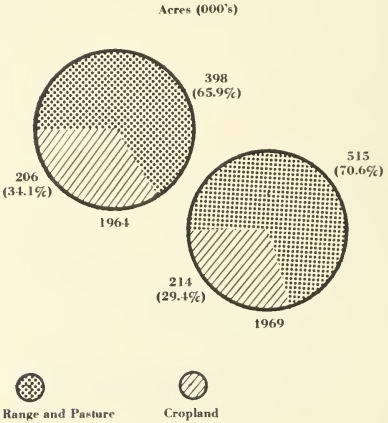
Even though increases in land in agriculture are noted in Figure 76 and Figure 78, the Columbia Rockies region has only 1 percent of Montana's agricultural land, about 30 percent of which is cropland (Figure 77 and Figure 79). However, the region does contain nearly 8.3 million acres of forestland, 42 percent of the state total (Figure 80). Three-

Figure 76. Columbia Rockies Agricultural Land in Farms, 1959, 1964, and 1969.



Sources: References 150 and 195.

Figure 77. Columbia Rockies Distribution of Agricultural Land, 1964 and 1969.

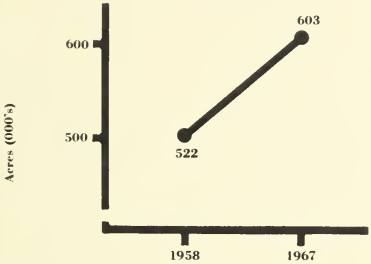


Sources: References 150 and 195.

fourths of the forest is controlled by the federal government. Half of all federal forestland in Montana is in the Columbia Rockies. Since 1970 the commercial federal forestland acreage has decreased 1.2 million acres (Figure 81).

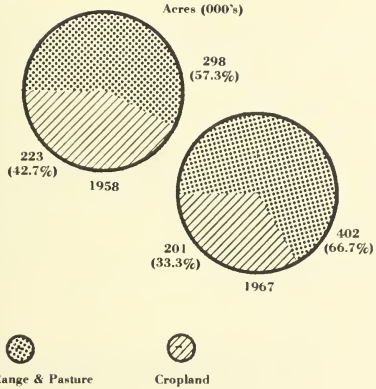
In the private and state, and federal forestland categories, the Columbia Rockies Region has the highest percentage of land classified commercial forest of any region in the state — 98 percent of private and state and 73 percent of the federal land.

Figure 78. Columbia Rockies Cropland, Range and Pasture, 1958 and 1967.



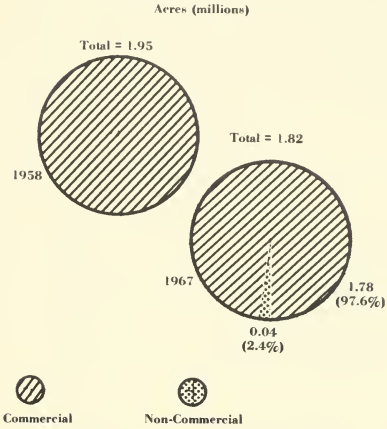
Sources: References 150, 151, and 152.

Figure 79. Columbia Rockies Distribution of Cropland, Pasture and Range, 1958 and 1967.



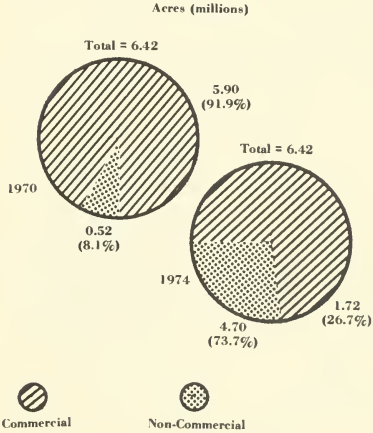
Sources: References 150, 151, and 152.

Figure 80. Columbia Rockies Private and State Forestland, 1958 and 1967.



Sources: References 150, 151, 152, and 153.

Figure 81. Columbia Rockies Federal Forestland, 1970 and 1974.



Sources: References 41 and 50. Figures exclude lands under reserved or wildlands classifications and include the Bitterroot, Flathead, Kaniksu, Kootenai, and Lolo National Forests.

The Columbia Rockies contain about half of all the wildlands in Montana, most of which are included in the seven classified or proposed wilderness areas: the Bob Marshall, Cabinet Mountains, Selway-Bitterroot, Scapegoat and Mission Mountains wilderness areas and the proposed Great Bear and Glacier wilderness areas. The region includes no primitive areas but does include about 2.5 million acres of roadless and new study areas (76) (Table 13).

Table 13. Columbia Rockies Wildlands, 1975.

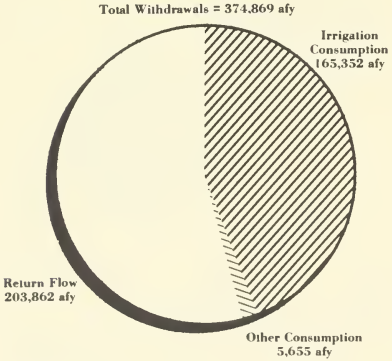
Classification	Acres
Wilderness	1,614,340
Proposed Wilderness	1,305,750
Primitive	0
Proposed Primitive	0
New Study Areas	866,790
Proposed New Study Areas	72,000
Roadless Areas (USFS)	1,727,894

Source: Reference 76. New study areas category includes approximately 100,000 contiguous acres in the Hoodoo and Scotchman Peak areas in Idaho.

WATER RESOURCES

The Columbia Rockies Region has the heaviest precipitation and the greatest water surplus in the state (81). Well over half Montana's total water supply (26,040,000 afy) exits the state through the Columbia Rockies via the Clark Fork and Kootenai rivers, yet the region accounts for only 3 percent of all withdrawals in the state, about half of which are consumed (134) (Figure 82). Instream uses, particularly hydroelectric power generation, are much more important than agricultural water use in the Columbia Rockies.

Figure 82. Columbia Rockies Water Withdrawals and Consumption of Withdrawals, 1970.

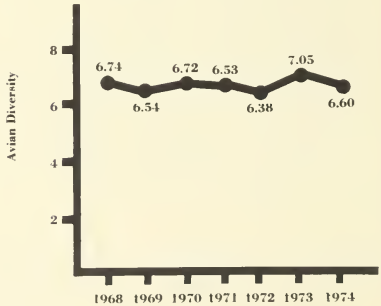


Source: Reference 134.

WILDLIFE DIVERSITY

Average breeding bird diversity on the Arlee and Woodman routes in the Columbia Rockies has remained remarkably stable since 1968 (212) (Figure 83). As in the Broad Valley Rockies and Yellowstone Rockies, however, subdivision activity and recreational real estate development on prime wildlife habitat continue unabated (85) (178). Roads and human activity are reaching into remote areas of the region, which contains the largest concentration of grizzly bears remaining in the lower 48 states. On July 28, 1975, the Fish and Wildlife Service (Department of Interior) listed the grizzly bear as a threatened species under the Endangered Species Act of 1973 (201), while reserving for the Montana Department of Fish and Game the option of managing the bear through special hunting regulations in what is commonly referred to as the Bob Marshal Ecosystem — the grizzly's last major stronghold in the state (121). The threatened grizzly bear, the endangered peregrine falcon and northern Rocky Mountain wolf and a host of other large and small game animals stand to be affected by oil and gas development proposed for the Flathead National Forest (179) (192).

Figure 83. Columbia Rockies Avian Diversity, 1968-1974.



Source: Reference 212.

AIR QUALITY

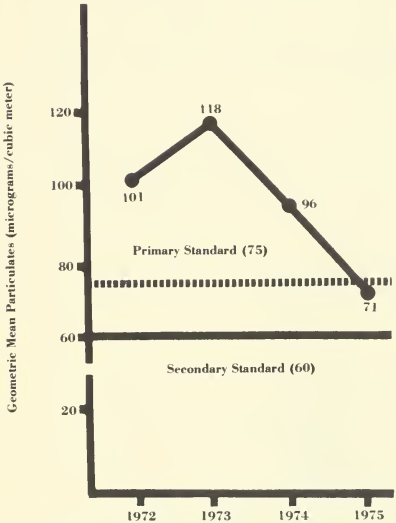
The Libby Valley has had an extreme air pollution problem in the past, the consequence of unpaved and dirty streets, slash burning on surrounding forests, unregulated open burning, and smoke from local industry coupled with nearly total stability of the valley air (145). For the last three years having complete data available (1972-74), mean annual particulate levels in Libby have exceeded the federal ambient primary standard (Figure 84). During the first four months of 1975, however, there appears to be a downward trend toward at least achieving the primary standard. Three firms in the Columbia Rockies — St. Regis Paper Co. and W. R. Grace Co. of Libby and Diamond International's lumber mill in Superior — are currently in violation of state clean air standards (99).

WATER QUALITY

The number of people supplied unsatisfactory drinking water in 1974 in the Columbia Rockies was less than half the number delivered water of similar quality in 1971 (Figure 85). However, over 10 percent of the population (the highest regional percentage in the state) was still delivered water not meeting bacterial standards (47).

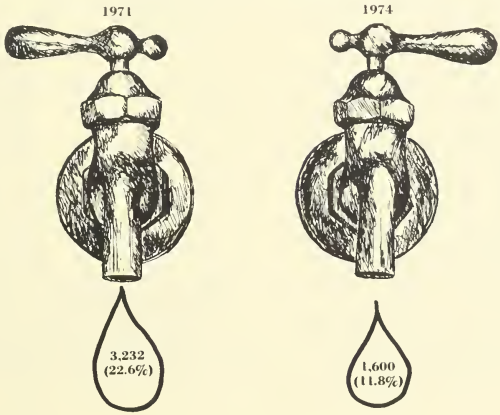
Among the state's environmental regions, the Columbia Rockies has the fewest number of miles of streams affected by non-point sources of pollution (Figure 86). This is primarily because the area has little farming, one of Montana's largest sources of non-point water pollution. Forestry, beyond a doubt, is the largest contributor to non-point stream pollution over most of the region.

Figure 84. Annual Geometric Mean Particulate Levels Recorded at Libby, 1972-1975.



Source: Reference 124. Measurement method was gravimetric using a high volume sampler.

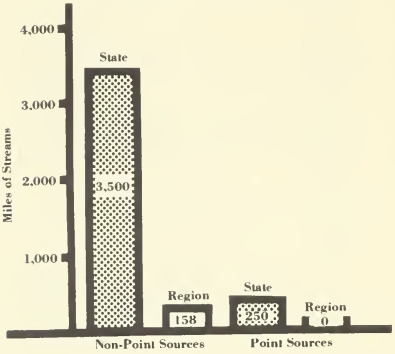
Figure 85. Columbia Rockies Population Delivered Unsatisfactory Drinking Water, 1971 and 1974.



Source: Reference 47.

In fact, the Flathead National Forest has been placed in a "high risk" category for water pollution, resulting from past timber harvesting practices and road construction activities (37). In addition, Libby Dam is causing serious nitrogen super-saturation problems in the Kootenai River, and industrial discharges of phosphorus from Canada are accelerating eutrophication in Lake Koocanusa behind Libby Dam.

Figure 86. Columbia Rockies Point and Non-Point Source Stream Degradation, 1975.



Source: Reference 129.

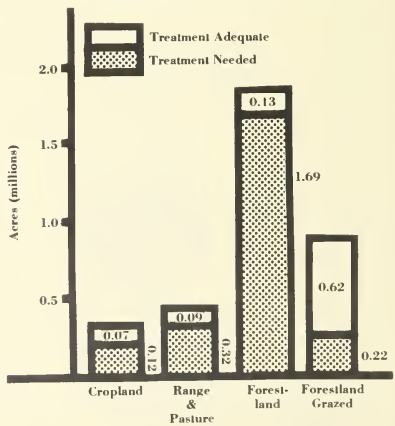
With only a handful of small municipal dischargers and one major industrial discharger (St. Regis Paper Company in Libby), no streams are currently degraded by point sources (129) (166). However, a new mineral development near Troy (3) (189), a proposed coal mine on Cabin Creek, a tributary of the Flathead River in British Columbia (5) (174), and possible oil and gas exploration and development on the Flathead National Forest (179) (192) could pose serious water quality problems for streams in the Columbia Rockies, as well as other major environmental and social problems. Water quality impacts in the Flathead drainage resulting from these and other proposed land uses in the Columbia Rockies will be addressed by the Flathead 208 Project, a regional planning organization recently organized under Section 208 of the 1972 Federal Water Pollution Control Act Amendments and funded by the Environmental Protection Agency. A more specific study of hydrologic impacts from the Cabin Creek coal development is underway as authorized by House Bill 622 of the 1975 Montana Legislature.

LAND QUALITY

Most private and state agricultural land in the Columbia Rockies is classified as forestland. Over 90 percent of this land needed timber establishment and reinforcement and/or timber stand improvement in 1967 (153) (Figure 87). More recently, reports have been received indicating poor timber-harvesting practices in the Bitterroot West Fork drainage in the southern part of the region and in the Fisher River drainage in the northern portion (44) (182).

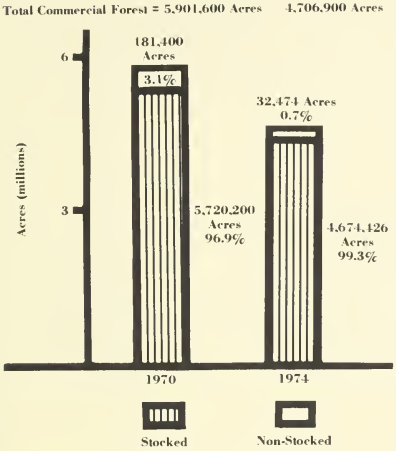
The acreage of non-stocked commercial forest in the Columbia Rockies declined appreciably between 1970 and 1974, as did the total acreage of commercial forestland (41) (66) (Figure 88). It is not clear, however, how much of this decline in non-stocked acreage was due to reforestation and how much was due to a change in classification, which excluded many high elevation areas from commercial consideration. Insects and disease have seriously affected timber production over much of the Columbia Rockies (115) and fluorides from the Anaconda aluminum smelter at Columbia Falls have significantly reduced lodgepole pine growth downwind from the plant (38). Oil and gas exploration contemplated for the Flathead National Forest could result in reduction of the timber resource base (184) (192). The Columbia Rockies Region contains the major parts of four national forests: Kootenai, Flathead, Lolo and Bitterroot. These constitute well over half the commercially forested acreage in Montana.

Figure 87. Columbia Rockies Private and State Agricultural and Forestland Requiring Conservation Treatment, 1967.



Source: Reference 153.

Figure 88. Columbia Rockies Stocked and Non-Stocked Commercial Forest under USFS Control, 1970 and 1974.



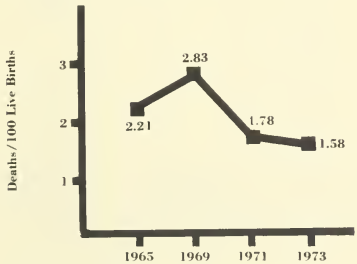
Sources: References 41 and 66.

HEALTH STATUS

The Columbia Rockies Region has, since 1969, shown the most improvement in the perinatal death rate and as of 1973 had the best rate in the state (Figure 89).

As in the Broad Valley Rockies though, the health status index conflicts with this measure; the Columbia Rockies has the worst index in the state (Table 14).

Figure 89. Columbia Rockies Perinatal Death Rate, 1965-1973.



Sources: References 118 and 125.

Table 14. Columbia Rockies Health Status Index, 1968-1972.

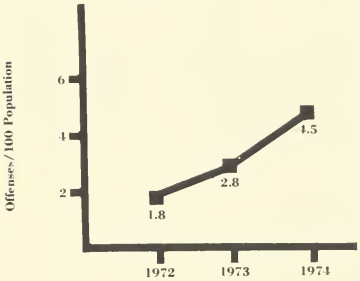
417.5

Source: Reference 78.

CRIME

The crime rate in the Columbia Rockies has had the most rapid, steady increase of any region in the state: 150 percent in 2 years (Figure 90).

Figure 90. Columbia Rockies Offenses Known to Police, 1972-1974.

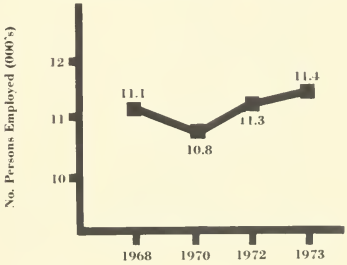


Source: Reference 52.

EMPLOYMENT

The Columbia Rockies added about 300 new jobs in the period 1968-1973 (Figure 91). The private non-farm sector

Figure 91. Columbia Rockies Total Employment, 1968-1973.



Source: Reference 196.

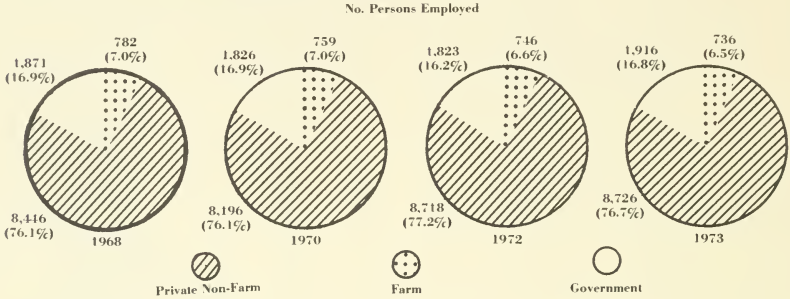
contributed the bulk of these positions while the farm and government sectors both showed an absolute decrease in workers. The private non-farm sector employs three out of four workers in this region, the highest percent of any region in the state (Figure 92).

The Columbia Rockies has continually had the highest unemployment rate in the state, which as of 1974 was almost twice the state average at 11.9 percent (Figure 93).

INCOME

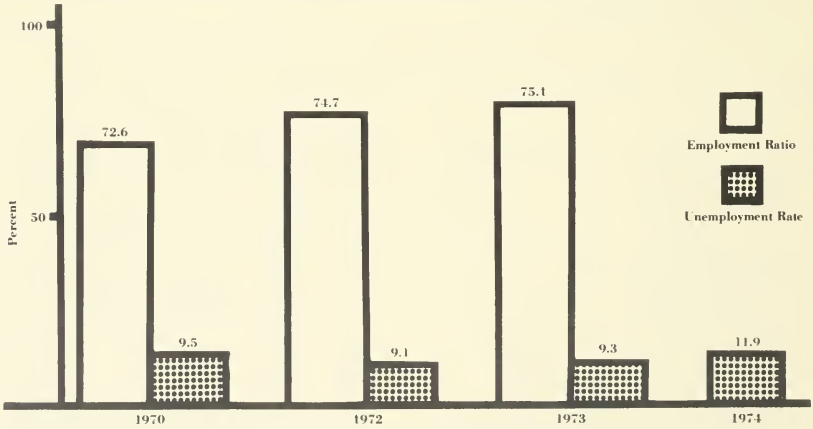
The Columbia Rockies experienced the only drop in real per capita personal income (PCPI) in the state, from 6 percent above the state average in 1968 to 22 percent below the state average in 1973 (Figure 94). Although it might appear that this is partly due to the very low earnings per employee (EPE) in the farm sector, it must be remembered

Figure 92. Columbia Rockies Employment by Sector, 1968-1973.



Source: Reference 196.

Figure 93. Columbia Rockies Unemployment Rate and Employment Ratio, 1970-1974.

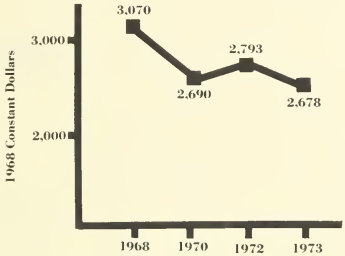


Sources: References 131 and 196. Unemployment rate computed using state Dept. of Labor and Industry Montana Labor Market Area data for Kalispell.

that this sector comprises only 7 percent of the region's employment. Also the government and private non-farm sectors show the highest real EPE in the state (Figure 95). A more likely explanation for the low PCPI is an unemployment rate well above the state average.

While this region has the lowest per capita income, it also had the lowest percent of families earning subsistence incomes in 1970 (Figure 96). Although the years are not strictly comparable, this indicates the possibility of a great divergence in incomes, with many individuals earning incomes just above the subsistence level and many earning higher incomes.

Figure 94. Columbia Rockies Per Capita Income, 1968-1973.

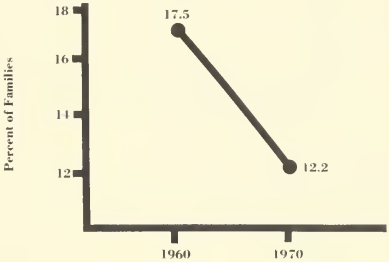


Sources: References 196 and 197.

LIBRARY CIRCULATION

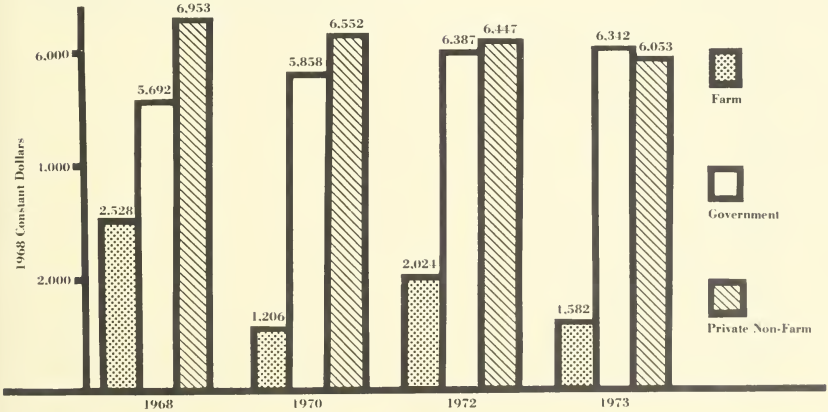
The Columbia Rockies Region includes Lincoln, Sanders, Mineral and parts of Flathead and Ravalli counties. During the statistical period, the Kalispell Carnegie Library merged with Flathead County Library, which probably contributed to the drop in circulation for the period between 1966 and 1970. Although Kalispell is in the Broad Valley Rockies, this merger may have affected library users in the nearby Columbia Rockies. In 1972 Sanders County was served by bookmobile from Lincoln

Figure 96. Columbia Rockies Families Earning Less than $3,000/Year in 1960 and $4,000/Year in 1970.



Source: Reference 198.

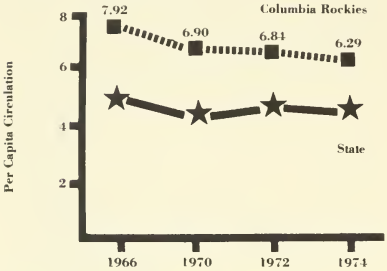
Figure 95. Columbia Rockies Earnings Per Employee, 1968-1973.



Source: Reference 196.

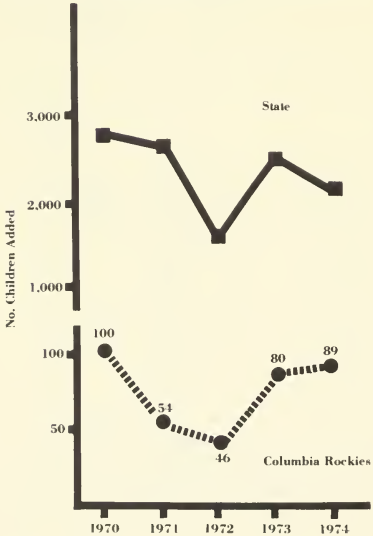
County Library. This service from a federation always increases the use of the library. The small collections in the libraries not served by the federation tend to become outdated and users feel they have read "all the books" the library has (Figure 97).

Figure 97. Columbia Rockies Library Circulation, 1966-1974.



Sources: References 146, 147, 148, and 149.

Figure 98. Columbia Rockies Children Added to Child Welfare Services, 1970-1974.



Source: Reference 137.

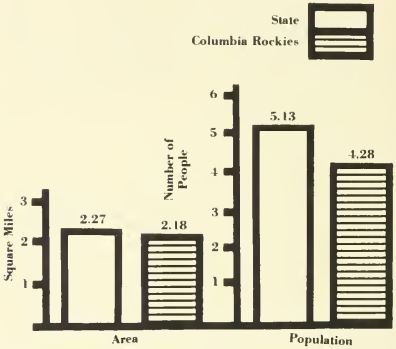
CHILD WELFARE

Since 1970, the number of children added to the Child Welfare Services case load in the Columbia Rockies has remained below 100 individuals (Figure 98).

RURAL ROAD SYSTEM

Although this is a sparsely populated region, the rural road system is slightly denser per square mile than the state average. The population served per mile of rural road is somewhat less than the state average (38) (130) (153) (Figure 99).

Figure 99. Columbia Rockies Rural Area and Population Served per Mile of Rural Road, 1970.



Sources: References 119, 130 and 153.

Map 5. Yellowstone Rockies

YELLOWSTONE ROCKIES

ENVIRONMENTAL PERSPECTIVE

The mountains of Montana adjacent to Yellowstone National Park form a beautiful, relatively humid, rather densely forested region. This is a land of recreation, timber supply, and water supply. Although it is the scene of the most intensive outdoor recreation activity in Montana, it has a very small permanent population and remains relatively unspoiled.

The Yellowstone Rockies cannot be understood without dealing to some extent with Yellowstone National Park. Most of the Park is in Wyoming. Only a fringe of it extends into Montana. But many aspects of the character and environment of the Yellowstone Rockies of Montana have to do with the special relationship between this region and the Park. The region lies between the Park and the Yellowstone-Clark Fork corridor. Three of the five major entry-ways of the Park are in the Treasure State. The only sizeable towns of the region, Gardiner and West Yellowstone, are Park entrance points. And the region is closely tied to Livingston and Bozeman, two of the major gateways to the Park. None of the highways traversing the Yellowstone Rockies is a major through route comparable in importance to those crossing the Broad Valley and Columbia regions. There have been no passenger tains on the Gardiner branch line for many years. Yet, the region is the scene of rather heavy traffic and intense recreation activity focusing on the Park and, more recently, also on the Big Sky Resort. Pickup campers, camper-trailers, chartered buses, and private airplanes are as much a part of the environment in summer, as are the creak of ski lifts and the ear-splitting rap of snowmobiles in winter.

Photo 15. Storm Castle Mountain in the Gallatin Canyon.

Photo 14. Upper Rock Creek and the Beartooth Plateau from the Red Lodge-Cooke City Highway.

Yellowstone National Park is better known for its geysers, hot springs, waterfalls, lakes, and wildlife than for beautiful mountain scenery. In fact, most of the Park is a forested tableland, the Yellowstone Plateau, which is nearly surrounded by magnificent mountains. Among these mountains, the four ranges to the north and northwest of the Park make up most of the region under discussion. From west to east, these ranges are the Madison, Gallatin, Absaroka, and Beartooth. They were rather severely glaciated during the Ice Age and contain small glacial remnants even today. They possess a bold splendor that far surpasses that of the Yellowstone Plateau landscape and compares favorably with the best of the mountain beauty found in the Rockies.

The mountain ranges themselves are largely uninhabited, are almost entirely enclosed in national forest, and embrace three primitive areas and much de facto wilderness. The only appreciable concentration of population aside from Gardiner, West Yellowstone, and Big Sky is in the Paradise Valley — broad, dry, irrigated and quite similar to the main valleys of the Broad Valley Rockies. The construction of Allenspur Dam (an idea of the Bureau of Reclamation) would inundate much of this magnificent valley. The other valleys of the Yellowstone Rockies are narrow, mostly humid, and provide little room for farming or settlement. Temperature conditions are similar to those in the higher valleys of the Broad Valley Rockies.

The region is important in water supply but has very little hydroelectric power development. The mountains are more humid than the Broad Valley Rockies, less humid than the Columbia Rockies. The Yellowstone River derives most of its water from the Yellowstone Rockies of Montana and the extension of this region in Wyoming. And the Missouri River receives part of its water, via its tributaries the Madison and Gallatin rivers, from this region. Some of the water supplied by the Yellowstone Rockies is used for irrigation and hydroelectric power production in the Broad Valley Rockies and in Great Plains Montana.

The Yellowstone Rockies are within the Rocky Mountain Douglas-fir Forest, the same forest type that covers the Broad Valley Rockies. However, due to better moisture conditions, the forests are somewhat more dense, luxuriant, and productive than those of the Broad Valley Region. The Yellowstone Rockies are important as a log supply region but have only a very modest sawmilling industry, confined to West Yellowstone. Most of the logs are hauled out and processed in Livingston, Bozeman, and Belgrade. The logging trucks add to the traffic from tourists.

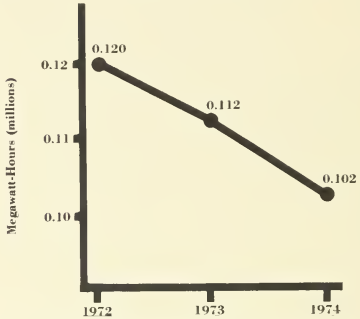
The region has a long history of mining, but there is no mining operation of any importance active today though new projects are in formative phases. The impacts of logging, ski center development, and former mining activities account in the main for the scars on the mountainsides. The greatest modification of the natural environment has resulted from construction and traffic along the communications corridors and from irrigation and grazing in the Paradise Valley. Nevertheless, compared to most of Montana, the air is unusually clean and the water rather high in quality.

Photo 16. Emigrant Peak and the Paradise Valley.

ENERGY*

The Yellowstone Rockies contain very few of Montana's energy resources: about 1 percent of its hydroelectric capacity (Figure 100) (Table 15) and only 10 million tons of potentially recoverable coal reserves (Table 16).

Figure 100. Yellowstone Rockies Hydroelectric Generation, 1972-1974.



Sources: References 64, 144, and 218. Figures represent net hydroelectric power generation, exclusive of plant use.

Table 15. Yellowstone Rockies Installed Hydroelectric Generating Capacity, 1973.

Maximum Nameplate Rating (Kw-Hours)
19,000

Source: Reference 164.

Table 16. Yellowstone Rockies Potentially Recoverable Coal Reserves, 1973.

Coal Type	Millions of Tons
Surface Subbituminous	10

Source: Reference 213.

* The absence of demographic and economic indicators for the Yellowstone Rockies results from the lack of urban centers in the region. Counties comprising the bulk of the Yellowstone Rockies — Madison, Gallatin, Park, Sweet Grass, Stillwater and Carbon — have most of their population and economic activity outside the region and are considered in either the Broad Valley Rockies or the Rocky Mountain Foreland. Population and economic indicators for these counties are therefore incorporated into one or the other of these adjacent regions.

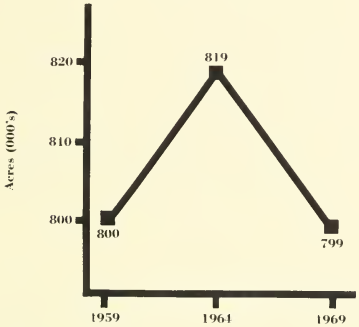
LAND RESOURCES

The Yellowstone Rockies, like the Columbia Rockies, contain about 1 percent of the agricultural land in Montana (Figures 101, 102, 103, and 104).

The region contains almost 10 percent of the total forestland in the state, 92 percent of which is federal. About 5 percent of the state commercial forestland is in the Yellowstone Rockies (Figure 105). Federal commercial forestland has decreased 40 percent or about 450,000 acres in the last four years (Figure 106).

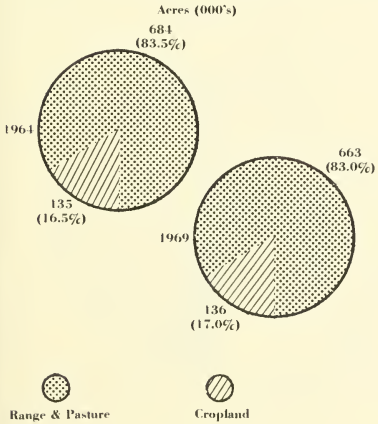
The Yellowstone Rockies contain about one-quarter of all wildlands in Montana. The region has no wilderness areas but three present primitive areas — Beartooth, Absaroka and Spanish Peaks — are being enlarged and proposed for wilderness status, as well as a portion of

Figure 101. Yellowstone Rockies Agricultural Land in Farms, 1959-1969.



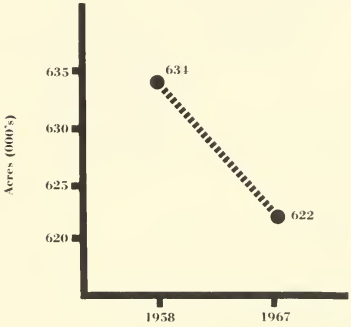
Sources: References 150 and 195.

Figure 102. Yellowstone Rockies Distribution of Agricultural Land, 1964 and 1969.



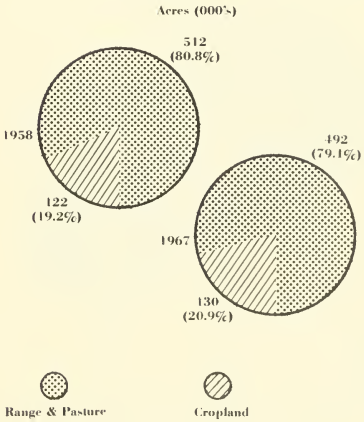
Sources: References 150 and 195.

Figure 103. Yellowstone Rockies Cropland, Range and Pasture, 1958 and 1967.



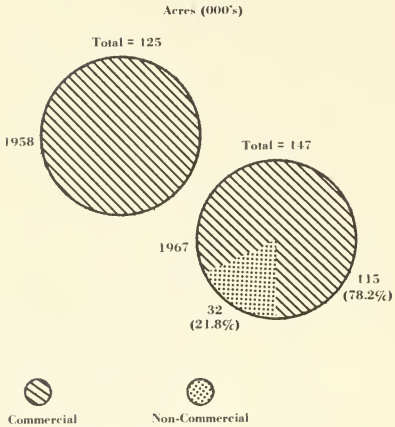
Sources: References 150, 151, and 152.

Figure 104. Yellowstone Rockies Distribution of Cropland, Range, and Pasture, 1958 and 1967.



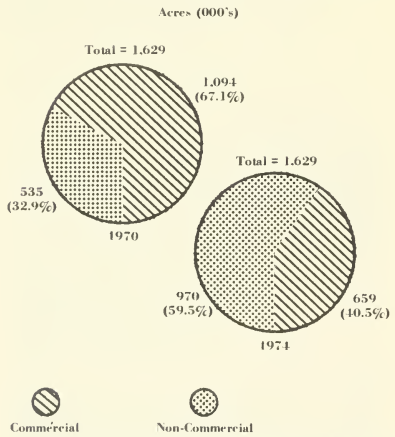
Sources: References 150, 151, and 152.

Figure 105. Yellowstone Rockies Private and State Forestland, 1958 and 1967.



Sources: References 151, 152, and 153.

Figure 106. Yellowstone Rockies Federal Forestland, 1970 and 1974.



Sources: References 41 and 50. Figures exclude lands under reserved or wildland classifications and include the Gallatin and Custer national forests.

Yellowstone National Park lying in Montana. The Beartrap Canyon Primitive Area is also in the Yellowstone Rockies. The region has about one million acres in roadless and new study areas (76) (Table 17).

Table 17. Yellowstone Rockies Wildlands, 1975.

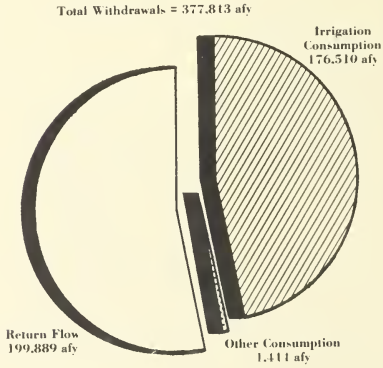
Classification	Acres
Wilderness	0
Proposed Wilderness	607,437
Primitive	348,415
Proposed Primitive	0
New Study Areas	590,572
Proposed New Study Areas	408,000
Roadless Areas (USFS)	214,186
Roadless Areas (BLM)	?

Source: Reference 76. Proposed wilderness category does not include Montana portion of proposed Yellowstone National Park Wilderness but includes 344,776 acres currently classified as primitive.

WATER RESOURCES

Although smaller in area and receiving less precipitation than the Columbia Rockies, the Yellowstone Rockies (Park County) withdraws and consumes slightly more water, but still only about 3 percent of the state total (134). Hydroelectric power generation is a relatively minor

Figure 107. Yellowstone Rockies Water Withdrawals and Consumption of Withdrawals, 1970.



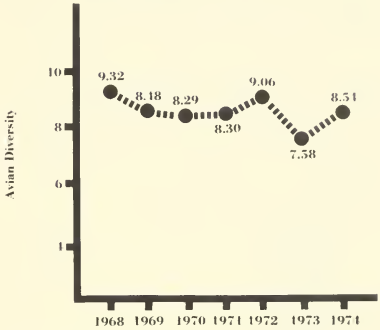
Source: Reference 134.

instream usage in the region and irrigated agriculture is practiced only in the Paradise Valley of the upper Yellowstone River. (The withdrawal and consumption figures for Park County also reflect irrigation activity outside the region along the Shields River.) The primary water uses in the Yellowstone Rockies are instream and non-consumptive, i.e., recreation, fish and wildlife (Figure 107).

WILDLIFE DIVERSITY

The Yellowstone Rockies has only one breeding bird survey route — the Chestnut route near Bozeman Pass — which it shares with the Broad Valley Rockies. Avian diversity (Figure 108) has been consistently high along the route for the last seven years (212). However, wildlife habitat in the Yellowstone Rockies is being subjected to the same pressure encountered elsewhere in western Montana as the result of recreational real estate developments such as Big Sky (176), subdivisions such as Beaver Creek South (19), and energy corridors such as the proposed Ennis to Big Sky transmission line (73). According to the Gallatin Canyon Study (154), by 1972 about one-third of the winter range in the Canyon had been lost to "processes of civilization." Inroads on key winter habitat, severe weather conditions and difficulties in managing a migrating herd that spends much of its time on a federal preserve (Yellowstone Park), culminated in over-population and mass starvation of Northern Yellowstone elk in the spring of 1975 (158). Renewed interest in the Stillwater mineral complex in the eastern portion of the Yellowstone Rockies has prompted public concern. Extensive studies of the impact on wildlife of potential mining activities in the area are underway (120).

Figure 108. Yellowstone Rockies Avian Diversity, 1968-1974.



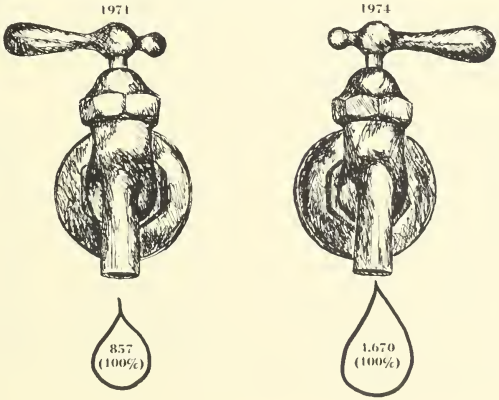
Source: Reference 212.

WATER QUALITY

The entire population of the Yellowstone Rockies on public water supplies was delivered satisfactory water in both 1971 and 1974, even though the population served by public water increased over 500 percent during that period (47) (Figure 109).

Causes of non-point source pollution in the Yellowstone Rockies include sediments from logging

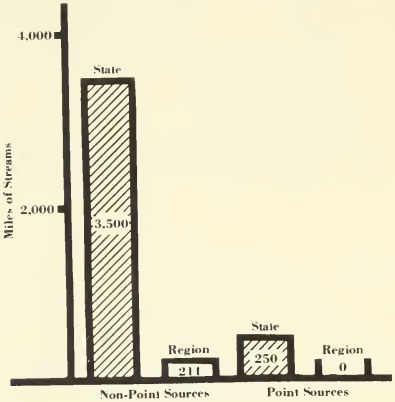
Figure 109. Yellowstone Rockies Population Delivered Satisfactory Drinking Water, 1971 and 1974.



Source: Reference 47.

practices, natural sediment aggravated by overgrazing, thermal discharges from Yellowstone National Park, and toxic metals from past mining activity. The Yellowstone Rockies have no significant effluents, hence no stream miles degraded by point sources (36) (129) (Figure 110).

Figure 110. Yellowstone Rockies Point and Non-Point Source Stream Degradation, 1975.



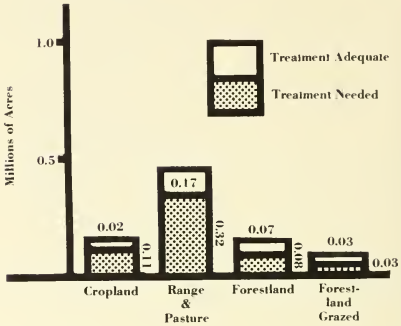
Source: Reference 129.

LAND QUALITY

Over half of all agricultural acreage in the Yellowstone Rockies (Park County) was in need of conservation treatment in 1967 (153). Poor forest practices on private lands, particularly in the Hyalite Creek drainage, have caused mass wasting and sedimentation problems (36) (Figure 111).

The Yellowstone Rockies is the least significant of the commercially forested regions of western or Rocky Mountain Montana. It consists almost entirely of the greater share of the Gallatin and Custer National Forests as well as a small corner of Yellowstone National Park. Both stocked and non-stocked commercial forest acreage declined between 1970 and 1974, as they did on all forests in Montana (41) (66), partially explainable by a change in classification removing many fragile and relatively inaccessible high areas from commercial consideration (50) (Figure 112). Despite limited commercial forest growth compared to other regions, the forested lands of the Yellowstone Rockies are singularly important from the standpoint of watershed, wilderness and recreational values.

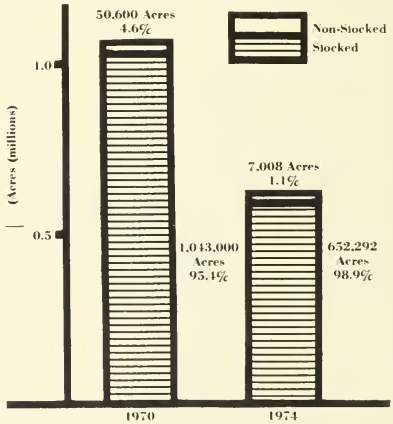
Figure 111. Yellowstone Rockies Private and State Agricultural Land and Forestland Requiring Conservation Treatment, 1967.



Source: Reference 153.

Figure 112. Yellowstone Rockies Stocked and Non-Stocked Commercial Forest under USFS Control, 1970 and 1974.

Total Commercial Forest = 1,093,600 Acres 659,300 Acres

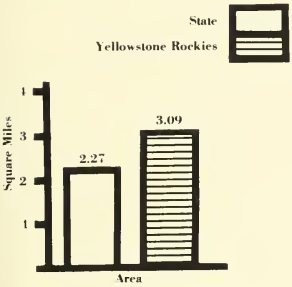


Sources: References 41 and 66.

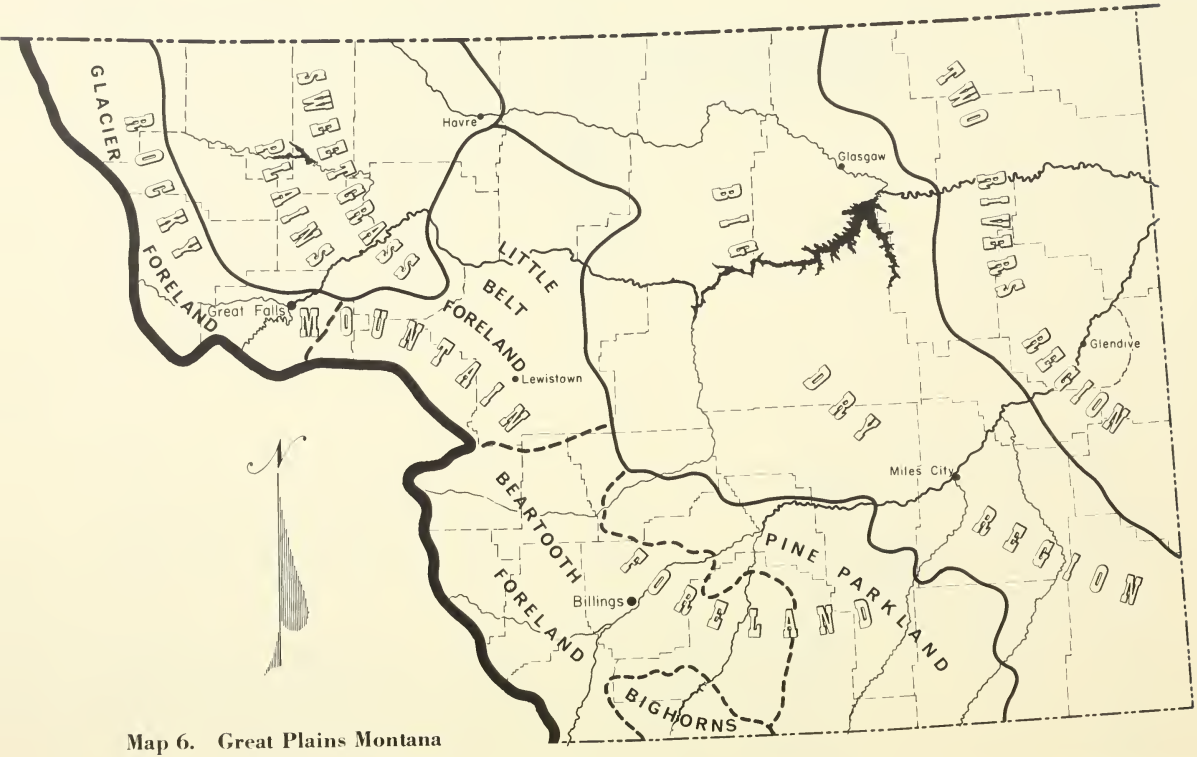
RURAL ROAD SYSTEM

Unlike the Columbia Rockies, this rugged, mountainous region has a very thin network of local roads, each mile serving over three square miles of rural countryside (119) (130) (153) (Figure 113).

Figure 113. Yellowstone Rockies Rural Area Served per Mile of Rural Road, 1970.



Sources: References 119, 130, and 153.



Map 6. Great Plains Montana

GREAT PLAINS MONTANA

ENVIRONMENTAL PERSPECTIVE

The northeastern three-fifths of Montana is on the Great Plains. This horizontal land of distant horizons is really "Big Sky Country." It is a vast expanse of plateaus and hills, plains and mountain outliers, grasslands and parklands, exotic* rivers and floodplain forests, yellow grainfields and brown fallow strips, vast ranches and narrow, irrigated strips, flour mills and stockyards, oil wells and fuel refineries, coal mines and thermal-electric plants. The cold winter, warm summer, semiarid steppe climate of the plains and plateau surfaces is similar to that of the valley bottoms of the Broad Valley Rockies except that, in Great Plains Montana, winters are more severe, summer days may get hotter, and generally there is more wind.

Most of the dry-land grain farming and three of the four major oil producing areas of the state are concentrated in the Triangle area and in the northeastern corner of the state in such a way that they serve to delimit two of the four environmental regions of Great Plains Montana. These are the Sweetgrass Plains and the Two Rivers Region. They are the only extensive areas in Montana in which the population is rather uniformly distributed and moderately dense.

The isolated eastern interior of Montana is easily recognizable as a distinctive environmental region. This mostly empty expanse — the Big Dry Region — is mainly grassy rangeland, has only patches of dry-land grain farming, and is traversed by Fort Peck Reservoir and by irrigated strips along the Milk and Yellowstone rivers.

Photo 18. Rural scene near Sidney, Two Rivers.

Photo 17. Powder River Basin, Big Dry.

The remainder of Great Plains Montana is the land along the Rocky Mountain Front. Named the Rocky Mountain Foreland, this heavily populated environmental region has all the traits that characterize Great Plains Montana as a whole. They are here rather intricately integrated. In addition, the region has two distinctive features, the chinook winds and the panoramic view of the mountain backdrop. These are nearly restricted to the Foreland, except that the influence of the chinook also extends across the Sweetgrass Plains.

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* Used in its geographic sense here to mean arising from humid areas upstream.

Map 7. Rocky Mountain Foreland

ROCKY MOUNTAIN FORELAND

ENVIRONMENTAL PERSPECTIVE

In terms of its diverse environments, complex economy, and dense population, the Rocky Mountain Foreland may be viewed as the eastern counterpart of the Broad Valley Rockies. Strong spatial contrasts in environmental conditions have made it easy to divide the region into subregions. Yet, the Foreland as a whole has a sufficient degree of unity to be considered a region. This unity resides in a fairly regular recurrence, more or less throughout the region, of a combination of several of the following features:

1) The bold Rocky Mountain Front is a panoramic backdrop in the landscape. As its name implies, the land is the land before — or in front of — the Rocky Mountains. The Front of the Rockies may be seen from the upland surface almost anywhere in the Foreland. For example, the sweeping view of the Beartooths from Billings, even though the city is 60 miles from the foot of the mountains, makes the city a place more livable than it would otherwise be.

2) The chinook — that warm, dry wind from the mountains that comes occasionally in winter. It brings relief from the severe cold, devours the snow, exposes the grass for range livestock, and produces minor flooding when ditches, drains, and storm sewers are frozen.

3) The foothills prairie, a more humid grassland than the short-grass steppe that originally covered most of the rest of Great Plains Montana. It extends almost continuously in the foothills and on the higher plateau surfaces along the mountain front from Alberta to Wyoming. It resembles the prairie grasslands of the foothill zone in the Broad Valley Rockies, and, along with them, constitutes the best nonirrigated grazing land in the state.

Photo 19. Coal stripmining operation near Colstrip in the Pine Parklands.

Photo 20. Square Butte west of Ulm, Glacier Foreland.

4) Parkland consisting of open stands of ponderosa pine or aspen with a grassy understory, or of dense groves of these trees with prairie openings between them. Ponderosa parklands characterize the Pine Parklands Subregion and are common in the Beartooth and Little Belt subregions of the Foreland. Aspen parklands are distinctive of the lush foothills in the Glacier Foreland. The parklands rival the foothills prairie in grazing value, are exceptionally high quality hunting grounds (Merriam's wild turkey), and have a special kind of esthetic appeal not possessed by either treeless rangeland or continuous forest. In parts of the Pine Parklands Subregion, the parklands approach the density of forest vegetation. Logging in these areas supplies the small sawmills in Roundup, Ashland, and Broadus.

5) Rocky Mountain outliers. These are clustered in the Little Belt Foreland and include the Snowy Mountains south of Lewistown, the Judith and Moccasin mountains north of that town, the Highwood Mountains east of Great Falls, and the Bearpaws and Little Rockies southeast of Havre. The Bighorns, although technically a part of the Rocky Mountains proper, may be viewed as a mountain outlier in the Montana context. Only the low, partially forested, northern end of the range extends into the Treasure State. The mountain outliers have the same kinds of rocks and geologic structure as the Rocky Mountains and are very different from the hills carved from Great Plains

rocks. They have Douglas-fir forest on their higher and more shady slopes, foothills prairie on their flanks. The mountain outliers are esthetically striking because they rise up so abruptly, and stand out so boldly, from the plateau surface on which they sit. It is not surprising that the only two ski centers in Great Plains Montana are in the Rocky Mountain outliers. The recreational value of these outliers, and of the parklands, is of special significance because these features are the nearest of their kind to the leisure-seeking residents of much of eastern Montana, the Dakotas, and points east.

6) "Foothill" ranching, in which the foothills prairie and the parklands are used as rangeland and, for some ranches at least, upland summer grazing, is obtained in the Rocky Mountains or the mountain outlier. Not all of the rangeland is prairie, parkland, or mountain outlier. In the drier portions of the Foreland, which include much of the Beartooth Foreland Subregion, the rangeland is the same kind of steppe grassland that characterizes the Big Dry Region. Billings is the most important stockyards and meat-packing center in Montana, and Great Falls is second. In addition to the stockyards proper, Billings has a large feedlot entirely within the urbanized area. Both cities draw livestock from far beyond the boundaries of the Rocky Mountain Foreland, of course, but their preeminence as livestock marketing and slaughtering centers draws attention to the importance of ranching in the Foreland and the excellent productivity of the foothill, parkland, and mountain outlier grazing lands compared to the other rangelands of Montana.

7) Patches of dry-land grain farming scattered more or less throughout the Foreland. The most important grain growing areas are in the Little Belt Foreland around Lewistown and in the Beartooth Foreland around Laurel and south of Hardin. Great Falls is the largest flour milling center in Montana. Its predominance in this regard does not result from the patches of wheat farming in the Foreland but rather from the city's location adjacent to the Sweetgrass Plains, one of the two major dry-land grain regions of the state. Billings is the second largest milling center in the state.

8) Rather broad strips or patches of irrigated farmland along the exotic rivers near where the latter emerge from the Rocky Mountains. Were it not for the exotic, mountain-fed streams as a source of water, there would be little or no irrigation in Great Plains Montana. The most important irrigated strips in the Foreland are (a) those along the Yellowstone and its tributaries the Clarks Fork and the Bighorn in the Beartooth Foreland and (b) those along the Sun, Teton, and Marias rivers in the Glacier Foreland. Most of the irrigated farms in the Foreland, like those in the Broad Valley Rockies, are primarily in livestock production based on irrigated pasture and hay. However, a crop which is important here but not in Rocky Mountain Montana is sugar beets. One of the two refineries of the state is in Billings.

Photo 21. Bighorn Canyon from Yellowtail Reservoir, Bighorns Subregion.

9) Rather heavy, but spotty, population. "Forelanders" are by no means uniformly distributed over the land. They are almost as unevenly spread, but for different reasons, as are "Rockymountaindonians." In the Foreland, population is sparse in the ranching areas. It is moderately dense and rather evenly spread in the dry-land grain farming areas. And it is very dense in the irrigated areas. The Foreland has more than its share of towns and cities. The urban component includes not only Billings and Great Falls but also Lewistown, another of the twelve regional trade centers, and a number of other sizeable towns. The largest of these are (a) Laurel, Hardin, Red Lodge, Big Timber, and Harlowton in the Beartooth Foreland; (b) Roundup and Forsyth in the Pine Parklands; and (c) Browning and Choteau in the Glacier Foreland.

Since the Foreland is one of the two regions that extend across the state from Canada to Wyoming, it is traversed by both the Yellowstone-Clark Fork corridor and the High Line (U.S. 2 and the northern mainline of the Burlington Northern). It is also crossed, at Great Falls, by Interstate 15. However, in contrast to the situation in the Broad Valley Rockies, there is little internal "pull" within the Foreland in terms of traffic and communications. The exception is the axis of oil and gas pipelines stretching from Alberta through Great Falls to Billings and Wyoming.

The Foreland figures rather importantly in the mineral-extraction, refining, and electric-power picture in the Treasure State. However, the areas involved are highly localized and do not characterize the region as a whole.

Two of the major hydroelectric power developments in Montana are located in the Foreland. One of these is Yellowtail Dam, which created Bighorn Lake, the largest reservoir in the Foreland. The other is the five dams at the Great Falls of the Missouri. The establishment of the metallurgical complex at the Electric City was related to the hydroelectric potential of the Falls.

The Rocky Mountain Foreland is the foremost oil refining region of the state. Billings and Laurel are the largest refining centers, and Great Falls has a medium sized refinery. As a business capital for the petroleum industry, Billings enjoys somewhat the same role in Montana as does Calgary in Alberta and Casper in Wyoming. Only a small part of the petroleum refined in the Foreland comes from the region itself, which has only one important producing area. This is the Elk Basin oil-and-gas field near Red Lodge.

Nearly all of the coal mining and exploration and most of the thermal-electric power production of the state are in the Rocky Mountain Foreland. Most of the coal exploration and strip mining activities are in the Decker, Colstrip, and Roundup areas of the Pine Parklands Subregion, whose boundaries have been drawn so as to include as much as possible of the strippable coal. Billings currently produces the lion's share of Montana's thermal-electric power, and new thermal plants are being constructed at Colstrip. Coal mining and power production using coal threaten to modify drastically the environment in the Pine Parklands and perhaps other areas of Great Plains Montana.

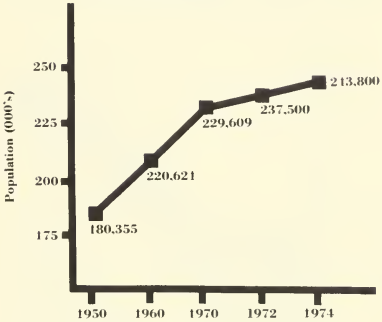
The natural environment of the Foreland has been greatly changed by grazing, dry-land cropping, irrigation, coal mining, power production, pipeline and transmission line construction, and the numerous manufacturing industries located primarily in Billings and Great Falls. To summarize, these industries are flour milling, meat packing, and copper, oil, and sugar refining. The distinctive appearance, odors, sounds, and smoke or dust of these industries are characteristic components of the urban environment in Montana's two largest cities, Billings and Great Falls.

POPULATION SIZE AND DENSITY

The Foreland experienced a population increase of over 63,000 from 1950 to 1974, second only to Broad Valley Rockies. However in the period 1950 to 1970 the region grew faster than Broad Valley Rockies. Much of this growth can be attributed to the two major urban areas, Great Falls and Billings (Figure 114).

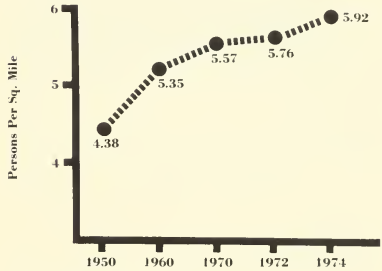
The region's population density is almost six persons per square mile and is very slowly approaching that of the Broad Valley Rockies (Figure 115).

Figure 114. Rocky Mountain Foreland Population, 1950-1974.



Sources: References 198, 216, and 217.

Figure 115. Rocky Mountain Foreland Population Density, 1950-1974.

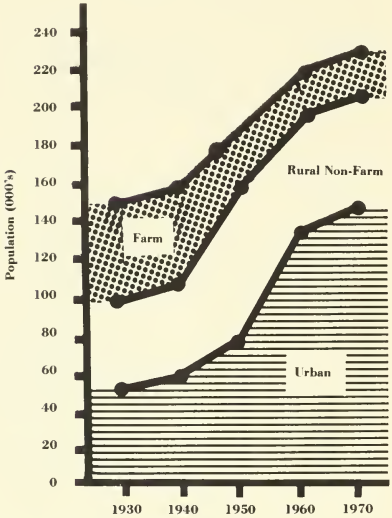


Sources: References 198, 216, and 217.

POPULATION DISTRIBUTION

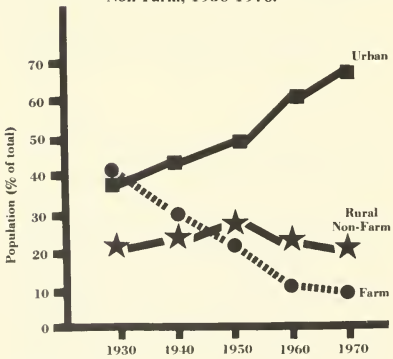
In 1930, more people in the Rocky Mountain Foreland Region lived on farms than in urban areas (Figure 116). Since then, the cities, especially Great Falls and Billings, have experienced extremely rapid growth, and over two-thirds of the region's people now live in urban areas. However, the 55 percent urban growth rate of the 1950s slowed to an 11 percent rise in the 1960s. As in all regions of the state, the farm population has decreased in absolute and relative size. The rural non-farm segment increased slightly in relative size between 1930 and 1950, but has declined since then and was slightly lower (in relative size) in 1970

Figure 116. Rocky Mountain Foreland Urban, Farm, and Rural Non-Farm Population, 1930-1970.



Source: Reference 119.

Figure 117. Rocky Mountain Foreland Percent of Population Urban, Farm, and Rural Non-Farm, 1930-1970.



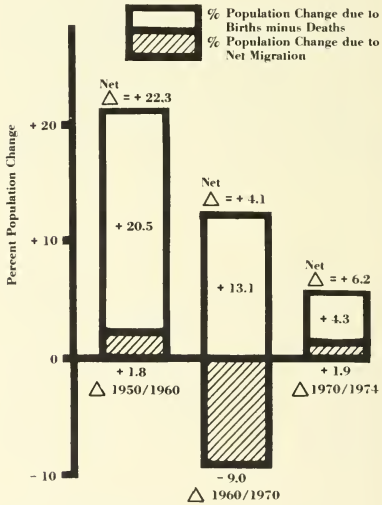
Source: Reference 119.

than in 1930 (119) (Figure 117). Bewteen 1970 and 1974 Cascade County and Yellowstone County gained 2,500 and 6,900 inhabitants, respectively. However Cascade County and the Great Falls area lost about 300 persons from 1973 to 1974 (9).

POPULATION CHANGE

The Rocky Mountain Foreland has ranked among the top three of Montana's fastest growing regions since 1950, even though the net gain of births over deaths has steadily decreased throughout this period. While there was a net in-migration of about 2 percent from 1950 to 1960 and from 1970 to 1974, there was a net out-migration of 9 percent of the population from 1960 to 1970 (Figure 118).

Figure 118. Rocky Mountain Foreland Population Changes (△) Reflected by Births minus Deaths and Net Migration, 1950-1974.



Sources: References 198 and 217.

ENERGY

To date practically all the coal production in the state has occurred in the Rocky Mountain Foreland (Figure 119). The region contains the bulk of the state's coal reserves: 77 percent of the economically recoverable reserves, or 11.7 billion tons (Table 18), and over 60 percent of the potentially recoverable reserves (Table 19).

About 4 percent of Montana's 1974 oil production came from the Foreland (Figure 120) and, similarly, almost 4 percent of the state's proven oil reserves are in the Rocky Mountain Foreland (Table 20).

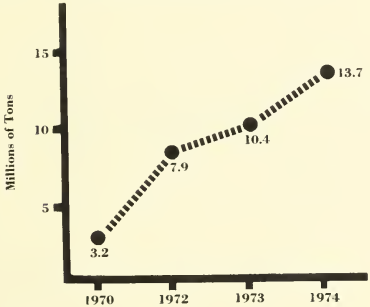
Unlike oil, almost 30 percent of Montana's 1974 natural gas production came from the Rocky Mountain Foreland, much of it from the Tiger Ridge Field (Figure 121). The Foreland contains 406 billion cubic feet of proven natural gas reserves, nearly 40 percent of Montana's total proven reserve (Table 21).

Table 18. Rocky Mountain Foreland Economically Recoverable Coal Reserves, 1973.

Coal Type	Millions of Tons	Resource Index
Surface		
Lignite	4,920	
Subbituminous	6,812	
Total	11,732	856

Source: Reference 163.

Figure 119. Rocky Mountain Foreland Coal Production, 1970-1974.



Source: Reference 140.

Table 19. Rocky Mountain Foreland Potentially Recoverable Coal Reserves, 1973.

Coal Type	Millions of Tons	Resource Index
Surface		
Lignite	8,200	
Subbituminous	11,410	
Underground		
Lignite	9	
Subbituminous	31,477	
Bituminous	689	
Total	51,785	3,780

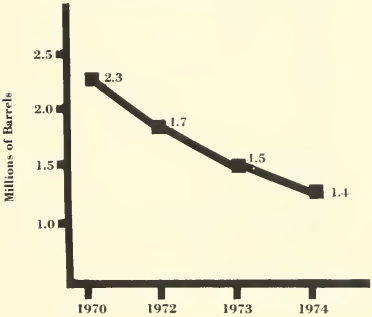
Sources: References 163, 208, and 213.

Table 20. Rocky Mountain Foreland Proven Recoverable Oil Reserves, 1974.

Millions of Barrels	Resource Index
11.0	7.8

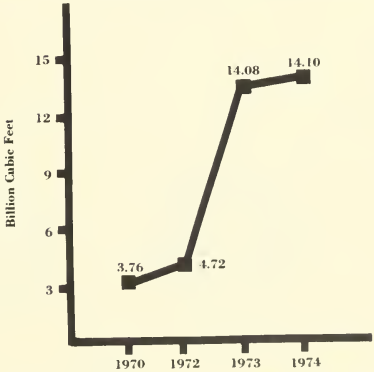
Source: Reference 143.

Figure 120. Rocky Mountain Foreland Oil Production, 1970-1974.



Source: Reference 143.

Figure 121. Rocky Mountain Foreland Natural Gas Production, 1970-1974.



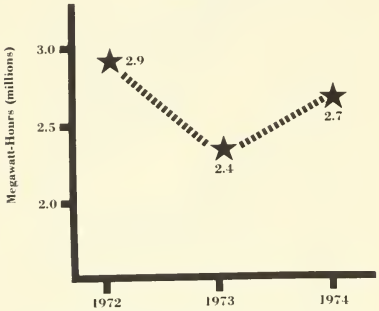
Source: Reference 143. Forty percent of Tiger Ridge Field production allocated to Rocky Mountain Foreland.

Table 21. Rocky Mountain Foreland Proven Recoverable Natural Gas Reserves, 1974.

Billion Cubic Feet	Resource Index
406	28.8

Sources: References 42, 58, 62, and 91. Figure excludes underground storage and includes one-half of the Tiger Ridge Field proven reserves.

Figure 122. Rocky Mountain Foreland Hydroelectric Generation, 1972-1974.



Sources: References 64 and 218. Figures represent net hydroelectric power generation, exclusive of plant use.

Table 22. Rocky Mountain Foreland Installed Hydroelectric Generating Capacity, 1973.

Maximum Nameplate Rating (Kw-Hours)
443,400

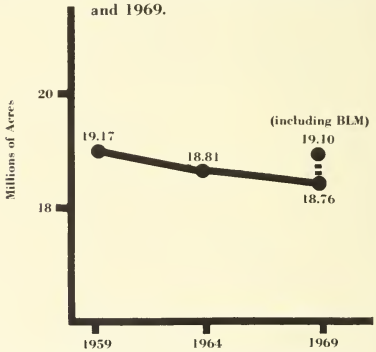
Source: Reference 164.

The Foreland also contains 30 percent of the hydroelectric capacity of Montana, making the region second only to the Columbia Rockies as a site for these facilities (Table 22). About 28 percent of Montana's 1974 net hydroelectric generation came from the Foreland (Figure 122).

LAND RESOURCES

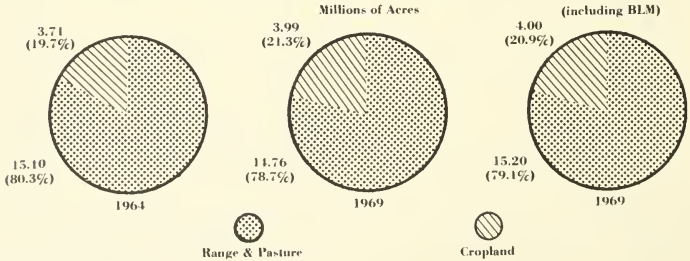
Almost 19 million acres or 27 percent of Montana's agricultural land is in the Rocky Mountain Foreland; one-fourth of its cropland and range and pastureland occur here. About 1 in 5 acres of agricultural land in the region is cropland. There was an increase in cropland of about 300,000 acres during the years 1958-1967. Apparently some of the increase came from converted range and pastureland as this acreage has shown a decline recently (Figures 123, 124, 125, and 126).

Figure 123. Rocky Mountain Foreland Agricultural Land in Farms, 1959, 1964, and 1969.



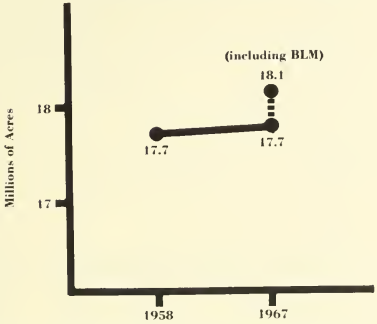
Sources: References 150 and 195. The Billings BLM district is included in the Rocky Mountain Foreland.

Figure 124. Rocky Mountain Foreland Distribution of Agricultural Land, 1964 and 1969.



Source: References 150, 151, and 152.

Figure 125. Rocky Mountain Foreland Cropland, Range, and Pasture, 1958 and 1967.



Sources: References 150, 151, and 152. The Billings BLM district is included in the Rocky Mountain Foreland.

There are 1.5 million acres of private and state forestland in the Rocky Mountain Foreland, and about 20 percent of the state total (Figure 127). According to groupings used here there is no federal forestland in the Rocky Mountain Foreland; only about 7 percent of the state's total forestland is found in the Rocky Mountain Foreland.

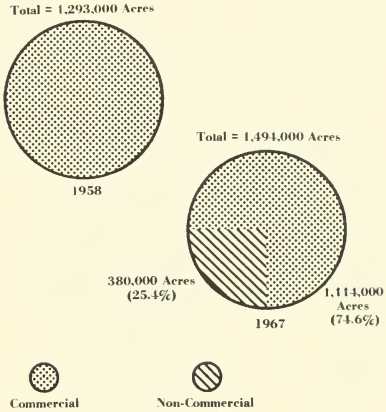
The Rocky Mountain Foreland has a little over 100,000 acres of wildlands in two roadless units managed by the U.S. Forest Service: the Highwoods and the Snowies. All of the Snowies unit has been proposed for study for possible inclusion in the National Wilderness Preservation System (76) (Table 23).

Table 23. Rocky Mountain Foreland Wildlands, 1975.

Classification	Acres
Proposed New Study Area	89,000
Roadless Areas (USFS)	110,360
Roadless Areas (BLM)	?

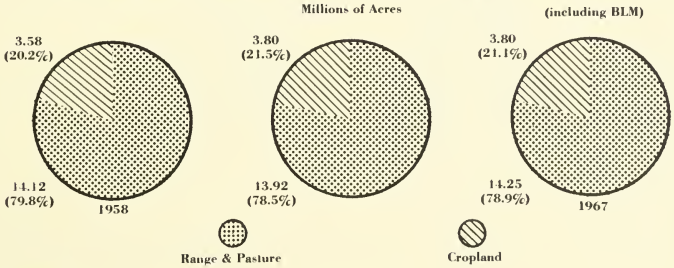
Source: Reference 76.

Figure 127. Rocky Mountain Foreland Private and State Forestland, 1958 and 1967.



Sources: References 150, 152, and 153.

Figure 126. Rocky Mountain Foreland Distribution of Cropland, Range, and Pasture, 1958 and 1967.

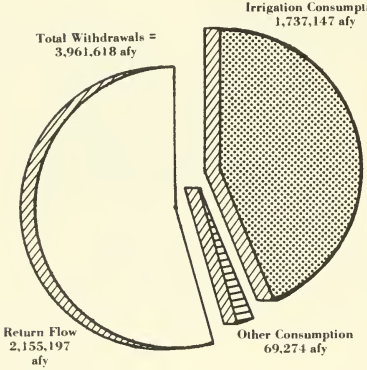


Sources: References 150, 151, and 152.

WATER RESOURCES

The Rocky Mountain Foreland accounts for 30 percent of the water withdrawn and consumed in the state, ranking second to the Broad Valley Rockies (134). The Yellowstone Basin, much of which is located in this region, has experienced an increase of 20,000 irrigated acres in the last two years and as many as 631,000 new irrigated acres are expected by the year 2000 (135). This additional acreage could consume 1,600,000 afy, nearly doubling the existing consumption level for the entire Rocky Mountain Foreland. Energy related activity could consume an additional 1,300,000 afy in the basin. These demands plus that required for instream flow protection would exceed Yellowstone basin supplies during an average water year (135) (Figure 128).

Figure 128. Rocky Mountain Foreland Water Withdrawals and Consumption of Withdrawals, 1970.

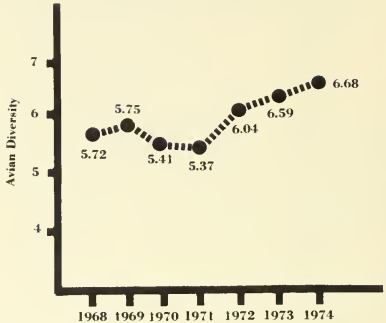


Source: Reference 134.

WILDLIFE DIVERSITY

Average breeding bird diversity along the six routes of the Rocky Mountain Foreland has been steadily increasing over the last three years (212) (Figure 129). Occupying the tension zone between the plains and the mountains, this region has a greater average diversity than any of the other plains regions but a lower average diversity than any of the regions of Rocky Mountain Montana. Mourning doves, which are now plentiful in the region, are reported to be very sensitive to air pollutants, particularly sulfur dioxide (115). Mourning dove numbers monitored along the Brandenberg route (about 20 miles downwind from

Figure 129. Rocky Mountain Foreland Avian Diversity, 1968-1974.



Source: Reference 212.

Colstrip) can be expected to give early warning of potentially dangerous emissions from coal conversion plants at Colstrip. Serious conflicts between coal development and wildlife have been anticipated in a series of wildlife inventory reports prepared recently by the Montana Department of Fish and Game under sponsorship of various federal agencies and private industries (83) (105) (113). Although the department reports that "nobody knows what will happen" regarding the effect of reclamation on wildlife (175), it is known with some certainty that coal mining would foreclose certain grouse mating grounds (169), and that plant emissions would impair wildlife productivity (133). Water withdrawals for power plants could have a detrimental effect on fish in the lower Yellowstone drainage (16).

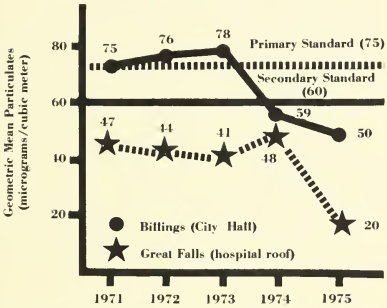
AIR QUALITY

The only Great Plains region with known significant air quality deterioration in Montana is the Rocky Mountain Foreland, particularly the metropolitan areas of Billings and Great Falls.

Billings. The year 1974 was the first in which mean annual particulate levels in Billings fell below either the primary or secondary ambient standards (Figure 130). The trend toward clean air appears to be continuing. However, Billings and Yellowstone County have other pollution problems besides particulates, including sulfur gases, odors and fluoride from a number of major industries, and dust and emissions associated with dirty and unpaved streets and automobile traffic. Three industries in the Billings area currently are in violation of state air quality standards: the Exxon and Cenex refineries and the Montana Power Company Corette plant (99). Air pollution control efforts in Billings have begun to switch from large industrial sources to small industries, homes and cars (88) (171).

Great Falls. Mean annual particulate levels in Great Falls have been below the federal ambient secondary standard for the last five years (Figure 130). For a city of comparable size, air pollution in Great Falls is not nearly the problem it is in Billings, due in part to much better ventilation (particularly chinook winds) and fewer heavy industries.

Figure 130. Annual Geometric Mean Particulate Levels Recorded in Billings and Great Falls, 1971-1975.



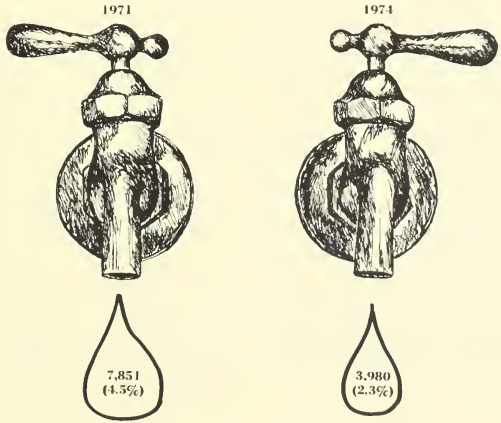
Source: Reference 124. Measurement method was gravimetric using a high volume sampler.

WATER QUALITY

With more people on public water supplies than any other region in 1971 — 174,127 — the Rocky Mountain Foreland had the third lowest percentage of those receiving unsatisfactory water: 4.5 percent. This percentage was cut in half in 1974, the third lowest rate in the state (Figure 131). The public water supply for the energy boom town of Colstrip was contaminated in the fall of 1974; however, the problem has been corrected (17) (18) (26).

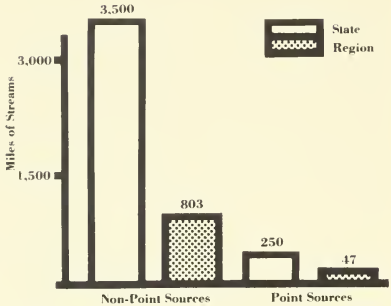
Most stream degradation in the Rocky Mountain Foreland results from natural sediments and salts washed away through poor land use practices. This includes the phenomenon of saline seep, potentially the most serious non-point source pollution problem in Great Plains Montana. Two major municipal dischargers — Billings and Great Falls — and seven principal industrial dischargers are mainly responsible for the 47 miles of streams degraded by point sources (129) (Figure 132). Significant problem areas include severe erosion of the Muddy Creek channel near Great Falls (due largely to poor irrigation practices), acid mine drainage in the Belt Creek drainage (from past mining activities), and bacteria in the Missouri River down to Fort Benton from the Great Falls sewage treatment plant effluent (35). The Muddy Creek sediment problem, perhaps the most troublesome in the Foreland, is expected to be the subject of a $250,000 control feasibility study by the Bureau of Reclamation, provided funding is appropriated by Congress (6). In the southern portion of the Foreland the Yellowstone River is getting cleaner (39), although "the potential for water quality degradation due to energy development . . . is enormous" (103).

Figure 131. Rocky Mountain Foreland Population Delivered Unsatisfactory Drinking Water, 1971 and 1974.



Source: Reference 47.

Figure 132. Rocky Mountain Foreland Point and Non-Point Source Stream Degradation, 1975.



Source: Reference 129.

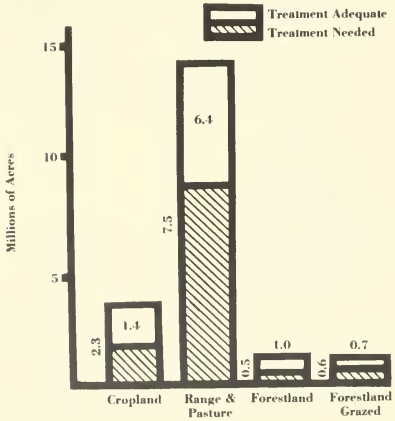
LAND QUALITY

Although most agricultural land in the Rocky Mountain Foreland is in range and pasture, the region's cropland appears to be in worse shape with over 60 percent requiring conservation treatment in 1967 (153) (Figure 133). "Much of the sediment in the Clarks Fork of the Yellowstone and Muddy Creek, a tributary of the Sun River, is known to result from agricultural practices" (129). Nearly 10 million acres of cropland, range and pasture were in need of treatment in the region in 1967 (153), compared to 95,875 acres damaged by saline seep in central Motnana (132) and 897 acres disturbed by strip mining in the Foreland as of 1974 (138).

The data in Figure 134 on saline seep damage in central Montana were obtained from two different sources, each of which used different census methods. The data for 1974 are probably more accurate than those of previous years. Therefore, while there appears to be a slight recovery from 1973 to 1974, this more likely reflects the fact that previous estimates for some counties were unduly high, especially for Stillwater County (92).

The Billings district of the Bureau of Land Management (BLM) coincides roughly with the Rocky Mountain Foreland Region and contains about 4 percent of all BLM lands in Montana. The ratio of declining to improving acres in 1963-1964 was 3:2 and over 50,000 acres were in poor or bad condition (49) (Figure 135).

Figure 133. Rocky Mountain Foreland Private and State Agricultural and Forestland Requiring Conservation Treatment, 1967.

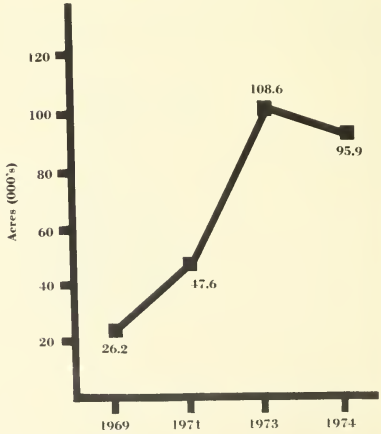


Source: Reference 153.

HEALTH STATUS

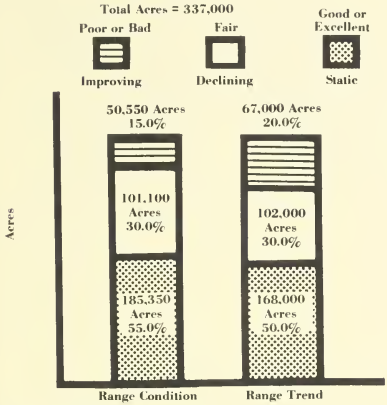
The Rocky Mountain Foreland has had steady improvement in the perinatal death rate since 1965 (Figure 136). Both the perinatal death rate and county health status index are close to the statewide average (Table 24).

Figure 134. Rocky Mountain Foreland Acres Damaged by Saline Seep, 1969-1974.



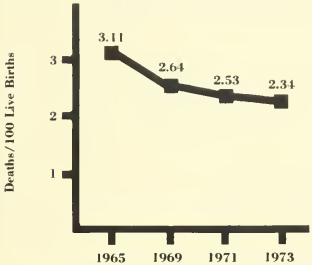
Sources: References 92 and 132.

Figure 135. Rocky Mountain Foreland Range Condition and Trend for Land under BLM Management, 1963-1964.



Source: Reference 49.

Figure 136. Rocky Mountain Foreland Perinatal Death Rate, 1965-1973.



Sources: References 118 and 125.

Table 24. Rocky Mountain Foreland Health Status Index, 1968-1972.

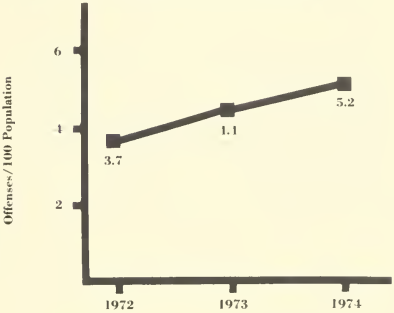
323.3

Source: Reference 78.

CRIME

The crime rate in the Rocky Mountain Foreland has steadily increased and has remained the highest in the state. It is twice as great as in the Sweetgrass Plains Region and over three times the rates in the Big Dry and Two Rivers regions (Figure 137).

Figure 137. Rocky Mountain Foreland Offenses Known to Police, 1972-1974.



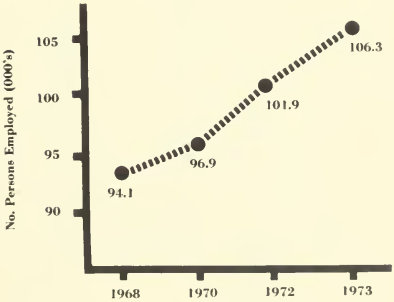
Source: Reference 52.

EMPLOYMENT

From 1968 to 1973 the Rocky Mountain Foreland added over 12,000 new jobs, an almost 13 percent increase (Figure 138). The private non-farm sector contributed about 10,500 of these and the remainder was caused by increases in the government sector. The farm sector had an absolute decline of 225 jobs. The government sector employs a greater percentage of workers in this region than any other region, slightly more than 1 in 5 (Figure 139).

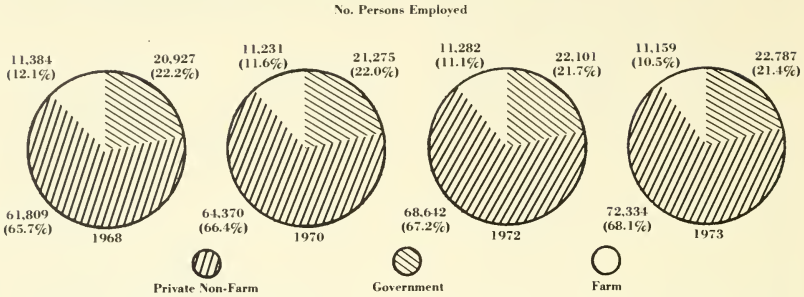
The unemployment rate in the Rocky Mountain Foreland showed a sharp increase during 1970-1972 but since then has remained stable (Figure 140).

Figure 138. Rocky Mountain Foreland Total Employment, 1968-1973.



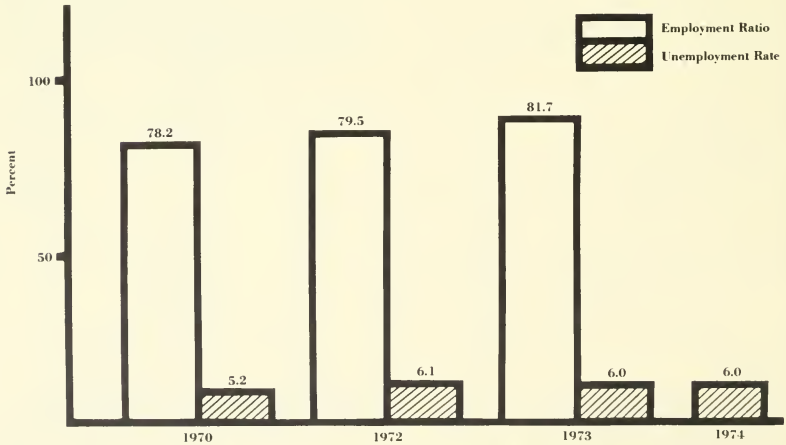
Source: Reference 196.

Figure 139. Rocky Mountain Foreland Employment by Sector, 1968-1973.



Source: Reference 196.

Figure 140. Rocky Mountain Foreland Unemployment Rate and Employment Ratio, 1970-1974.



Sources References 131 and 196. Unemployment rate computed using state Dept. of Labor and Industry Montana Labor Market Area data for Great Falls, Billings, Lewistown, and Hardin.

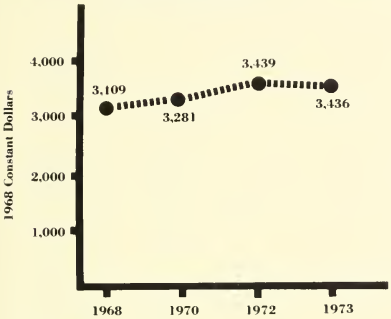
INCOME

The Rocky Mountain Foreland has had a steady increase in per capita personal income of close to the state average, while in absolute terms staying consistently above the average (Figure 141).

The region has been led by strong EPE growth in the farm sector (Figure 142). The government sector showed a slight increase while the private non-farm sector had an absolute decline, although the smallest of any region in the state.

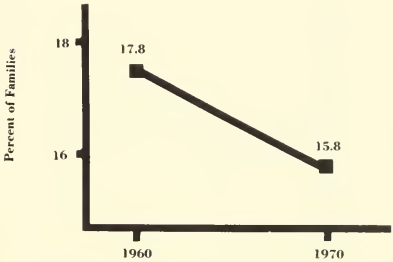
There was a slight improvement in the percentage of families earning subsistence incomes although less improvement than the state as a whole (Figure 143).

Figure 141. Rocky Mountain Foreland Per Capita Income, 1968-1973.



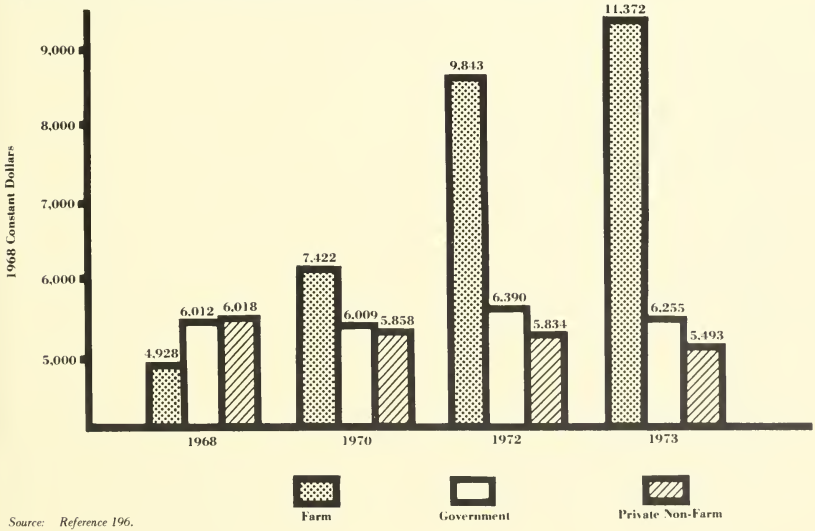
Sources: References 196 and 197.

Figure 143. Rocky Mountain Foreland Families Earning Less than $3,000/Year in 1960 and $4,000/Year in 1970.



Source: Reference 198.

Figure 142. Rocky Mountain Foreland Earnings Per Employee, 1968-1973.

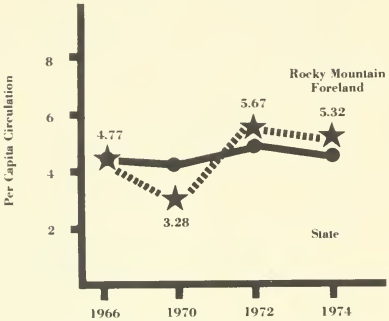


Source: Reference 196.

LIBRARY CIRCULATION

This very large area does not coincide with any of the federation library service areas. The Rocky Mountain Foreland includes the two largest cities in the state — Billings and Great Falls — with two of the largest libraries. It also contains Golden Valley County where no public library service exists (Figure 144).

Figure 144. Rocky Mountain Foreland Library Circulation, 1966-1974.

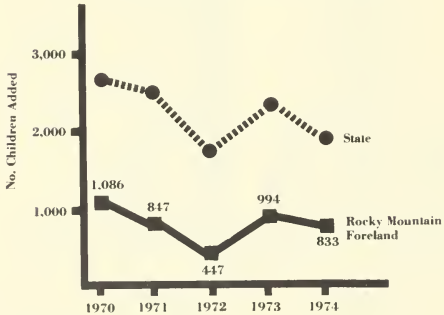


Sources: References 146, 147, 148, and 149.

CHILD WELFARE

The number of children in the Rocky Mountain Foreland added to the Child Welfare Service case load has followed the statewide trend (Figure 145).

Figure 145. Rocky Mountain Foreland Children Added to Child Welfare Services, 1970-1974.

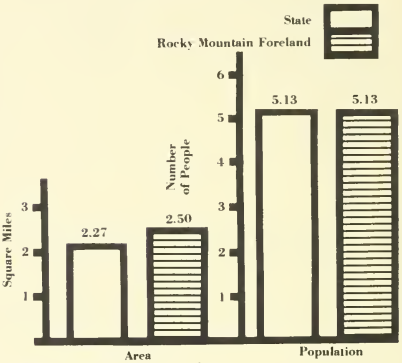


Source: Reference 137.

RURAL ROAD SYSTEM

Even though each mile of rural road in the Foreland serves the same area as in the Broad Valley Rockies, the number of people served per mile of road is much less. This is a reflection of the fact that the rural population in the Forelands is a smaller fraction of the total than in the Broad Valley Rockies (119) (130) (153) (Figure 146).

Figure 146. Rocky Mountain Foreland Rural Area and Population Served per Mile of Rural Road, 1970.



Sources: References 119, 130, and 153.

Map 8. Sweetgrass Plains

SWEETGRASS PLAINS

ENVIRONMENTAL PERSPECTIVE

This region is environmentally similar to the Two Rivers Region. Were these regions not spatially separated, they would be considered a single region. Both are major grain, petroleum, and natural gas producing areas of the state. Some milling and oil refining is present. The population is more uniformly spread and the towns are more evenly spaced than in the other regions of the state.

The landscape of the Sweetgrass Plains is mainly characterized by dry-land grain farming. Wheat is the principal crop, but increasing amounts of barley are produced. There is little irrigation. The grain crops are grown by the fallow system and other dry-farming methods. Giant machinery is employed. The grain and fallow fields are characteristically laid out in alternate north-south strips, perpendicular to the predominant wind direction. The waving fields of what and the rectangular patterns make the dry-land grain landscape visually distinctive. Cultivation has greatly modified the soil. The bare fallow strips are a ready source of dust as are gravel crushing and road construction activites in the area. And the practice of the fallow system for nearly half a century has brought about the saline seep problem. The roar of diesel tractors, the chaff from combines, and the whistle of freight trains are very much a part of the "wheat-fallow environment." A typical "wheat town," such as Chester, is easily recognizable because of its rail line, grain elevators, agricultural implement dealers, and gasoline and pesticide distributors.

Photo 22. A saline seep on the Highwood Bench.

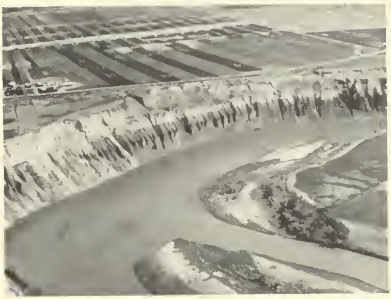


Photo 23. Aerial view of the Missouri River near Fort Benton.

More winter wheat than spring wheat is produced in the Sweetgrass Plains, whereas the reverse is true in the Two Rivers Region. The Sweetgrass Plains have a drier summer, a less severe winter, and more snow than the Two Rivers Region. Winter wheat is better adapted to these conditions than spring wheat. Also, the Sweetgrass Plains have a higher proportion of the land under cultivation than does northeastern Montana. This is due to the smoother topography of the Sweetgrass Plains, the only large area of genuine plains in Montana.

The plains, plateaus, and hills of Great Plains Montana are formed on rather soft sedimentary rocks. North of the Missouri River, the plains and plateaus are covered with glacial till deposits. The topography of the till-covered areas is more rounded and less rough than that of the stream-dissected areas south of the Missouri. The layers of sedimentary rock are not quite horizontal, rather they undulate. It is in the upwarps — arches or domes — of these rock layers that petroleum and natural gas are found. One of these upwarps, the Sweetgrass Arch, is located in the Sweetgrass Plains Region and constitutes one of the four major oil-and-gas producing areas of the state. There are medium sized petroleum refineries at Cut Bank and Kevin. Cut Bank, Shelby, and Conrad are the principal "oil towns." The landscape and atmosphere of the drilling areas and oil towns are similar to those to be described in the Two Rivers Region, the most important of Montana's environmental regions in petroleum production.

The population is moderately dense in the Montana context, that is, less dense than that of irrigated districts but more dense than that of ranching areas. Both the rural

population and the towns are more evenly spread over the land than anywhere else in the Big Sky country. The region is traversed by the High Line and Interstate 15, which cross at Shelby. Havre, one of the 12 regional trade centers of the state, is situated in the northeastern corner of the Sweetgrass Plains, but much of the region is served by Great Falls.

The country road network is the most dense in Montana, but this high accessibility does not foster a significant recreation industry. About the only recreation attractions are the several irrigation reservoirs and the section of the Missouri which crosses the region in the Ft. Benton area. The Sweetgrass Hills, a small group of mountain outliers standing upon the Sweetgrass Plains, have some appeal for recreation. But the predominance of private land ownership in and around them greatly limits public access. They are of exceptional esthetic value to the region because of their conspicuousness.

Cultivation, road building, drilling operations, and settlement have so completely transformed the Sweetgrass Plains that few vestiges remain of the blue grama-western wheatgrass-needlegrass short-grass steppe that originally covered the plains of the region.

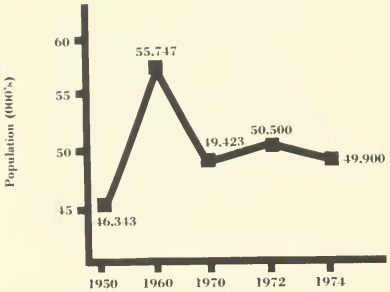
POPULATION SIZE AND DENSITY

The population in the Sweetgrass Plains grew very slowly from 1950 to 1970, 6.6 percent, and has remained stable since then (Figure 147). The region's population density has fluctuated throughout the 1950-1974 period, but has remained low (Figure 148).

POPULATION DISTRIBUTION

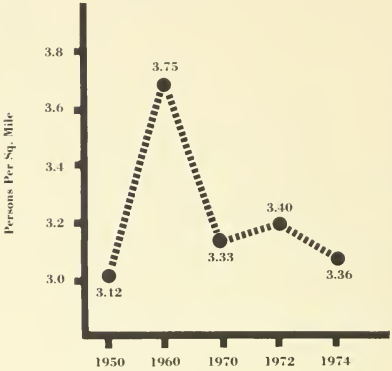
The Sweetgrass Plains is one of three regions of the state where total population has been declining in the past

Figure 147. Sweetgrass Plains Population, 1950-1974.



Sources: References 198, 216, and 217.

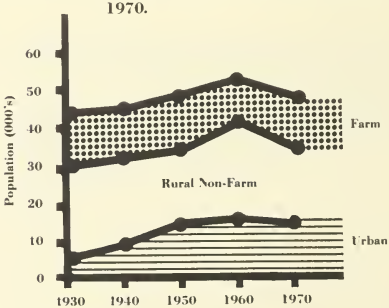
Figure 148. Sweetgrass Plains Population Density, 1950-1974.



Sources: References 198, 216, and 217.

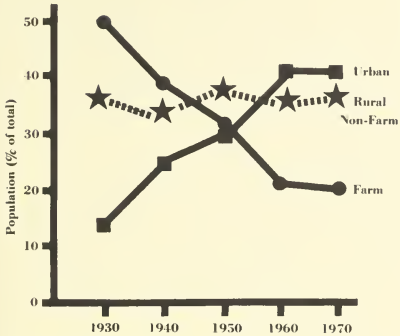
15 years (Figure 149). Since 1930, the farm population has halved in size and has gone from just under 50 percent to just over 20 percent of the total for the region. The rural non-farm segment has held steady in relative size, but urban areas grew rapidly between 1930 and 1960, and the urban population is now the largest segment (Figure 150). All three segments experienced a 6 percent to 9 percent drop in size during the 1960s. Of the four urban areas (Havre, Cut Bank, Shelby and Conrad), only Conrad's population rose during the 1960s (9), but in 1975 Havre appeared to experience an influx of people due to a recent resurgence in coal, oil, and gas exploration.

Figure 149. Sweetgrass Plains Urban, Farm, and Rural Non-Farm Population, 1930-1970.



Source: Reference 119.

Figure 150. Sweetgrass Plains Percent of Population Urban, Farm, and Rural Non-Farm, 1930-1970.



Source: Reference 119.

POPULATION CHANGE

The Sweetgrass Plains went from vigorous population growth in the 1950s to an abrupt decline in the 1960s, due both to a decrease in net gain of births over deaths and a large percentage of the population leaving the region. Out-migration has surpassed in-migration since 1950. The situation since 1970 appears to have stabilized, achieving a net overall growth of 1.0 percent (Figure 151).

ENERGY

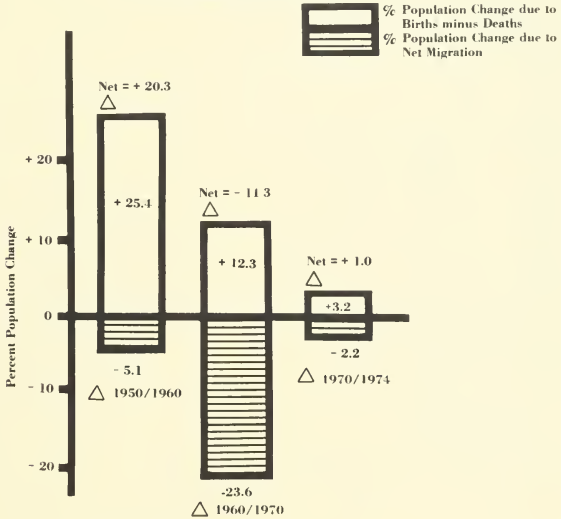
The Sweetgrass Plains has a very small amount of potentially recoverable coal reserves (Table 25) and no hydroelectric facilities, although small amounts of coal have been extracted recently in the region.

Table 25. Sweetgrass Plains Potentially Recoverable Coal Reserves, 1973.

Coal Type	Millions of Tons
Surface	
Subbituminous	61

Source: Reference 213.

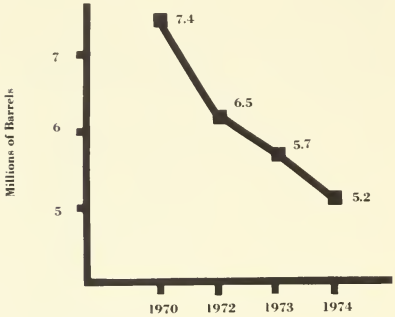
Figure 151. Sweetgrass Plains Population Changes (△) Reflected by Births minus Deaths and Net Migration, 1950-1974.



Sources: References 198 and 217.

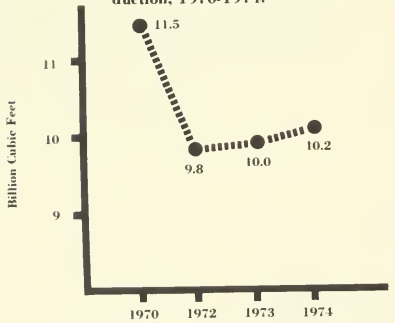
The Sweetgrass Plains accounted for 15 and 20 percent respectively of Montana's 1974 oil and natural gas production (Figure 152 and Figure 153). It contains a fourth of the proven oil reserves in Montana and has the greatest expected life of such reserves of any region in the state, almost 15 years (Table 26). It contains about 20 percent of the state's natural gas reserves, with an expected life of 19 years at current rates of production (Table 27).

Figure 152. Sweetgrass Plains Oil Production, 1970-1974.



Source: Reference 143.

Figure 153. Sweetgrass Plains Natural Gas Production, 1970-1974.



Source: Reference 143. Twenty percent of Tiger Ridge Field production is allocated to Sweetgrass Plains Region.

Table 26. Sweetgrass Plains Proven Recoverable Oil Reserves, 1974.

Millions of Barrels	Resource Index
75.3	14.5

Source: Reference 143.

Table 27. Sweetgrass Plains Proven Recoverable Natural Gas Reserves, 1974.

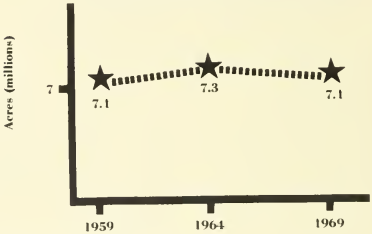
Billion Cubic Feet	Resource Index
194	19.0

Sources: References 42, 58, and 62.

LAND RESOURCES

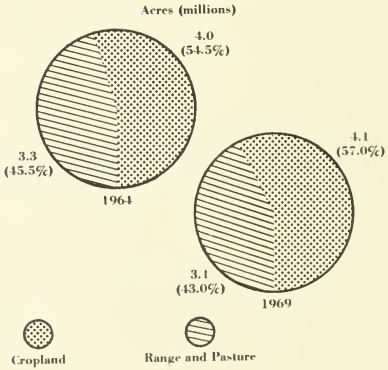
The Sweetgrass Plains contains about 10 percent of the state's agricultural land; however, it contains 25 percent of

Figure 154. Sweetgrass Plains Agricultural Land in Farms, 1959, 1964, and 1969.



Sources: References 150 and 195.

Figure 155. Sweetgrass Plains Distribution of Agricultural Land, 1964 and 1969.

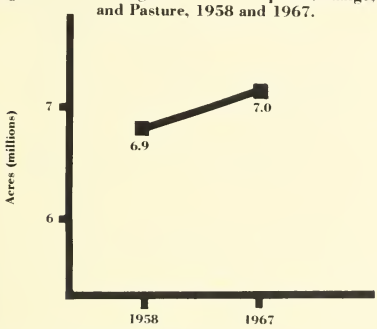


Sources: References 150 and 195.

the state's cropland: about 4 million acres. Today almost 60 percent of this region's agricultural land is in cropland showing an increase of almost 200,000 acres in the period 1958-1967. Range and pastureland showed a slight decline indicating that some of this land was converted to cropland since the total amount of land in agricultural use remained fairly stable (Figures 154, 155, 156, and 157).

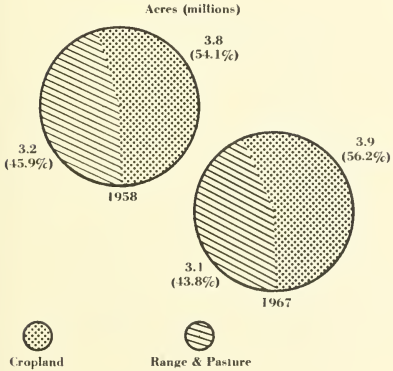
There are 97,000 acres of private and state forestland in the Sweetgrass Plains, 70,000 of which are classed as commercial (Figure 158).

Figure 156. Sweetgrass Plains Cropland, Range, and Pasture, 1958 and 1967.



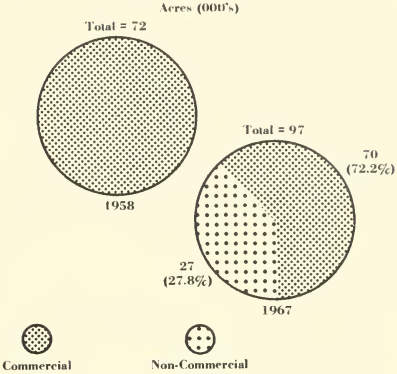
Sources: References 150, 151, and 152.

Figure 157. Sweetgrass Plains Distribution of Cropland, Range, and Pasture, 1958 and 1967.



Sources: References 150, 151, and 152.

Figure 158. Sweetgrass Plains Private and State Forestland, 1958 and 1967.

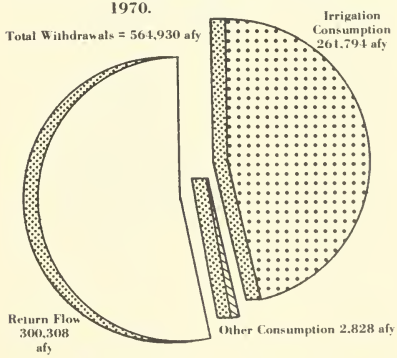


Sources: References 150, 151, and 153.

WATER RESOURCES

Primarily a region of dry-land agriculture, the Sweetgrass Plains accounts for only 4 percent of the water withdrawn and depleted in the state (134) (Figure 159). Even so, about 70 miles of the Teton River are chronically dewatered as the result of irrigation withdrawals (129), although the river may have stopped flowing naturally prior to irrigation. Tiber Dam was built on the Marias River for irrigation but to this day little if any water is stored for irrigation purposes.

Figure 159. Sweetgrass Plains Water Withdrawals and Consumption of Withdrawals, 1970.

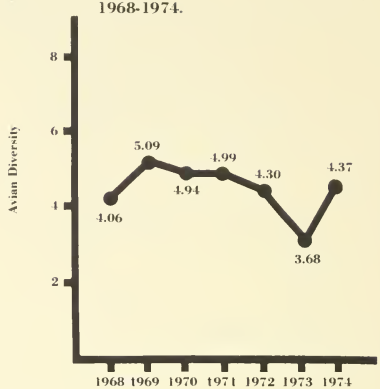


Source: Reference 134.

WILDLIFE DIVERSITY

Bird diversity along the Sunburst route in the northwest corner of the Sweetgrass Plains has been on a general decline in recent years (212) (Figure 160). As evaluated by bird observations along this route, the Sweetgrass Plains has the lowest avian diversity of any environmental region in the state, an indication of a limited array of habitats in this largely agricultural region. About 94 percent of the region is devoted to agriculture and almost 60 percent of the agricultural land is cropland (195), which long ago replaced the native prairie that supported bison, elk, sheep and grizzly bear. Most deer habitat is along sheltered river bottoms where whitetails are holding their own, thanks partly to restricted hunting seasons (74).

Figure 160. Sweetgrass Plains Avian Diversity, 1968-1974.



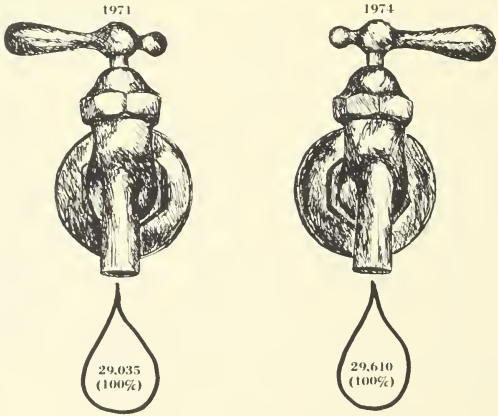
Source: Reference 212.

WATER QUALITY

The entire population of the Sweetgrass Plains served by public water supplies was delivered suitable drinking water in both 1971 and 1974 (47) (Figure 161).

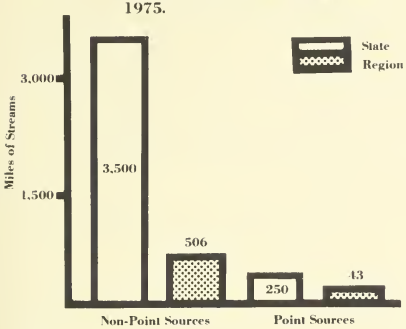
Most stream pollution in the Sweetgrass Plains is from salts, sediment, elevated temperatures and dewatering caused by agricultural practices. One of the smallest regions in the state, the Sweetgrass Plains has the third highest mileage of streams degraded (129) (Figure 162). The most severe water pollution problem in the region, particularly in the Marias River basin, is salinity from saline seep. "Moderately severe" problems are ammonia toxicity from Conrad and Cut Bank sewage pond overflows and dewatering of the Teton River by irrigation withdrawals, with salts and nutrients added downstream by return flows (87). Agriculturally derived salts and nutrients are also added to the Teton by discharge from the Fish and Game Department's Freezeout Lake Waterfowl Poject (74). The Milk River from Canada to Havre receives some minor agricultural pollution (33) but the Missouri River above Fort Benton is significantly affected by effluent from the Great Falls sewage treatment plant (35) and perhaps by lawn fertilizers and other chemicals contained in urban runoff. Groundwater problems from oil and gas development have also been reported from the Sweetgrass Plains.

Figure 161. Sweetgrass Plains Population Delivered Satisfactory Drinking Water, 1971 and 1974.



Source: Reference 47.

Figure 162. Sweetgrass Plains Point and Non-Point Source Stream Degradation, 1975.

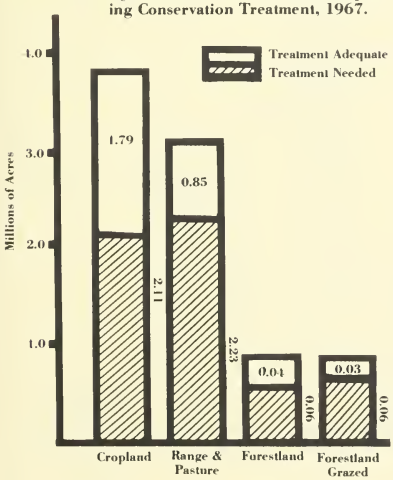


Source: Reference 129.

LAND QUALITY

Cropland is the single largest agricultural land use in the Sweetgrass Plains. Over 2 million acres or 54 percent of the cropland was in need of conservation treatment in 1967 (Figure 163). Although range and pasture rank second in land use acreage, more range and pasture acres (2,230,042) than cropland acres (2,106,618) were in need of treatment in 1967 (127). More recently, with increased grain prices, poor to marginal land is being plowed and converted to crops with attendant wind erosion and air pollution. The use of fertilizers and chemicals for controlling weeds and insect pests is also increasing in the Sweetgrass Plains.

Figure 163. Sweetgrass Plains Private and State Agricultural and Forestland Requiring Conservation Treatment, 1967.

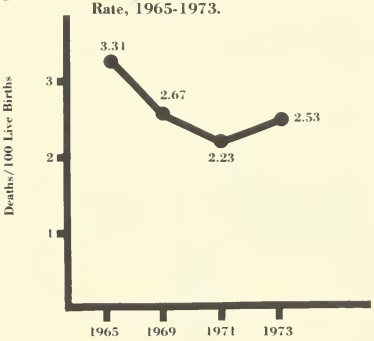


Source: Reference 153.

HEALTH STATUS

The Sweetgrass Plains is one of only two regions in the state experiencing a worsening of the perinatal death rate during the period 1965-1973 (Figure 164). The county health index is given in Table 28.

Figure 164. Sweetgrass Plains Perinatal Death Rate, 1965-1973.



Sources: References 118 and 125.

Table 28. Sweetgrass Plains Health Status Index, 1968-1972.

324.0

Source: Reference 78.

CRIME

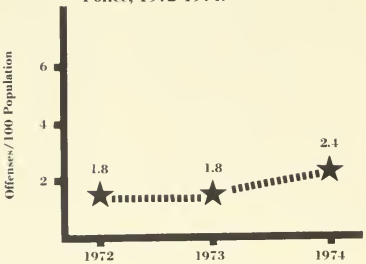
The crime rate in the Sweetgrass Plains, like that in the Big Dry and Two Rivers regions, is lower than the statewide average, although an increase was recorded in 1973-1974 (Figure 165).

EMPLOYMENT

Over 2,000 jobs were added in the Sweetgrass Plains in the period 1968-1973, 1,600 of which were contributed by the private non-farm sector and the remainder from the government sector (Figure 166). The farm sector had an absolute decline of 83 workers or only 1.5 percent. However, that sector still employs almost 1 in 4 workers (Figure 167).

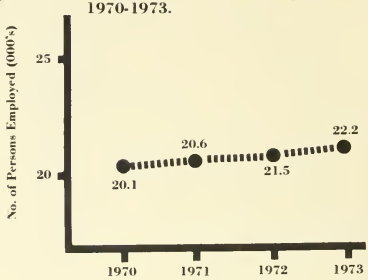
The unemployment rate increased between 1970 and 1972 and has remained stable since then at about 6 percent, which is below the state average (Figure 168).

Figure 165. Sweetgrass Plains Offenses Known to Police, 1972-1974.



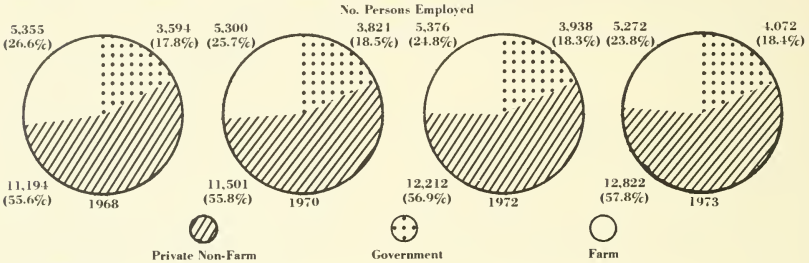
Source: Reference 52.

Figure 166. Sweetgrass Plains Total Employment, 1970-1973.



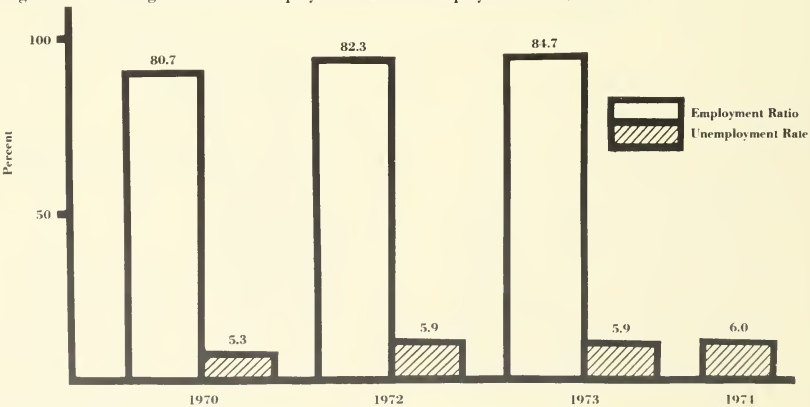
Source: Reference 196.

Figure 167. Sweetgrass Plains Employment by Sector, 1968-1973.



Source: Reference 196.

Figure 168. Sweetgrass Plains Unemployment Rate and Employment Ratio, 1970-1974.



Sources: References 131 and 196. Unemployment rate computed using state Dept. of Labor and Industry Montana Labor Market Area data for Shelby and Havre.

INCOME

The Sweetgrass Plains has consistently ranked at or near the top in PCPI. Its rate of growth has also exceeded the state average and as of 1973 was 26 percent above the state average (Figure 169).

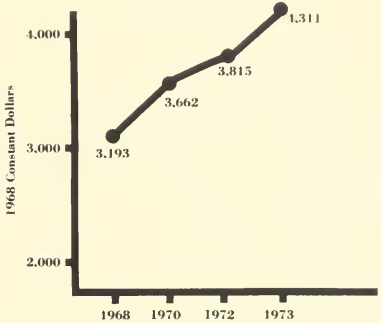
The growth in personal earnings is totally due to the farm sector, which employs almost 1 in 4 workers and shows an average earnings per employee (EPE) of almost $19,000 per year in 1973 (Figure 170). The government sector showed a stable EPE. The private non-farm sector showed an absolute decline.

The percentage of low-income families has remained fairly stable (Figure 171).

LIBRARY CIRCULATION

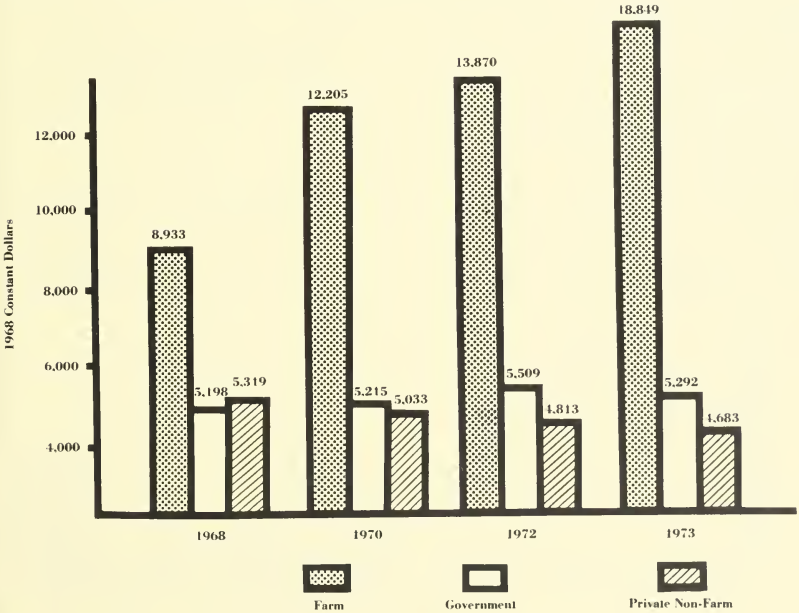
The Sweetgrass Plains Region has decreased in population since 1966. No report of circulation statistics was received in 1974 from Toole County, and this affects the circulation picture for the year. In Hill County there are

Figure 169. Sweetgrass Plains Per Capita Income, 1968-1973.



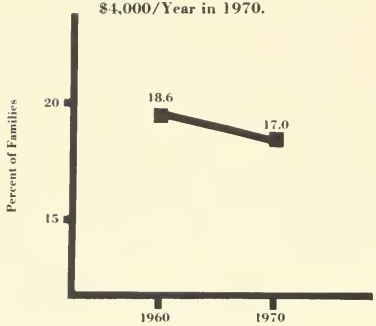
Sources: References 196 and 197.

Figure 170. Sweetgrass Plains Earnings Per Employee, 1968-1973.



Source: Reference 196.

Figure 171. Sweetgrass Plains Families Earning Less than $3,000/Year in 1960 and $4,000/Year in 1970.



Source: Reference 198.

two public libraries which probably could be consolidated for better and more economical library service to the area. The combined city-county funding of one strong public library — easily accessible and well stocked — would probably generate greater use. The library circulation trend is contained in Figure 172.

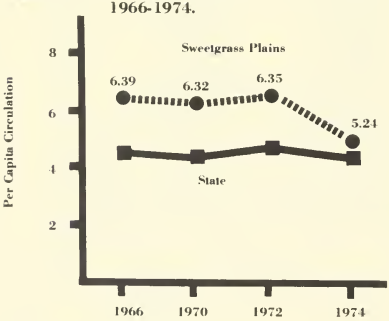
CHILD WELFARE

The number of children receiving child welfare services in the Sweetgrass Plains decreased 27 percent between 1973 and 1974 (Figure 173).

RURAL ROAD SYSTEM

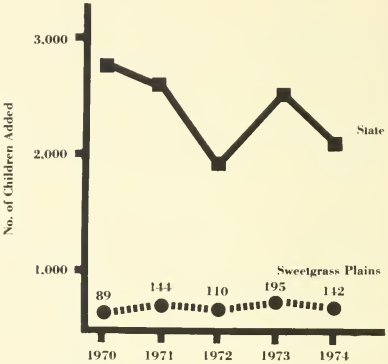
In spite of its relatively small population, the Sweetgrass Plains has the most complete system of local roads serving the rural population. Rural mileage per square mile of area is almost double the state average (Figure 174). This is perhaps because of the gentle terrain and the regular geometry of agricultural fields in the region. In such rural regions as the Sweetgrass Plains, there is an almost total dependence on private transportation. For example, in Chester there is no bus, train or taxi service.

Figure 172. Sweetgrass Plains Library Circulation, 1966-1974.



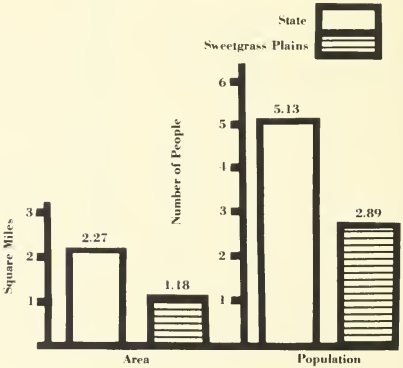
Sources: References 146, 147, 148, and 149.

Figure 173. Sweetgrass Plains Children Added to Child Welfare Services, 1970-1974.

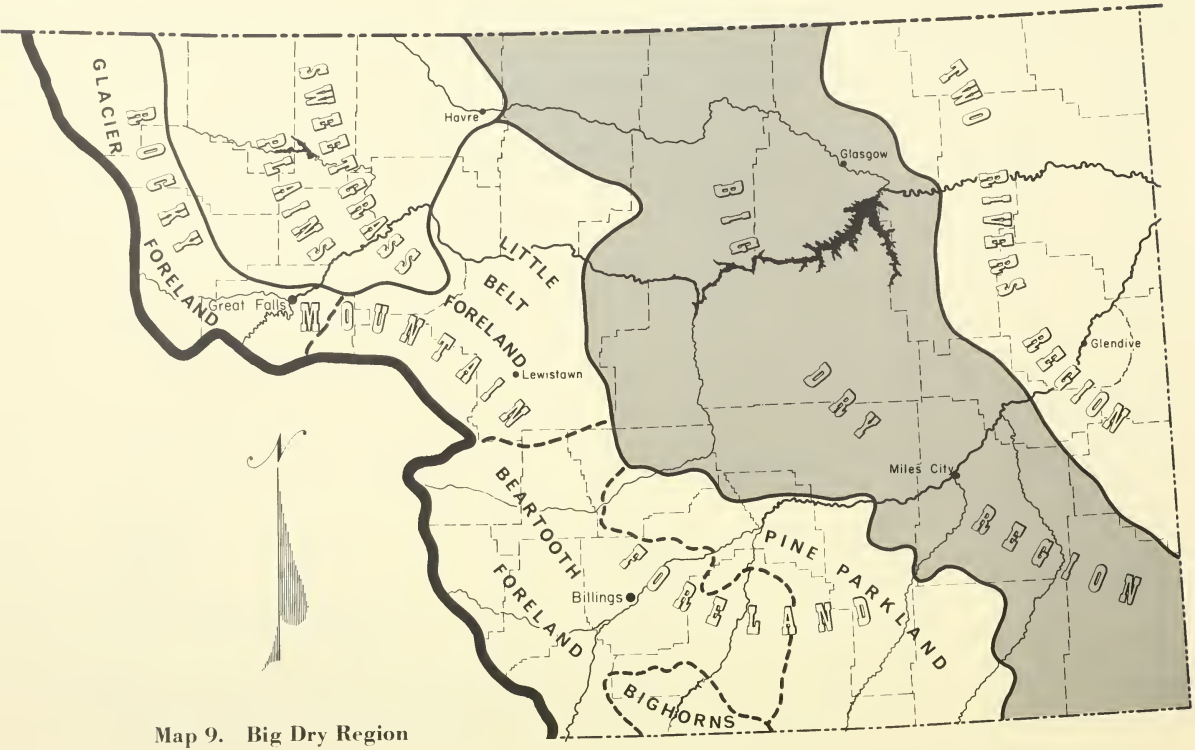


Source: Reference 137.

Figure 174. Sweetgrass Plains Rural Area and Population Served per Mile of Rural Road, 1970.



Sources: References 119, 130, and 153.



Map 9. Big Dry Region

BIG DRY REGION

ENVIRONMENTAL PERSPECTIVE

The Big Dry is one of the largest environmental regions in Montana and at the same time one of the least populated. It takes its name from Big Dry Creek to suggest the forlorn character of this vast eastern interior of the Treasure State. The region is a great grassy expanse traversed by two irrigated valleys and by Ft. Peck Reservoir.

These three linear features, which extend across the Big Dry, break up the remainder of the region into four interfluvial areas. These areas are the genuine "cow country" that is prominent in the Eastern stereotype of Montana. They are vast expanses of what was originally blue grama-western wheatgrass-needlegrass short grassland. These rangelands have been greatly modified by grazing, cultivation (now mostly abandoned), and erosion. Numerous weedy or shrubby species have increased and invaded at the expense of the native perennial grasses. The terrain is rather rough: till-covered plateau north of Ft. Peck Reservoir, stream-dissected plateau between the reservoir and the Yellowstone, and rough hills and plains south of this river. Beef cattle and sheep are raised on the immense ranches. The ranch headquarters are widely spaced and often marked by windmills in this land of intermittently dry streams. The bawl of calves, the baa of sheep, the smell of branding, and the jingle of spurs are still a big part of life in the ranching country. Patches of dry-land grain farming occur, especially north of the Milk River and in the Rock Springs area between Miles City and Jordan. But

Photo 24. Rimrocks near Winnett.

Photo 25. Mule deer and sandstone outcrops in the Big Dry Region.

rangeland dominates the region. The rangeland is of little interest for recreation except hunting. There are limited areas of special interest, such as Medicine Rocks near Ekalaka.

Population is scant in the ranching areas. Hamlets and villages are few and towns do not exist. In this age of fast cars and highways, ranchers no longer shop in the "ranchers' towns." These are Jordan, Broadus, and Ekalaka. They show signs of serious decline and deterioration. The road net is among the least dense in the state, comparable in this regard to the Columbia Rockies. In pronounced contrast to the wheat country, there is only one significant railway branch line in the entire Big Dry.

More of the population and towns of the region are concentrated along the narrow irrigated strips in the incised valleys of the Milk and Yellowstone rivers. The Milk River towns are Glasgow, Malta, Harlem, and Chinook. Miles City, which probably retains more of the "cowboy" flavor than any other Montana town its size, is the only sizeable community along the Big Dry sector of the Yellowstone. It is these, rather than the "ranchers' towns," that serve most of the ranching area as well as the irrigated strips. Miles City and Glasgow are among Montana's 12 regional trade centers, and Glasgow is the smallest of these. The irrigated strips are also the main transportation corridors of the Big Dry region. The Yellowstone-Clark Fork corridor passes through Miles City and parallels the Yellowstone here. And the High Line follows the Milk River route across this region. By contrast, Montana 200, which crosses the region at the latitude of Jordan, has little traffic.

Ft. Peck Reservoir extends nearly all the way across the Big Dry Region. It is the largest body of water in Montana, and the powerplant at Ft. Peck Dam is one of the state's largest. The reservoir is nestled among the Missouri River Breaks (hills) and has many arms. It is the focus of water-oriented recreation in this dry region. The reservoir and much of the breaks are enclosed in Charles M. Russell National Wildlife Refuge. The road network in this part of Montana was greatly disrupted by the creation of Ft. Peck Reservoir, which is bridged only at its narrow western extremity. There is very little population in this section of the Big Dry Region. The government village of Ft. Peck is very small.

There is more public land in the Big Dry than in any other region of Great Plains Montana. The publicly owned tracts are mostly Taylor Grazing and Bankhead-Jones lands, which are administered by the U.S. Bureau of Land Management. There are some state-owned lands. Most of these public lands are leased to ranchers for grazing. That so much of the land in the Big Dry had not been homesteaded when the Taylor Grazing Act was passed in 1934 is vivid testimony that the land is among the poorest in Montana. And it is because nearly all of the Missouri Breaks was in public ownership that it was so easy to assemble such a large block of land as the wildlife refuge in relatively recent time.

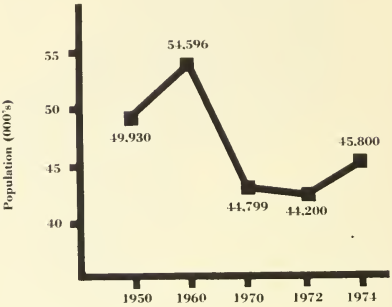
The most productive single oil-and-gas field in Montana is located in the Big Dry. This is the Bell Creek Field in the Powder River country southeast of Broadus. This field is situated on the periphery of the Black Hills dome. A much less important petroleum area in the Big Dry is the Musselshell producing area northeast of Roundup; Sumatra is the most important in this group of fields. Finally, the Bowdoin Field northeast of Malta is one of the most productive gas fields in Montana. Small refineries at Chinook and Mosby complete the fossil fuels picture in the Big Dry Region. The latter refinery produces jet fuel only.

Grazing, cultivation, irrigation, and mineral fuels extraction have greatly modified the land of the Big Dry. Of these, grazing has affected the most extensive areas. However, in terms of emptiness, parts of the Big Dry are nearly as "wild" as are the wilderness areas of Rocky Mountain Montana. The vast horizons and wide open spaces have a special esthetic quality unmatched by any other region of Montana.

POPULATION SIZE AND DENSITY

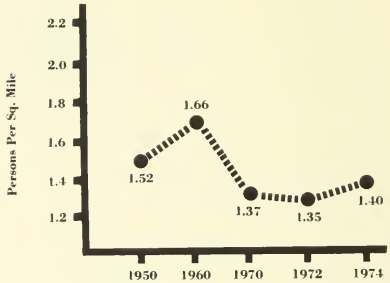
The Big Dry experienced a steady population decline from 1960 to 1972, nearly 9,000 persons (Figure 175). Much of the decline has been attributed to the closing of the U.S. Air Force base at Glasgow. In the last two years, however, population has grown slightly. The Big Dry has the lowest population density in the state: 1.4 persons per square mile (Figure 176). The low density is the result of the large-scale ranching units of the region.

Figure 175. Big Dry Population, 1950-1974.



Sources: References 198, 216, and 217.

Figure 176. Big Dry Population Density, 1950-1974.

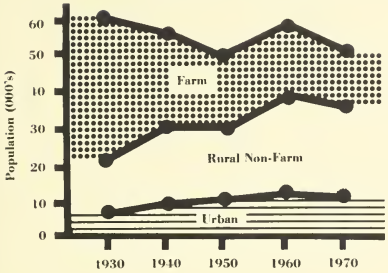


Sources: References 198, 216, and 217.

POPULATION DISTRIBUTION

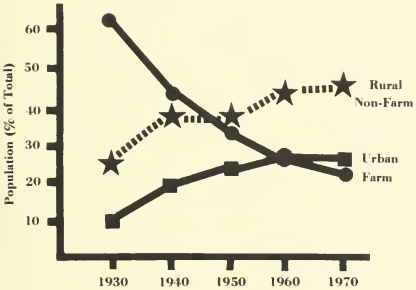
The Big Dry Region is another region of total population decrease, but unlike the Sweetgrass Plains Region, Big Dry's decline has been a long-term one, and the population of the region was smaller in 1970 than in 1930 (Figures 177 and 178). Until 1960, the decline was entirely within the farming segment, while the non-farming population grew slowly but steadily. Only during the 1950s was the growth of the non-farm population rapid enough to counterbalance the decline in the farm population. Since 1960, all three segments have experienced decline, and both urban areas (Glasgow and Miles City) lost population during this period (119). Between 1970 and 1974 Powder River County lost the greatest share of its population of all the counties in the state: 24 percent, or about 700 persons (9).

Figure 177. Big Dry Urban, Farm, and Rural Non-Farm Population, 1930-1970.



Source: Reference 119.

Figure 178. Big Dry Percent of Population Urban, Farm, and Rural Non-Farm, 1930-1970.



Source: Reference 119.

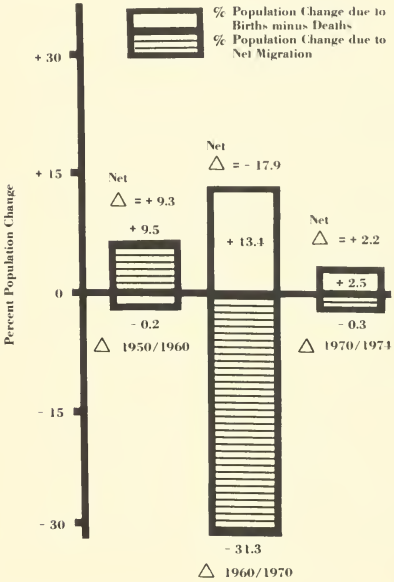
POPULATION CHANGE

The Big Dry has experienced the most radical population fluctuations of all the environmental regions of the state. The region experienced net growth in the 1950s, due entirely to in-migration, and a net decline in the 1960s, due largely to a net out-migration of nearly a third of the region's population. The Big Dry is the only region having less than zero population growth in recent times (1950-1960). Conditions appear to have stabilized at a modest growth rate since the beginning of this decade (Figure 179).

ENERGY RESOURCES

The Big Dry has about 10 percent of Montana's economically recoverable coal and 20 percent of Montana's potentially recoverable coal reserves (Tables 29 and 30).

Figure 179. Big Dry Population Changes (△) Reflected by Births minus Deaths and Net Migration, 1950-1974.



Sources: References 198 and 217.

Table 29. Big Dry Economically Recoverable Coal Reserves, 1973.

Coal Types	Millions of Tons
Surface	
Lignite	1,610
Subbituminous	6
Total	1,616

Source: Reference 163.

Table 30. Big Dry Potentially Recoverable Coal Reserves, 1973.

Coal Type	Millions of Tons
Surface	
Lignite	2,670
Subbituminous	10
Underground	
Lignite	12,230
Subbituminous	689
Total	15,599

Sources: References 163 and 208.

The region is the second largest oil producer in the state, with 38 percent of 1974 total production (Figure 180). However, it contains only 25 percent of the state's proven oil reserves; hence the 6-year resource index for oil (Table 31).

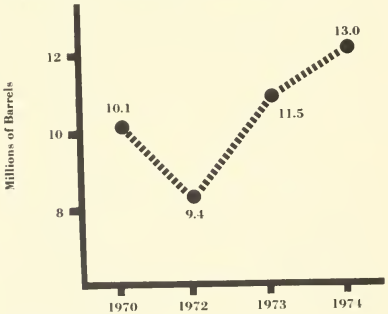
The Big Dry was responsible for almost 30 percent of Montana's 1974 natural gas production (Figure 181). However, the region contains almost half of the state's proven natural gas reserves and has the highest natural gas resource index (Table 32). Ft. Peck dam and powerplant, which represents 11 percent of the state's hydroelectric capacity, was responsible for 12 percent of the net hydroelectric generation statewide in 1974 (Figure 182) (Table 33).

Table 31. Big Dry Proven Recoverable Oil Reserves, 1974.

Millions of Barrels	Resource Index
76.9	5.9

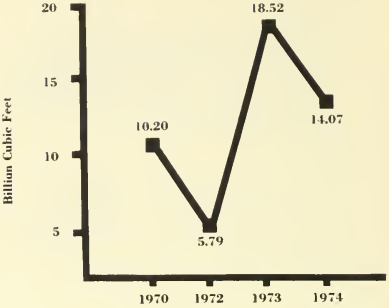
Source: Reference 143.

Figure 180. Big Dry Oil Production, 1970-1974.



Source: Reference 143.

Figure 181. Big Dry Natural Gas Production, 1970-1974.



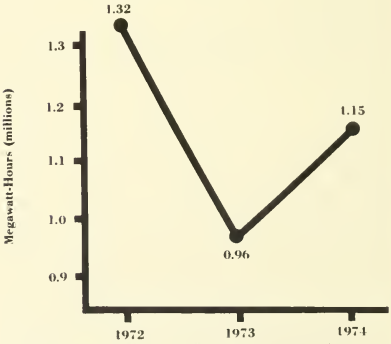
Source: Reference 143. Forty percent of Tiger Ridge Field production is allocated to Big Dry Region.

Table 32. Big Dry Proven Recoverable Natural Gas Reserves, 1974.

Billion Cubic Feet	Resource Index
480	34.0

Sources: References 42, 58, and 61. Half of the Tiger Ridge Field proven reserves are allocated to the Big Dry Region.

Figure 182. Big Dry Hydroelectric Generation, 1972-1974.



Sources: References 144 and 218. Figures represent net hydroelectric power generation, exclusive of plant use.

Table 33. Big Dry Installed Hydroelectric Generating Capacity, 1973.

Maximum Nameplate Rating (Kw-Hours)
165,000

Source: Reference 164.

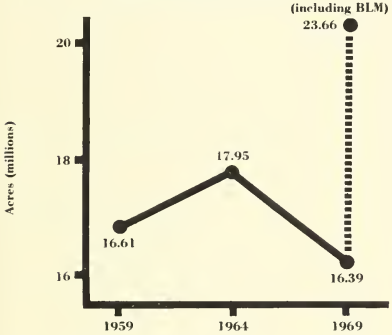
LAND RESOURCES

Thirty-five percent of the state's agricultural land is found in the Big Dry, the largest percent of any region in the state. Over 90 percent of this land is range and pastureland, including BLM land, for a total of over 40 percent of Montana's range and pastureland. Range and pastureland in the region have shown an increase of about 600,000 acres during the period 1958-1967. Cropland has declined about 300,000 acres (Figures 183, 184, 185, and 186).

There are 463,000 acres of private and state forestland in the Big Dry, 365,000 of which are classed as commercial (Figure 187).

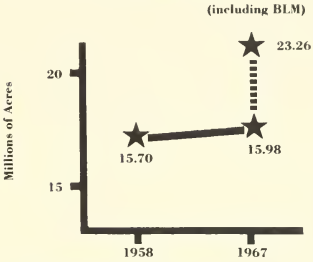
The U.S. Fish and Wildlife Service and the Bureau of Land Management have proposed to transfer about 200,000 acres of the C. M. Russell National Wildlife Range and the UL Bend National Wildlife Refuge to wilderness status (76) (Table 34).

Figure 183. Big Dry Agricultural Land in Farms, 1959, 1964, and 1969.



Sources: References 150 and 195.

Figure 185. Big Dry Cropland, Range, and Pasture, 1958 and 1967.



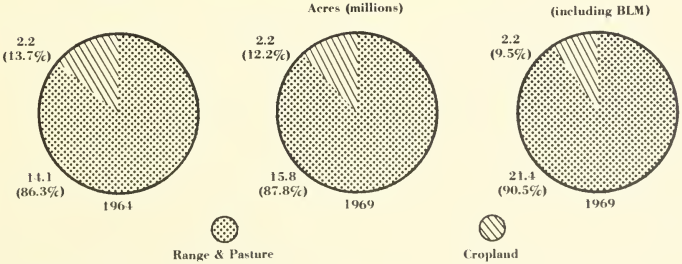
Sources: References 150, 151, and 152.

Table 34. Big Dry Wildlands, 1973.

Classification	Acres
Proposed Wilderness	195,833
Roadless Areas (BLM)	?

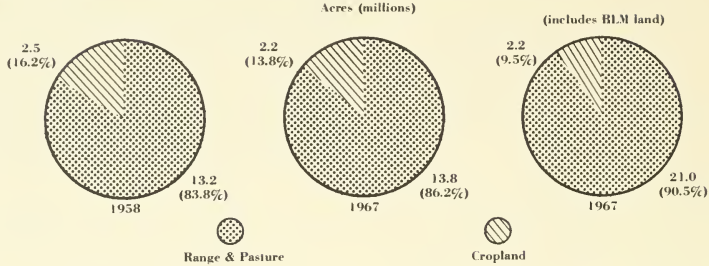
Source: Reference 76.

Figure 184. Big Dry Distribution of Agricultural Land, 1964 and 1969.



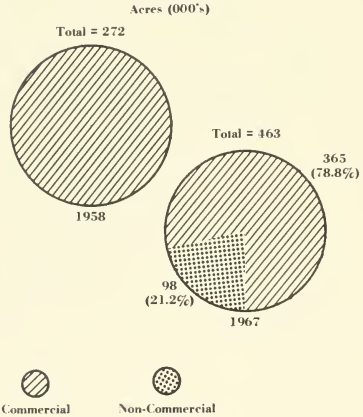
Sources: References 150 and 195.

Figure 186. Big Dry Distribution of Cropland, Range, and Pasture, 1958 and 1967.



Sources: References 150, 151, and 152.

Figure 187. Big Dry Private and State Forestlands, 1958 and 1967

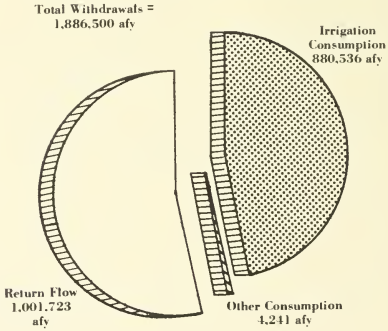


Sources: References 150, 152, and 153.

WATER RESOURCES

The Big Dry, the least watered of Montana's environmental regions, accounts for 15 percent of the water withdrawn and consumed in the state, ranking third behind the Broad Valley Rockies and the Rocky Mountain Foreland (134) (Figure 188). Most irrigated agriculture in the region lies along the Milk and Yellowstone rivers, whose waters are principally derived in the Columbia Rockies and the Yellowstone Rockies, respectively. The Powder River in the southern part of the Big Dry has energy related water claims exceeding its average annual flow (96). Recently, the first agricultural water reservation in the Yellowstone River Basin was filed by the Buffalo Rapids Project for 116,564 acre-feet a year to irrigate lands between Miles City and Glendive (97).

Figure 188. Big Dry Water Withdrawals and Consumption of Withdrawals, 1970.



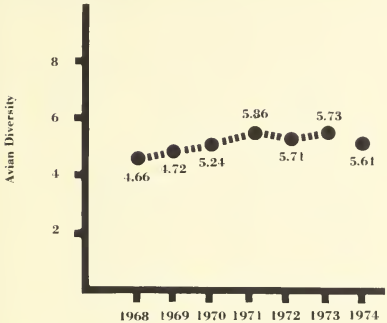
Source: Reference 134.

WILDLIFE DIVERSITY

Average bird diversity along the eight breeding bird survey routes located in the Big Dry has been stable over the last four years following a general rise that commenced in 1969 (212) (Figure 189).

Much public concern has been expressed recently over the Secretary of Interior's assignment of sole responsibility

Figure 189. Big Dry Avian Diversity, 1968-1974.



Source: Reference 212.

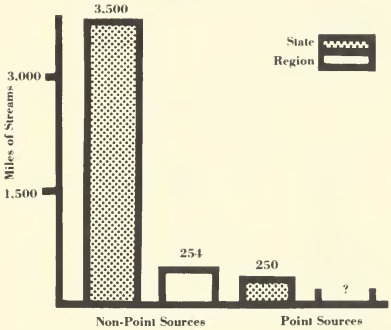
for management of the Charles M. Russell National Wildlife Range to the Bureau of Land Management (11), whose primary mission is oriented toward livestock grazing. The Range is now managed jointly with the U.S. Fish and Wildlife Service. However, legislation is currently pending in Congress that would prevent this transfer and allow the Secretary of Interior discretion in leaving the Range under dual management or transferring it entirely to the U.S. Fish and Wildlife Service. Elsewhere in the Big Dry, uranium mining threatens the wildlife-rich Long Pines area (215).

WATER QUALITY

The percentage of people served unsatisfactory drinking water from public supplies in the Big Dry decreased 70 percent between 1971 and 1974 (47) (Figure 190).

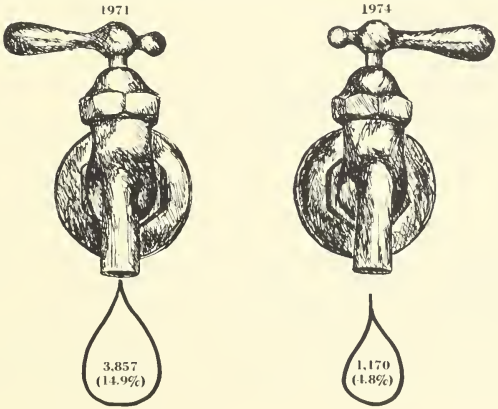
Streams degraded in the Big Dry are the Musselshell River (150 miles), the Milk River (80 miles) and Lodge Creek (24 miles). Poor land use practices are to blame for most of the degraded mileage (Figure 191). A segment of the

Figure 191. Big Dry Point and Non-Point Source Stream Degradation, 1975.



Source: Reference 129.

Figure 190. Big Dry Population Delivered Unsatisfactory Drinking Water, 1971 and 1974.



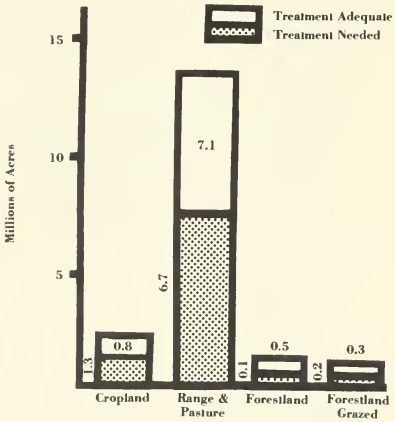
Source: Reference 47.

Milk River of unknown length is polluted by inadequate sewage treatment at Hinsdale and Glasgow (33) (129). Water quality in the Little Missouri River Basin in the extreme southeastern part of the Big Dry is rated "poor to fair" (102). However, the Big Dry has been spared from most of the saline seep problems of dry-land farming regions to the east and west.

LAND QUALITY

The Big Dry has some of the most fragile, sparsely vegetated soils in Montana. The region has nearly 14 million acres of range and pasture, about half of which were in need of improvement in 1967 (Figure 192). Over 60 percent of the region's two million acres of cropland needed conservation treatment in 1967 (153).

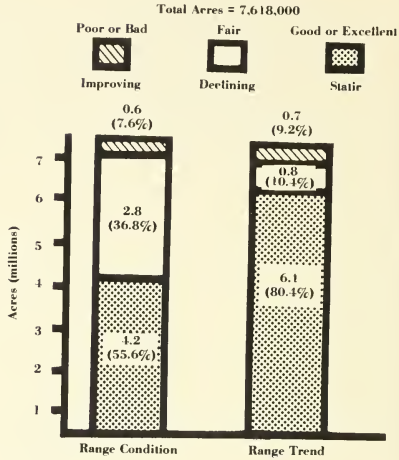
Figure 192. Big Dry Private and State Agricultural and Forestland Requiring Conservation Treatment, 1967.



Source: Reference 153.

The Malta, Miles City and Lewistown districts of the Bureau of Land Management (BLM) coincide roughly with the Big Dry environmental region. Over 80 percent of BLM lands in Montana are located within this region. The Big Dry range situation in 1963-1964 is shown in Figure 193. Although more acres were declining than improving and substantial acreage was in poor or bad condition, Big Dry range conditions for BLM land were significantly better than those of the Rocky Mountain Foreland and the Broad Valley Rockies.

Figure 193. Big Dry Range Condition and Trend for Land under BLM Management, 1963-1964.

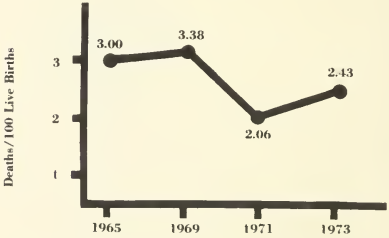


Source: Reference 49.

HEALTH STATUS

The Big Dry has recorded a fairly erratic perinatal death rate, with an increase during the most recent two-year period (Figure 194). Its health status index is the second best in the state, indicative of the general improving trend in these indexes from west to east across the state (Table 35).

Figure 194. Big Dry Perinatal Death Rate, 1965-1973.



Sources: References 118 and 125.

Table 35. Big Dry Health Status Index, 1968-1972.

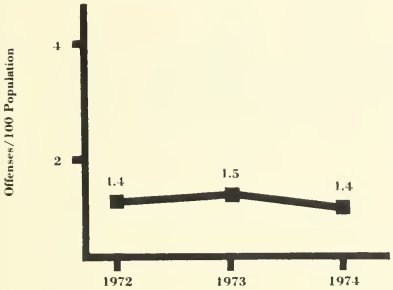
314.6

Source: Reference 78.

CRIME

The Big Dry has the lowest crime rate in the state (Figure 195). The rate has also remained very stable. The region also has the lowest population density in the state.

Figure 195. Big Dry Offenses Known to Police, 1972-1974.

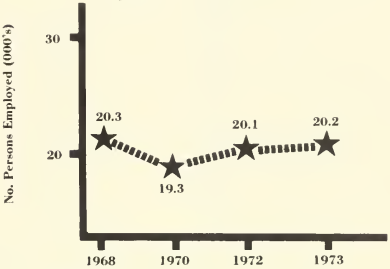


Source: Reference 52.

EMPLOYMENT

The Big Dry had the only absolute decline in jobs in the state during 1968-1973 (Figure 196). This was caused by the closure of the Glasgow Air Force Base between 1968 and 1970. Since 1970 there has been an actual increase of about 900 jobs.

Figure 196. Big Dry Total Employment, 1968-1973.

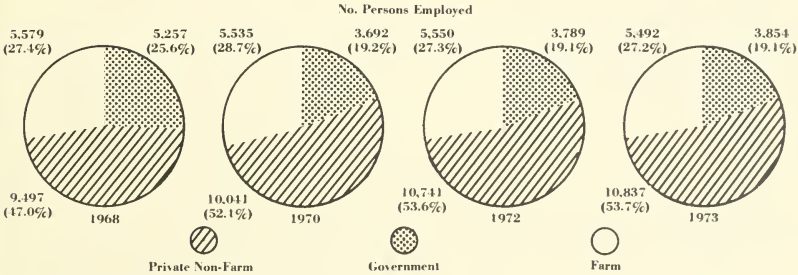


Source: Reference 196.

The airbase closure caused the sharp decrease in the relative strength of the government sector, which declined by about 1,400 positions over the five years (Figure 197). 1,340 new jobs were added in the private non-farm sector, making it the largest percent increase recorded in the state. However, this region still employs the lowest percentage of private non-farm workers of any region in the state. The farm sector lost about 90 workers but still employs over 27 percent of the workforce, slightly lower than in Two Rivers.

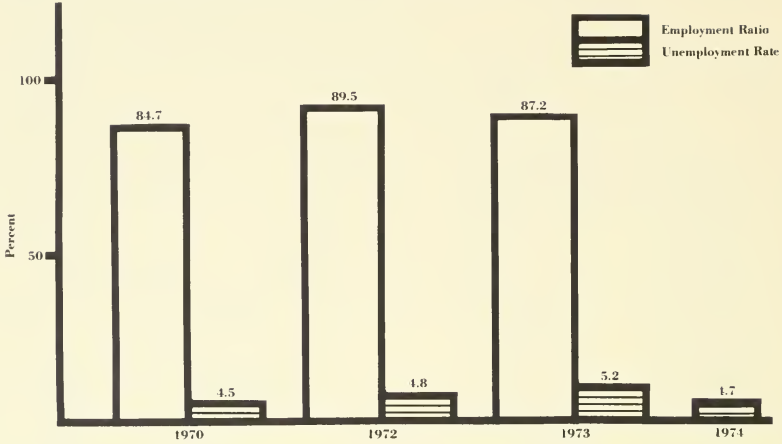
The unemployment rate has been consistently below the state average and has remained fairly stable over the period 1970-1974 (Figure 198). It is the second lowest in the state, the lowest being Two Rivers.

Figure 197. Big Dry Employment by Sector, 1968-1973.



Source: Reference 196.

Figure 198. Big Dry Unemployment Rate and Employment Ratio, 1970-1974.

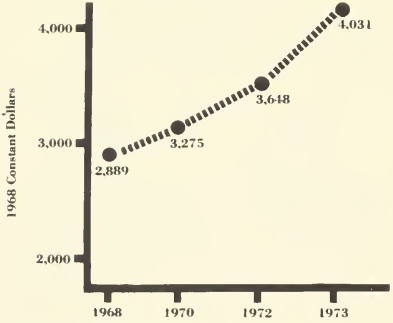


Sources: *References 131 and 196. Unemployment rate computed using state Dept. of Labor and Industry Montana Labor Market Area data for Glasgow and Miles City.*

INCOME

The Big Dry recorded significant gains in real per capita personal income during the five year period (Figure 199). It went from almost 40 percent below the state average to 18 percent above. In 1973, the region had the second highest PCPI in the state. Again this was due to growth in real earnings per employee in the farm sector, which more than tripled during the same period, the second largest increase in the state. However, while the government sector remained fairly stable the private non-farm sector had the largest percent decline in the state, almost 20 percent during the period (Figure 200).

Figure 199. Big Dry Per Capita Income, 1968-1973.



Sources: *References 196 and 197.*

The percent of families earning subsistence incomes decreased between 1960 and 1970 but remained 25 percent greater than the state average with about 1 in 5 at this level as of 1970 (Figure 201).

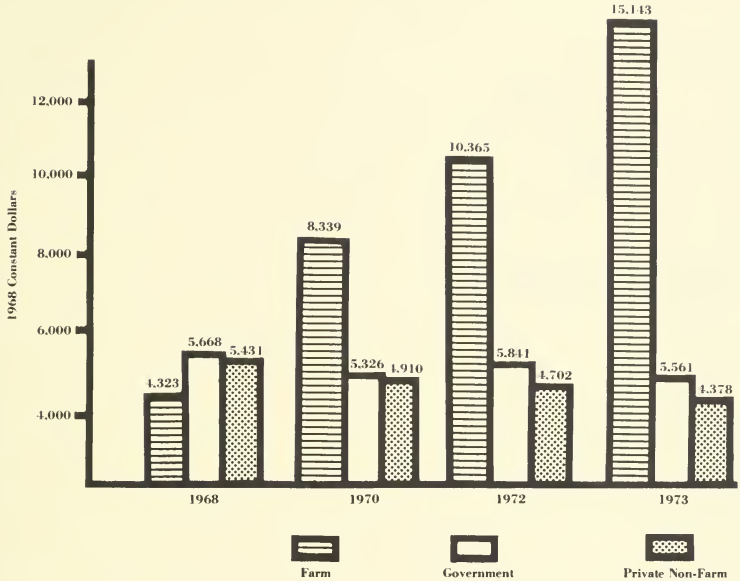
LIBRARY CIRCULATION

Since 1966 the area has lost about 9,000 people. In 1966 there was no circulation report from Glasgow City-County Library in Valley County. Undoubtedly this influenced the low circulation figure for Big Dry, since the library reports over 53,000 in circulation the next year. Carter County's participation in bookmobile service through the Sagebrush Federation accounts for increased circulation in the area (Figure 202).

CHILD WELFARE

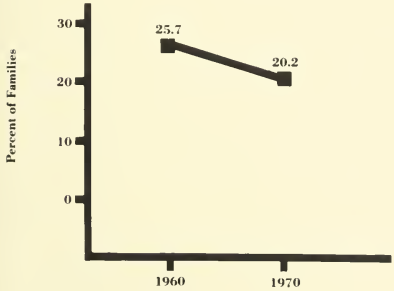
The number of children added to the Child Welfare Services case load in the Big Dry has remained low and relatively stable from 1970 to 1974 (Figure 203).

Figure 200. Big Dry Earnings Per Employee, 1968-1973.



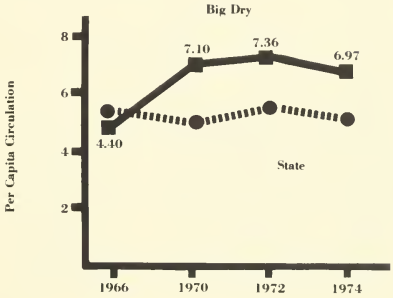
Source: Reference 196.

Figure 201. Big Dry Families Earning Less than $3,000/Year in 1960 and $4,000/Year in 1970.



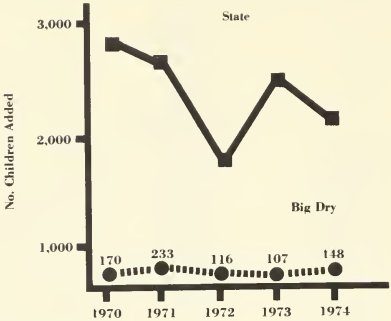
Source: Reference 198.

Figure 202. Big Dry Library Circulation, 1966-1974.



Sources: References 146, 147, 148, and 149.

Figure 203. Big Dry Children Added to Child Welfare Services, 1970-1974.

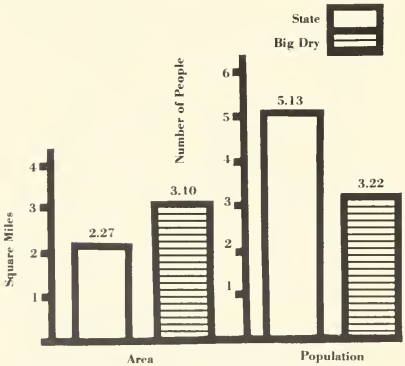


Source: Reference 137.

RURAL ROAD SYSTEM

The Big Dry has a thin network of rural roads serving the vast expanses of sparsely populated and sometimes rugged grazing lands. Each mile of road serves over three square miles of rural countryside (Figure 204).

Figure 204. Big Dry Rural Area and Population Served per Mile of Rural Road, 1970.



Sources: References 119, 130, and 153.

Map 10. Two Rivers Region

TWO RIVERS REGION

ENVIRONMENTAL PERSPECTIVE

Northeastern Montana resembles the Sweetgrass Plains in that it is a grain, petroleum, and natural gas region. It differs from the Sweetgrass Plains in several respects. The Two Rivers Region is generally colder because it lacks the chinook wind of the Sweetgrass Plains. It is not surprising that a town here was named "Froid," which is French for "cold"! Due to somewhat different climate from that of the Sweetgrass Plains, the present region grows mainly spring, rather than winter, wheat. Also, the Two Rivers grows a substantial amount of sugar beets, dry beans and potatoes on irrigated farmland along the Yellowstone and Missouri rivers, the convergent alignment of which gives the region its name. (Both regions have frost-free growing seasons in excess of 130 days along their major river valleys.) The Two Rivers Region has rougher land than the Sweetgrass Plains and so proportionally less is under cultivation. Finally, Two Rivers produces more oil than any other environmental region of Montana.

The region encompasses two of the four major petroleum-producing areas of the state. One of these is the Cedar Creek Arch, which extends from Baker to slightly beyond Glendive and yields both oil and natural gas. The other area is in the four counties in the northeastern corner of Montana, which yields oil without much associated gas production. A medium sized petroleum refinery is located at Wolf Point. The rocking, up-and-down motion of the oil-well pumps, the smell of oil refineries, and many acres of mobile homes are significant features of the environment in the petroleum areas of this and other Great Plains Montana regions.

Photo 26. Farmland west of Sidney.

Photo 27. Lambert, Montana.

The characteristics of dry-land grain farming and the resulting modifications of the natural environment are similar to those described in the Sweetgrass Plains. The Two Rivers Region is an area of till-covered plateau north of the Missouri, stream-dissected plateau between the two rivers, and plains with widely spaced hills south of the Yellowstone. The greater amount of rough land is the cause of the smaller proportion of land under cultivation, compared to the Sweetgrass Plains. The uncultivated areas are used for grazing of range livestock. More spring wheat than winter wheat is grown because there is a greater concentration of precipitation in summer and, being virtually out of reach of the chinook, the winter is colder than in the Sweetgrass Plains.

The strips of irrigated farming along the two rivers are similar to the other irrigated areas of eastern Montana except that there is a concentration of sugar beet production along the Yellowstone in this region. There is a sugar refinery at Sidney.

A noticeable concentration of towns and rural population occurs along the irrigated strips. However, the population contrast between the irrigated valleys and the interfluvial areas is not nearly as pronounced as in the Big Dry Region. The largest towns of the region — Glendive, Sidney, and Wolf Point — are located along the irrigated valleys. Glendive is one of the 12 regional trade centers of Montana. The northeastern corner of the region is in the trade area of Williston, North Dakota, which is only 20

miles from the Montana line and is larger than any of the towns of the Two Rivers Region.

The Yellowstone-Clark Fork corridor branches at Glendive. Interstate 94 and the southern mainline of the Burlington Northern extend eastward from Glendive rather than continuing northeastward along the Yellowstone. However, the traffic on Montana 16, which descends the Yellowstone Valley from Glendive to Sidney, is about as heavy as that on the interstate. The High Line traverses the Two Rivers Region along the Missouri. The region has the most dense rail network in Montana, and the density of its web of rural roads is second only to that of the Sweetgrass Plains.

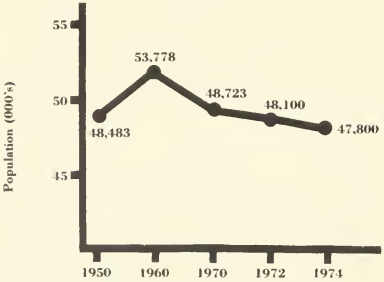
The main recreational attractions of the Two Rivers Region are the Makoshika Badlands near Glendive, the numerous tiny lakes in the glaciated sector of the region, and the hunting of game birds, some of which use the grainlands as a source of food. The region supports sizeable populations of antelope, mule and whitetail deer and fishing for the archaic paddlefish and floating the Yellowstone are becoming increasingly popular.

Due to the concentration of precipitation in the growing season — the most pronounced summer maximum found anywhere in the state — northeastern Montana originally had a western wheatgrass-needlegrass mixed-grass steppe, a less dry type than the short-grass steppe which characterized the Sweetgrass Plains and the Big Dry. Dry-land grain farming and extraction of fossil fuels have greatly modified the natural environment in the Two Rivers Region.

POPULATION SIZE AND DENSITY

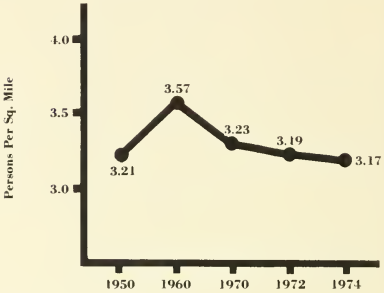
Two Rivers is the only region that has experienced a steady population decline since 1960 (Figure 205). Its population density has remained very close to that for Sweetgrass Plains, perhaps reflecting similar mixes of agricultural activity that include both wheat farming and ranching (Figure 206).

Figure 205. Two Rivers Population, 1950-1974.



Sources: References 198, 216, and 217.

Figure 206. Two Rivers Population Density, 1950-1974.

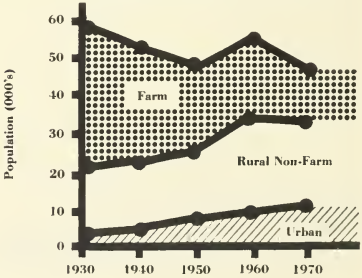


Sources: References 198, 216, and 217.

POPULATION DISTRIBUTION

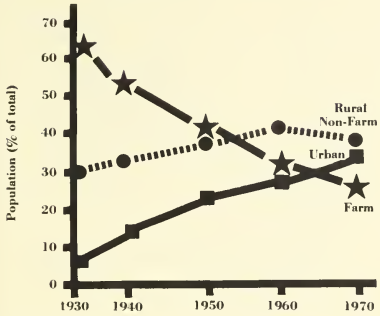
The population trends in the Two Rivers Region are nearly identical to those of the Big Dry: net population decline, reduction in the number of farm families, and a general decline in the rural population, all especially prominent since 1960 (Figures 207 and 208). One difference between the Big Dry and Two Rivers is that the urban segment of Two Rivers increased slightly during the 1960s, due primarily to the town of Baker reaching the 2,500-person threshold for classification as an urban place during that period (119).

Figure 207. Two Rivers Urban, Farm, and Rural Non-Farm Population, 1930-1970.



Source: Reference 119.

Figure 208. Two Rivers Percent of Population Urban, Farm, and Rural Non-Farm, 1930-1970.



Source: Reference 119.

POPULATION CHANGE

Population trends in the Two Rivers have been similar to those in the Sweetgrass Plains in recent times: growth in the 1950s due to births exceeding deaths, population decline in the 1960s from out-migration, and relative stability since 1970, with out-migration surpassing in-migration by substantial margins since 1950 (Figure 209). The Two Rivers is the only region losing population in this decade.

ENERGY RESOURCES

Two Rivers contributed about 2.5 percent of Montana's 1974 coal production, all from the Knife River mine near Savage (Figure 210). The region contains almost 2 billion tons of economically recoverable coal reserves, about 13 percent of the state total (Table 36). It is also second only to Rocky Mountain Foreland in the amount of potentially recoverable coal, having about 20 percent of the state total (Table 37).

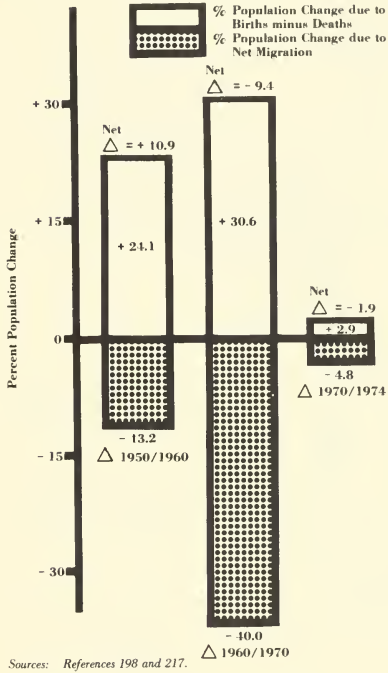
It is the most important oil producing region in the state with 43 percent of 1974's oil production (Figure 211) and almost half of the state's proven oil reserves (Table 38).

Table 36. Two Rivers Economically Recoverable Coal Reserves, 1973.

Coal Type	Millions of Tons	Resource Index
Surface		
Lignite	1,939	6,463

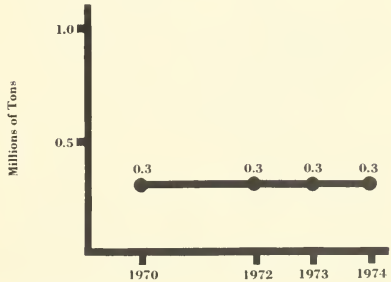
Source: Reference 163.

Figure 209. Two Rivers Population Changes (△) Reflected by Births minus Deaths and Net Migration, 1950-1974.



Sources: References 198 and 217.

Figure 210. Two Rivers Coal Production, 1970-1974.



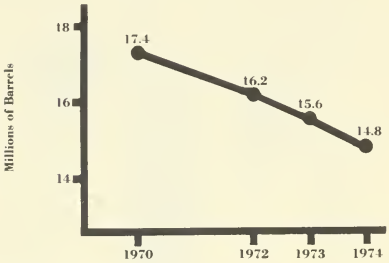
Source: Reference 140.

Table 37. Two Rivers Potentially Recoverable Coal Reserves, 1973.

Coal Type	Millions of Tons	Resource Index
Surface Lignite	3,230	
Underground Lignite	13,883	
Total	17,113	57,043

Sources: References 163 and 208.

Figure 211. Two Rivers Oil Production, 1970-1974.



Source: Reference 143.

Table 38. Two Rivers Proven Oil Reserves, 1974.

Barrels	Resource Index
144,277	9.7

Source: Reference 143.

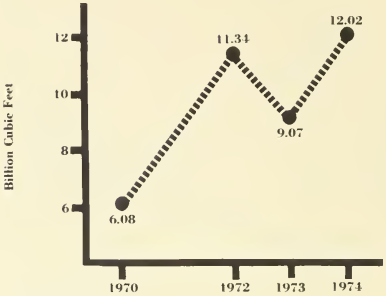
Table 39. Two Rivers Proven Natural Gas Reserves, 1974.

Billion Cubic Feet	Resource Index
28	2.3

Source: Reference 62.

Two Rivers is the second largest regional producer of natural gas, with 24 percent of 1974's production (Figure 212). However, it contains only 3 percent of the state's proven natural gas reserves, giving it a natural gas resource index of only 2.3 years (Table 39). This is quite low and may be subject to some data inaccuracies.

Figure 212. Two Rivers Natural Gas Production, 1970-1974.



Source: Reference 143.

LAND RESOURCES

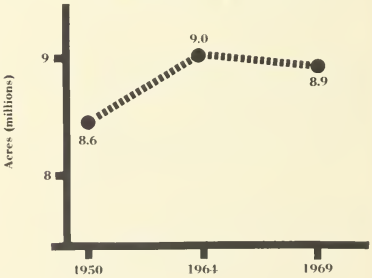
Two Rivers contains 13 percent of the state's total agricultural land. Like Sweetgrass Plains, however, it contains almost one-fourth of the state cropland acreage, about 3.9 million acres. This is 43 percent of the region's total agricultural acreage. There has been an increase in cropland of about 300,000 acres during the period 1964-1969, and an increase of over 1 million acres in the period 1958-1967.

About 7 percent of the state's range and pastureland is in Two Rivers. In this category during 1964-1969, there was a loss of about 400,000 acres (Figures 213, 214, 215, and 216).

There is comparatively little forestland in the region: only 42,000 acres (Figure 217).

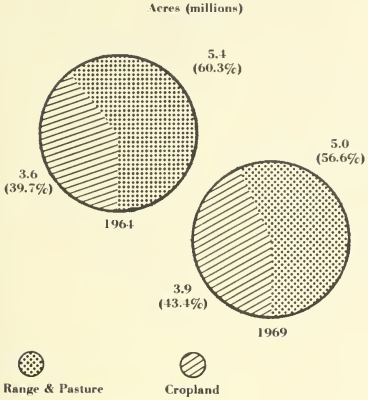
The U.S. Fish and Wildlife Service has proposed to transfer over 11,000 acres of the Medicine Lake National Wildlife Refuge to wilderness status (76) (Table 40).

Figure 213. Two Rivers Agricultural Land in Farms, 1959, 1964, and 1969.



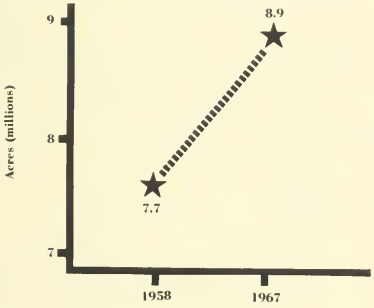
Sources: References 150 and 195.

Figure 214. Two Rivers Distribution of Agricultural Land, 1964 and 1969.



Sources: References 150 and 195.

Figure 215. Two Rivers Cropland, Range, and Pasture, 1958 and 1967.



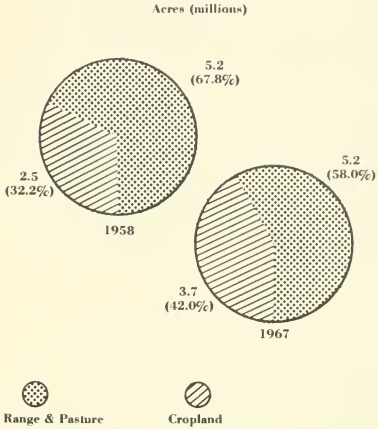
Sources: References 150, 151, and 152.

Table 40. Two Rivers Wildlands, 1975.

Classification	Acres
Proposed Wilderness	11,366
Roadless Areas (BLM)	?

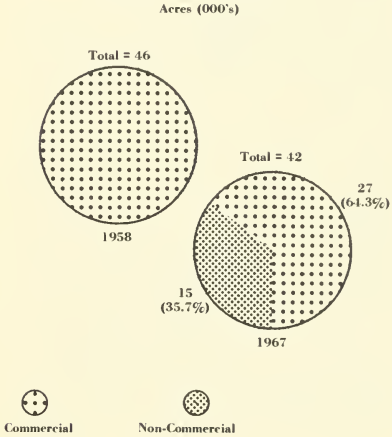
Source: Reference 76.

Figure 216. Two Rivers Distribution of Cropland, Range, and Pasture, 1958 and 1967.



Sources: References 150, 151, and 152.

Figure 217. Two Rivers Private and State Forestland, 1958 and 1967.

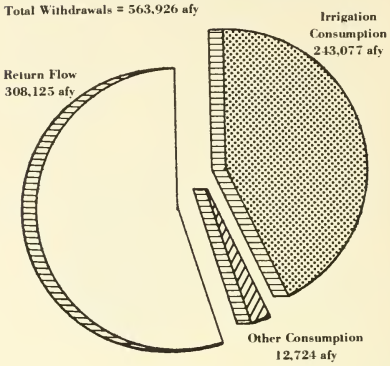


Sources: References 150, 152, and 153.

WATER RESOURCES

Similar to the Sweetgrass Plains in agricultural land use, the Two Rivers Region accounts for only 4 percent of the water withdrawn and depleted in the state, most of it for irrigation along the Yellowstone and Missouri rivers (134) (Figure 218). Proposed coal processing activities along the Poplar River just north into Saskatchewan and near the Big Dry Arm of Fort Peck Reservoir west of Circle would further diminish water supplies to the region. Burlington Northern has filed application to divert 67,000 afy from the Big Dry Arm (13) and, when fully developed, the Saskatchewan power plant will consume about 7,800 afy from the East Fork of the Poplar River, a river that yields an average of 11,900 afy (29). More than a third of Montana's total water supply (16,678,000 afy) leaves the state through this region via the two rivers for which it is named: the Missouri and the Yellowstone (134).

Figure 218. Two Rivers Water Withdrawals and Consumption of Withdrawals, 1970.

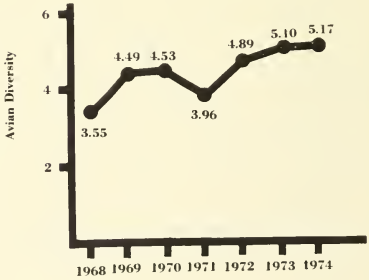


Source: Reference 134.

WILDLIFE DIVERSITY

Average avian diversity along the Redstone, Circle and Savage routes in the Two Rivers has been increasing steadily since 1968 except for a slight drop in 1971 (21) (Figure 219). Like the Sweetgrass Plains, the Two Rivers is a region of intensive agriculture and has a correspondingly low average breeding bird diversity. The effects on wildlife in the region by the proposed Burlington Northern fertilizer plant near Circle are undetermined.

Figure 219. Two Rivers Avian Diversity, 1968-1974.



Source: Reference 212.

WATER QUALITY

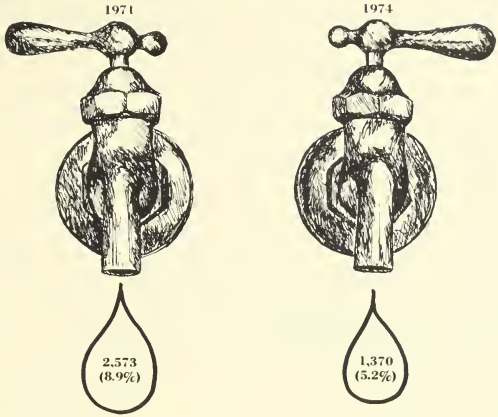
In 1974, in the Two Rivers, only about half as many people were delivered unsatisfactory drinking water from public supplies as in 1971 (47) (Figure 220). Salt water from oil drilling operations in the Plentywood area has contaminated stockwater wells and affected an estimated 200 acres of land (84).

Streams degraded in the Two Rivers include the Redwater River (80 miles), Muddy Creek (70 miles) and the Poplar River (100 miles), all affected by natural salts thought to be aggravated by land use practices (Figure 221). However, more detailed work is needed to identify the sources of these problems (32). The extent of pollution from point sources in the region is not known at this time (129). In the lower Yellowstone Basin high concentrations of salts and suspended sediment — much of them natural — are the primary causes of water quality degradation (103). In the lower Missouri River Basin, saline seep is rated the most serious non-point source pollution problem with poor quality irrigation return flows rated second (32). Many questions remain unanswered regarding impacts on water quality and quantity of a proposed 1,200 megawatt coal-fired generating station in Saskatchewan, a few miles north of the Canadian line along the East Fork of the Poplar River (15) (25) (29).

LAND QUALITY

Cropland and range and pasture are about equally important private land uses in the Two Rivers Region. Over two million acres each of cropland and range and pasture were in need of conservation treatment in 1967 (153) (Figure 222). Although the percentage of agricultural land

Figure 220. Two Rivers Population Delivered Unsatisfactory Drinking Water, 1971 and 1974.

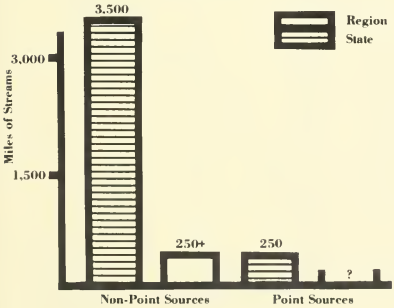


Source: Reference 47.

needing treatment is high, soil conservation problems appear to be relatively less severe here than in any other environmental region in the state.

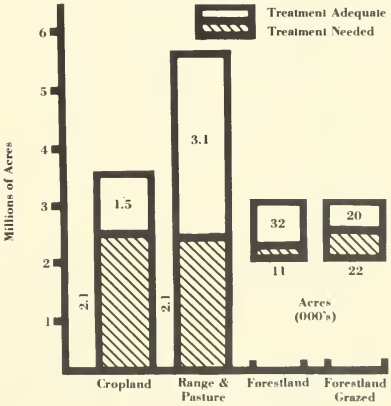
The region had 45,649 acres damaged by saline seep in 1974 (132). The saline seep system of northeastern Montana is almost totally included in the Two Rivers Region and separated by the Big Dry from the functionally different soil systems of central and northcentral Montana. About a third of the total acres damaged by saline seep are located in the Two Rivers where, as elsewhere in the state, the problem is becoming progressively more serious (92) (132) (Figure 223).

Figure 221. Two Rivers Point and Non-Point Source Stream Degradation, 1975.



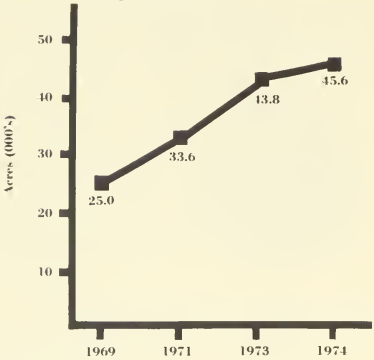
Source: Reference 129.

Figure 222. Two Rivers Private and State Agricultural and Forestland Requiring Conservation Treatment, 1967.



Source: Reference 153.

Figure 223. Two Rivers Acres Damaged by Saline Seep, 1969-1974.

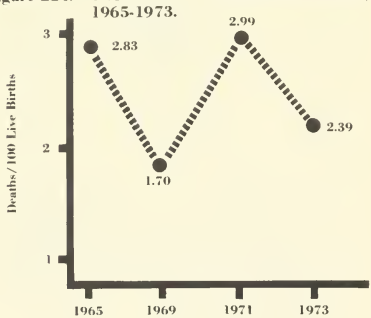


Sources: References 92 and 132.

HEALTH STATUS

Two Rivers has recorded erratic movement in its perinatal death rate, with significant improvement in the rate in the most recent period, 1971-1973 (Figure 224). Its health status index is the best in the state (Table 41). There seems to be a general relationship between population densities and the health status index: as densities decrease, the health status index seems to improve.

Figure 224. Two Rivers Perinatal Death Rate, 1965-1973.



Sources: References 118 and 125.

Table 41. Two Rivers Health Status Index, 1968-1972.

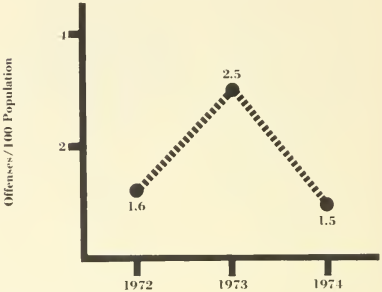
286.4

Source: Reference 78.

CRIME

The crime rate in Two Rivers is almost as low as that in the Big Dry and substantially lower than the state average (Figure 225). Its population density is the second lowest in the state.

Figure 225. Two Rivers Offenses Known to Police, 1972-1974.

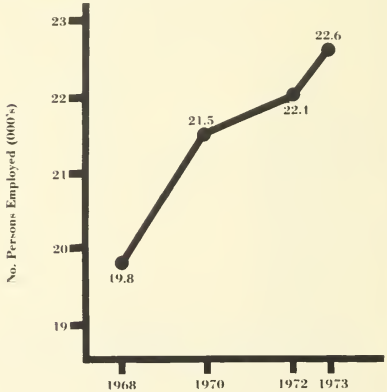


Source: Reference 52.

EMPLOYMENT

The Two Rivers Region added about 2,800 new jobs during the period (Figure 226). The percentage increase in jobs was the second greatest in the state, almost 15 percent. The private non-farm sector was responsible for nearly all the new jobs. The government sector gained about 300 new

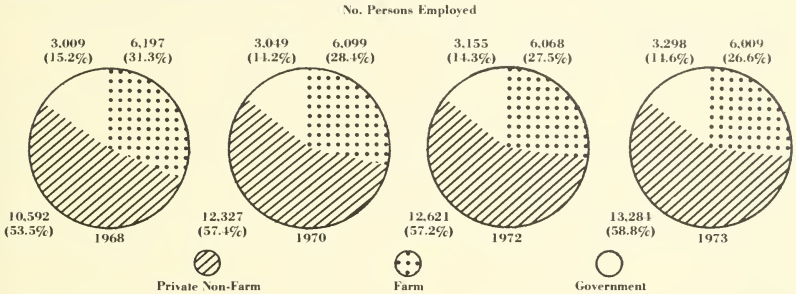
Figure 226. Two Rivers Total Employment, 1968-1973.



Source: Reference 196.

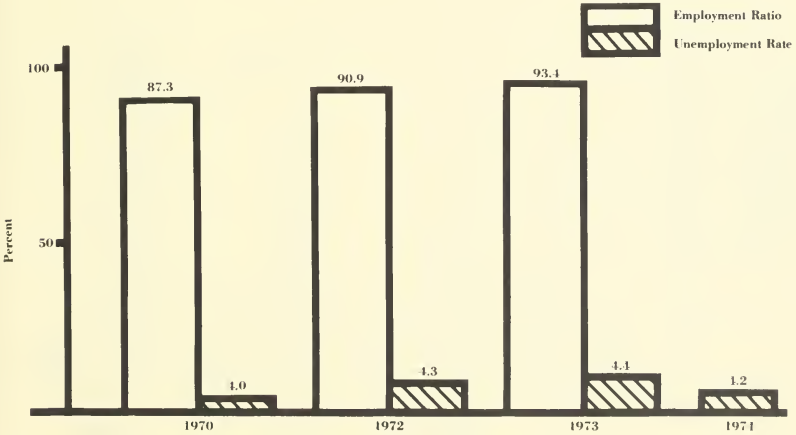
jobs while the farm sector lost about 200 (Figure 227). The farm sector is strongest in Two Rivers with 27 percent of the total employment; the government sector is the smallest here of any region, accounting for less than 15 percent of the total region's employment. This region also enjoys the lowest unemployment rate of any region, 4.2 percent; the employment ratio is also the highest, exceeding 90 percent (Figure 228).

Figure 227. Two Rivers Employment by Sector, 1968-1973.



Source: Reference 196.

Figure 228. Two Rivers Unemployment Rate and Employment Ratio, 1970-1974.



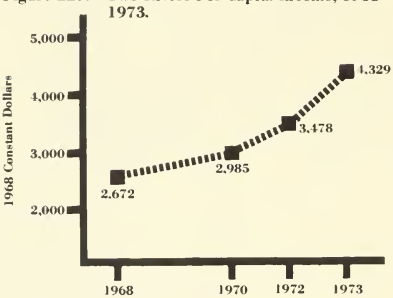
Sources: References 131 and 196. Unemployment rate computed using state Dept. of Labor and Industry Montana Labor Market Area data for Glendive.

INCOME

Among the regions, Two Rivers showed the greatest improvement in real per capita personal income, a 60 percent increase. In 1973, it had the highest PCPI in the state (Figure 229). This large increase was led by the farm sector which more than tripled its real earnings per employee, showing the highest absolute increase of any region in the state (Figure 230). The government sector has remained the lowest real EPE in the state and the private non-farm sector had the second largest decline in real EPE in the state, almost 16 percent during the five year period 1968-1973.

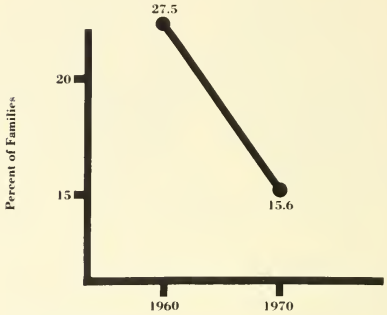
During the 1960-1970 period, Two Rivers showed the greatest improvement in the percentage of low income families with a 43 percent decline — from the highest in the state to slightly below the state average (Figure 231).

Figure 229. Two Rivers Per Capita Income, 1968-1973.



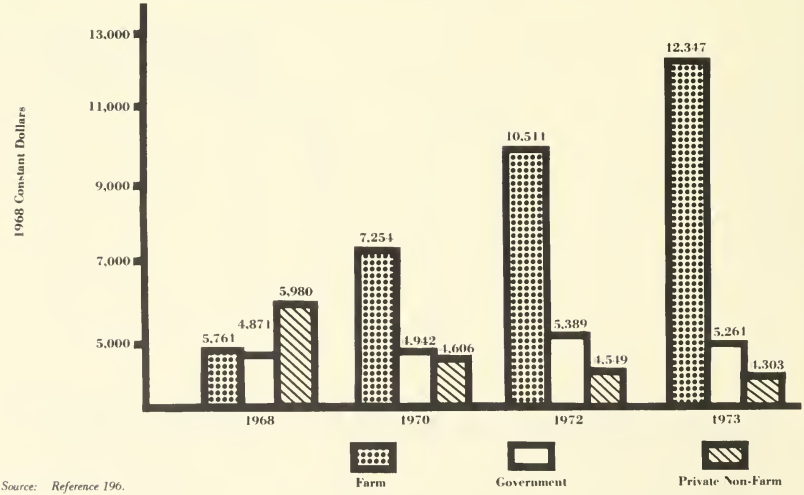
Sources: References 196 and 197.

Figure 231. Two Rivers Families Earning Less than $3,000/Year in 1960 and $4,000/Year in 1970.



Source: Reference 198.

Figure 230. Two Rivers Earnings Per Employee, 1968-1973.



Source: Reference 196.

LIBRARY CIRCULATION

The circulation in this region has fluctuated least among all the regions of the state. It has a higher per capita circulation now than in 1972.

The region lost about 2,000 population during the statistical period. Sheridan County's circulation nearly doubled from 1966-1974. The circulation statistics for Wibaux in 1966 and 1970 were unreported. The eight-year circulation trend is reported in Figure 232.

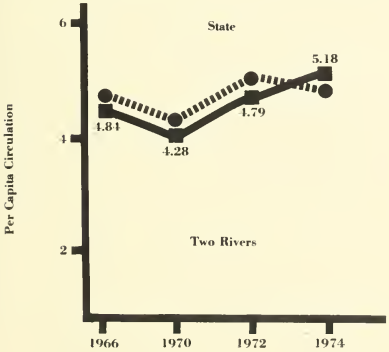
CHILD WELFARE

The number of children added to the Child Welfare Services case load in Two Rivers increased 61 percent from 1970 to 1974 (Figure 233).

RURAL ROAD SYSTEM

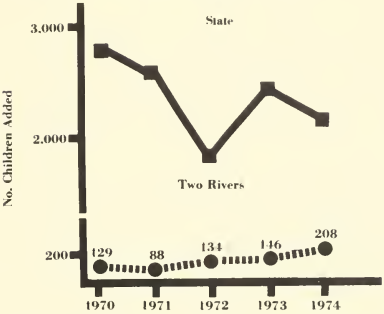
The rural road network of the Two Rivers is slightly more concentrated than the state average, perhaps because of the region's terrain and agricultural land use, which are similar to those of the Sweetgrass Plains (Figure 234).

Figure 232. Two Rivers Library Circulation, 1966-1974.



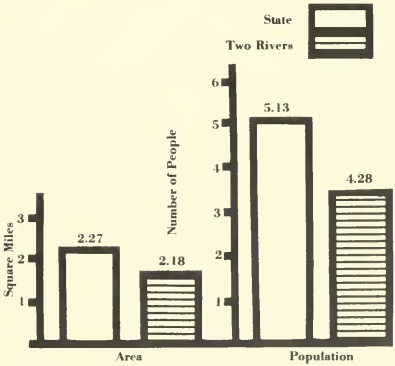
Sources: References 146, 147, 148, and 149.

Figure 233. Two Rivers Children Added to Child Welfare Services, 1970-1974.



Source: Reference 137.

Figure 234. Two Rivers Rural Area and Population Served per Mile of Rural Road, 1970.



Sources: References 119, 130, and 153.

THE EQC INDICATORS PROGRAM

The indicators used in this report were carefully selected in the belief that they most clearly represented environmental conditions in Montana. As the Environmental Quality Council staff reviewed the indicators reported in the *First Annual Report* (1972) and gathered information on indicator efforts in other states and some federal agencies, it was decided that the collection of original data was beyond the staff's capability and exceeded the Council's duties outlined in the Montana Environmental Policy Act (30).

Consequently, the task began by examing the current status of data collecting and monitoring activities of state and federal agencies operating in Montana. The results of that project are presented in *Environmental Monitoring in Montana*, the insert to this report. Review of these activities lead to the establishment of four criteria which determined whether monitoring data could be considered for inclusion in this EQC report: 1) availability of monitored data; 2) extensive, preferably statewide, coverage; 3) reflect real environmental conditions and changes, and 4) relevance to environmental policymaking and program administration.

The EQC *Fourth Annual Report* (1975) presents data that reflect Montana environmental conditions and trends using this rationale. In analyzing the material considered for inclusion here, it became clear that some of the indicators are unclear, inadequate, and perhaps misleading. In addition, the staff became painfully aware of significant information gaps and recognized that regularly monitored data in other areas were required to present a more accurate picture of environmental trends and conditions in Montana. Some of these information needs are:

1. Energy consumption and waste by sector
2. Energy exploration activities
3. Aesthetics (litter, billboards, junkyards, etc.)
4. Recreation availability and quality
5. Housing
6. Plant diversity
7. Encroachment on wildlands and wildlife habitat
8. Productive potential of agricultural lands
9. Encroachment on agricultural lands by other activities
10. Conversion of agricultural land
11. Spread of noxious weeds
12. Access to medical care
13. Access to transportation

Ideally, it is hoped that this report will stimulate a systematic and comprehensive examination of the current status of environmental monitoring activities in Montana. Properly conducted, and with enough interest from citizens who share the EQC's belief that accurate data are prerequisite to informed action, that review will utlimately result in better indicator data.

What follows here is an explanation of the indicators contained in this report.

POPULATION SIZE AND DENSITY

Population levels are a basic determinant, along with income and consumption patterns, of the aggregate demand for natural resources and environmental amenities. Resource depletion and environmental degradation are hastened as the ecosystem is required to support ever increasing numbers of people. The quality of life in a given area also may be directly related to the *population density* in that area because demand for land resources is to an extent proportional to population density. However, in sparsely settled regions people are less subject to socializing influences and suffer from what is commonly termed "the social cost of space."

POPULATION DISTRIBUTION

The distribution of a population among urban, rural nonfarm and agricultural sectors is a key to patterns of resource allocation and intensity of environmental pollution. A highly urbanized population is subject to the social stresses that accompany high density living, but at the same time has access to many social and cultural amenities not available in more sparsely settled regions. Monitoring population distribution figures over time indicates the increase and decrease of the various segments of Montana's population, and thus, to an extent, the changing character of life in the state.

POPULATION CHANGE

Large scale change or rapid turnover of a community's citizens may contribute to instability and stress. Constant stress inhibits the establishment of social bonds and personal relationships. Viewed regionally, *population change* may reflect the land's long-term ability or inability

to support people, given environmentally acceptable levels of development. Fertility, mortality and migration collectively contribute to a change in population although their separate effects on community stability are probably somewhat different.

ENERGY RESOURCES

Widely used energy resources in Montana include coal, oil, natural gas, and hydroelectric power. Montana's non-renewable fossil energy resources will play a vital role in the state's future: they will be extracted to provide energy for Montanans and for export to the rest of the nation, and through severance taxes will provide significant revenue for the state. In a few years, coal production taxes may provide Montana's single largest source of tax revenue. Wisely spent, this money can assist in improving the quality of life for future generations of Montanans.

Energy production entails public costs in the form of environmental degradation, particularly in the cases of surface coal mining and coal conversion facilities, and in the options for the future that are foreclosed by consuming these resources today. *Fuels depletion* will also affect the state's economy because as the more readily available resources are extracted, it becomes more costly to extract the remaining resources. The effect of fuels depletion is magnified by the concurrent foreclosure of alternative uses for fuels in manufacture of fertilizer, medicines, plastics, and other products. An index illustrating the consequences of energy resources depletion computes the *ratio of recoverable reserves to annual production*. It can be used to indicate the status of the resource base and to approximate the number of years that present production rates can be maintained.

LAND RESOURCES

Montana's agricultural and forestlands are its most important natural resources because the products from these lands are renewable. With proper care, they should retain their productive capabilities into the foreseeable future. Unlike mineral resources, which are finite and will someday be exhausted, renewable land resources probably will become increasingly more important to the state's economy.

Wildlands are a benchmark for modern man. Here ecosystems that evolved through millions of years continue endless flows of energy and cycles of matter. Here space-age man finds escape from the "future shock" his artificial systems and monocultures have created. As technology spreads into ever more remote areas, our remaining wildlands will become ever more valuable for their natural characteristics.

Today *forestlands* not only provide significant employment opportunities in western Montana but maintain and enhance recreational opportunities, supply needed diversity for the support of wildlife, and are an integral part of natural water supply systems.

Agricultural land contributes to the support of wildlife and is a prime determinant of our low population densities and the rural way of life so important in Montana. In addition, of course, agriculture is the mainstay of Montana's economy — directly providing about 13 percent of the jobs and forming the basis for the economic health of Great Plains Montana.

Wood products and foodstuffs will remain essential trade commodities barring unforeseen technological developments of competitive substitutes. The long-term economic and ecologic viability of Montana's forest and agricultural land resources will depend on many developments — some beyond control of the state's citizens. Essential for adequate planning are qualitative and quantitative baseline data about these resources, simply how much land there is, how it is spatially distributed throughout the environmental regions and what the general uses of the land are. Trends in these data over time will give some indication of the potential role these basic resources will be able to play in Montana's future.

It was noted in the Statewide Summary that two agricultural land indicators are available: "agricultural land in farms" and "cropland, range and pasture." Each major survey was based on different criteria and the data are not comparable. Neither source appears to be sensitive and timely enough to give a clear, accurate, and current account of statewide trends in agricultural land, which is essential for planning and policy purposes.

WATER

Water is as important to human resource systems as it is to life itself. In an undisturbed condition, the flow of water into, through, and out of the state is fairly constant; it is replenished and purified by the natural environment and sustains a host of biological communities beneficial to man. But in withdrawing, consuming, and contaminating water, people deplete and degrade the water resource to the detriment of fish and wildlife and human pursuits as well. Both surface and underground waters may be affected in this way.

Useful indicators of the water resource are the *amounts of water withdrawn* and later returned, and the amount of *water consumed* and removed permanently from the system. Groundwater withdrawals also are important indicators relating to the water resource.

MINERALS PRODUCTION

In addition to being an important source of revenue, the non-fuel minerals produced in Montana have been strategic in national defense and critical to the nation's metallurgical industry. *Mineral production levels* have and will continue to be influenced by the national economy and changes in technology. Because mineral extraction is becoming increasingly energy consumptive, future minerals production also will depend in part on the price of fossil fuels (79). Mineral extraction is frequently accompanied by severe social and ecological disruption, as the history of old Montana mining camps shows.

WILDLIFE DIVERSITY

Dennis Flath, the Montana Department of Fish and Game's nongame and threatened species wildlife biologist, illustrates the role wildlife diversity plays in the Montana environment (86):

> The welfare of wildlife populations is inextricably tied to the quality and quantity of available habitat. This precept applies to mice and moose alike: A healthy habitat produces healthy wildlife populations. And nongame species rank among the most reliable indicators of the land's vigor, diversity and stability.
>
> In the web of life, a diverse and complex fauna indicates ecological stability. . . . By monitoring species diversity and population levels of nongame wildlife, researchers can determine when and where the ecological integrity of Montana is at stake.

Statewide, the Montana Department of Fish and Game monitors three biological parameters that are keyed to management of big game species: browse utilization, fawn/doe ratio, and animal population estimates. These parameters have many shortcomings that tend to minimize their value as environmental indicators (70), not the least of which is their exclusive preoccupation with game species representing only a small segment of wildlife.

Birds are the largest single group of backboned animals in Montana and 351 species, including both game and nongame birds, have been identified (122). Birds are highly mobile opportunists, taking advantage of nearly every available ecological niche. Each species requires certain environmental conditions, so the population of a given species correlates with the extent of that species' preferred habitat. The number of species in an area indicates the variety of available habitat types.

Birds are easy to observe and receive attention from both professional ornithologists and amateur bird watchers. Annual spring surveys have been conducted over selected routes statewide since 1968. Christmas bird counts have been organized at certain localities since the early part of this century.

The annual spring breeding bird census is Montana's most comprehensive wildlife monitoring effort. Most of the state's 28 census routes are covered each year between June 1 and July 7. (See map on insert *Environmental Monitoring in Montana.)* Qualified observers follow standard procedures and carefully note prevailing weather conditions (82).

Data on the number of species and individuals recorded per route were obtained from computer printouts supplied by the U.S. Fish and Wildlife Service (212). Data for each route-year were plugged into the following formula:

$$d = \frac{m - 1}{\ln N}$$

where *d* is the *avian diversity index*, *m* is the number of species recorded per route, *ln* is the natural logarithm function and *N* is the total number of individuals recorded per route. This index is averaged over each region for each year that data are available. As the value of *d* increases, it can be assumed that community complexity and ecosystem stability also increase, and as *d* decreases, ecosystem integrity is on the decline.

Beyond the avian diversity index, population levels of certain habitat specific, useful, or nuisance bird species can be used to indicate more specific environmental conditions. Wildlife, as an early warning system, works both ways: either a decrease or an increase in certain species can alert us to environmental problems (191). The Smithsonian Institution has developed a list of wildlife species indicative of aesthetic quality, chemical contamination, garbage and filth contamination, crop damage, urban degradation, recreation, and wildlife management effectiveness (183). Twenty-one of these animals, including 17 bird species, occur in Montana, making the system applicable in the state. Population trends of selected indicator species may be used where population levels are high enough to be statistically significant.

Use of breeding bird survey data to measure ecosystem stability has some pitfalls, however. First, only one group of animals is censused. No account is given to floral diversity or to other animal groups. Secondly, annual vagaries in the weather may temporarily mask population fluctuations or long-term changes in diversity caused by man. Thirdly, avian diversity would remain relatively constant even if a desirable species were replaced by an undesirable species. In spite of these problems, the breeding bird surveys and avian diversity remain the best available indicator of the health and vigor of Montana's wildlife community and of the effectiveness of managing this resource under the state's Nongame and Endangered Species Act of 1973.

From the mourning dove to the grizzly bear, "all wildlife acts as an indicator of a quality environment to man. As wildlife habitat disappears, human habitat becomes a little less livable — and certainly less desirable" (177).

AIR QUALITY

The status of Montana's major air pollution problems is indicated by data from monitoring stations in nine problem areas. (See map on insert *Environmental Monitoring in Montana.)* Individual air pollution parameters, namely *particulates, sulfation rates,* and *fluoride,* are used as prime indicators of air quality at selected localities for the purpose of this report. The following five criteria were used to choose parameters and reporting stations: 1) the station is active; 2) at least three years of data are available (to show trends); 3) the station reports the maximum ambient level in the area; 4) the parameter is most characteristic of the ambient air pollution problem in the area; and 5) the station is close to a population center. In addition, the status of compliance by industrial plants with the federal Clean Air Act Amendments of 1970 is used to indicate the progress toward meeting air quality standards set by law.

WATER QUALITY

Water quality, especially the quality of drinking water, is of fundamental importance to Montana citizens. Nearly 250 locally operated public water supplies are inspected annually for bacterial contamination by the Montana Department of Health and Environmental Sciences. The occurrence of fecal coliform bacteria, as an indicator of the probability of the presence of pathogenic bacteria, is the most meaningful and broadly applicable measure of drinking water quality. The indicator used here is *the percent of the population in each region served by public water supplies not meeting bacteriological standards* established by the state Department of Health and Environmental Sciences.

Clean water from Montana's lakes and streams is used for domestic purposes, recreation, fish and wildlife, agriculture and industry. Montana has some of the best quality surface waters in the country. Surface water can be degraded by municipal and industrial point sources, and by non-point sources such as land erosion and urban runoff, which contribute sediment, elevated salinity and temperature, flow changes from dewatering, and toxic agents such as pesticides, herbicides and heavy metals. One indicator of the extent of point and non-point sources of pollution in each region is the *number of stream miles degraded*. The effects of point and non-point sources sometimes overlap in that the same reach of stream may be degraded by both. Degradation does not necessarily mean a violation of Montana water quality standards, but it does indicate beneficial use is being affected. Monitoring of this indicator over time will give a clear picture of how well the state is accomplishing the objectives of the Federal Water Pollution Control Act Amendments of 1972.

QUALITY OF CROPLAND, RANGE AND WOODLAND — PRIVATE SECTOR

As world population and affluence grow so does the demand for food and forest products, often to the point of surpassing the land's ability to sustain production without adverse environmental consequences. The shallowness and dryness of much of Montana's soil make it extremely susceptible to abuse from grazing, logging, mining, cropping, and other activities. Inventories of *conservation treatment needs* on private and state-owned lands in Montana are conducted periodically, providing the basis for evaluating the quality of soil, grass and timber on private lands. In addition, cumulative acres affected by strip mining and saline seep are tallied by various agencies.

A significant correlation exists between agricultural and forestland treatment needs on one hand and the quality and quantity of Montana's surface water resources on the other: Inefficient agricultural irrigation methods contribute to chronic stream dewatering. Sediment derived from soil erosion on unprotected lands is another serious problem.

QUALITY OF FORESTS AND RANGELAND — PUBLIC SECTOR

About a third of Montana's 93 million acres is under federal ownership, most of it in forest and rangeland. One of the many possible indicators of land quality in national forests is the total *acres of commerical forestlands that are non-stocked*, or in need of reforestation. Advisers on forestland quality (67) (72) (75), note that no single indicator is sufficient and that it is necessary to address forest resources from both commercial and total forest standpoints. Although many forest indicators have been proposed, the lack of data on an annual or owner-specific basis is a real constraint. On a total forest basis, management practices on private and public forests are partially reflected by changes in other resource indicators, i.e., air quality, water quality and wildlife diversity.

The two prime forest indicators used in this report — *total non-reserved commercial forestland* and *percent of commercial forestland that is non-stocked* — are sufficient to show the available stock of commercial grade timber and the condition of commercial forests on public lands in Montana. For a broader perspective, readers are referred to *A Descriptive Analysis of Montana's Forest Resources*, a recent publication by the U.S. Forest Service Intermountain Forest and Range Experiment Station (180).

As an indicator of forest quality, the number of forest acres or number of trees visibly defoliated by insects and diseases might be considered. However, only certain forest pests are reported and appropriate indicators are difficult to isolate.

The best quality measure of federal grazing lands appears to be *range condition*, which the Bureau of Land Management describes as "the relative position of a range with regard to the attainable standard determined by resource managers on the basis of site potentialities" (57). Vegetation, its suitability for herbivores and its protection of soil, is the most important determinant of range condition. This indicator is grazing oriented, however, and does not necessarily reflect total ecosystem integrity or suitability for wildlife. Also, this indicator says nothing of the condition of rangelands managed by the U.S. Fish and Wildlife Service and the federal Bureau of Reclamation.

HEALTH STATUS

Montana's Constitution guarantees each citizen the right to a clean and healthful environment. Good health is prerequisite to full development of an individual's interests and productive capacities and for enjoyment of Montana's unique quality of life. The *perinatal death rate* — number of infant deaths per 100 live births — is a good indicator of collective health status. Another health indicator is the *county health status index* (78). This index was compiled once using 1968-1972 data for 12 variables: infant death rates, neonatal death rates, postneonatal death rates,

accidental fatality rates (for motor vehicle deaths), accidental fatality rates (other), low birth weight rates, age adjusted death rates, combined suicide-homocide death rates, uterine cancer death rates, fetal death rates, liver cirrhosis death rates, and lung cancer death rates. Each county was ranked one through 56 for each variable with a rank of 56 representing the worst case. County ranks for each variable were added and total county scores aggregated and averaged for each region giving an average score that correlates directly with health in that region, i.e., a higher score represents greater health problems. Individual county scores range from 143 (best) to 515 (worst) with an average of 337.

It should be noted that for some environmental regions, the perinatal death rate and county health status index contradict each other. This is because the perinatal death rate is only one of twelve variables used to compute the index. When that index is high (from 337 to 515) and the perinatal death rate low, it means other variables used to calculate the index were high. The county health status index may reflect more accurately the overall health of a region, however, its one-shot nature limits its utility as an indicator over time.

CRIME

The man-made environment includes a set of laws to circumscribe human behavior. Violation of these laws constitutes crime. A personal sense of security is an important component of a quality human environment. Increasing crime rates indicate decreasing personal security. Although subject to differences in local reporting systems, *offenses known to police* (all crimes reported to police) appears to be the best crime indicator available (52). However, about half of all crimes go unreported to police.

EMPLOYMENT

A job is a basic requirement of a healthy environment for most adult Montanans. Securing and holding meaningful work is a prime determinant of individual self-respect, and hence of social welfare and stability. Employment and unemployment statistics are perhaps more basic measures of the health of Montana's economy than average income since income indicators alone fail to show the impact of the economy on individual citizens. For example, real per capita income can rise because some workers are moving into higher wage brackets while at the same time unemployment rates can be increasing due to growth in employment opportunities lagging behind growth in labor force. In fact, this happened in Montana in the 1970-1972 period.

Interpretations of employment and unemployment rates should be made with caution. An increase in jobs will cause an increase in local population to the extent that the local labor force does not fill the new positions. It is possible that this in-migration of people will exceed the capacity of the local economy to fully employ the associated labor force, hence an increase in unemployment. In such a situation an increase in employment opportunities can lead to a higher unemployment rate. Unemployment greatly inhibits individual and collective achievement. It is also economically costly in terms of taxes on employers, costs of administering public employment agencies, and loss of human productivity and purchasing power. Unemployment and underemployment also have high social costs.

For these reasons, *total employment* data are indicators of the "people" side of Montana's economy and its basic productivity. *Employment by sector* illustrates the relative strengths of the private nonfarm, farm, and government sectors in providing jobs, as well as indicating structural changes in the economy over time. The *employment ratio* has been estimated and included along with the *unemployment rate* because the employment ratio takes into account total working age population and avoids certain problems of definition connected with the term unemployed (157).

Two sources of employment data have been used in this report: the Regional Economic Information Service (REIS) data of the U.S. Department of Commerce and data compiled by the Montana Department of Labor and Industry's Employment Security Division. REIS is generally considered more comprehensive since it utilizes the state's primary data in addition to those of other federal sources. Other principal differences are that REIS includes military employment, has a broader definition of agricultural employment, and does not adjust for dual job holders, i.e., one person holding two jobs is counted as "2" for total employment. Strict comparisons of unemployment rate and employment ratio data are not possible due to the different geographical boundaries used to compute each, the unemployment rate corresponding to Montana Department of Labor and Industry "Labor Market Areas" and the employment ratio to county boundaries.

INCOME

Personal income plays a significant role in the environment, for it provides a perceivable measure of personal security and freedom and serves to motivate social and economic activity. The "American dream" has, in large part, been based on the belief that all citizens are entitled to increasing levels of affluence that will reach them if the pay is fair and the work completed satisfactorily. To a great extent the belief has proven itself.

Yet the direct relationship between income and consumption has a curiously disturbing side effect. While the material needs of many citizens largely have been met, "rising expectations" seem to place never-ending demands on the environment and public resources. This phenomenon has, in part, been responsible for recent high rates of inflation that, ironically, tend to erode the increased purchasing power originally sought. In short, acquisition and consumption through increased income, although it is an important element of individual and societal well-being, has many other impacts on the quality of life and must be placed in perspective with the many

other human needs that cannot be satisfied through increased purchasing power alone.

The basic measure of income used in this report is *per capita income.* Income data include all earnings plus property, interest and dividend income. The data are presented here in constant 1968 dollars. But, because many citizens are without adequate income to supply even basic necessities data on *families earning less than minimum incomes* are included. So long as some citizens are unable to sustain minimal living standards, our economic system is not fulfilling its potential. *Earnings per employee* for the private nonfarm, farm, and government sectors shows the average dollar return to labor in each sector and hence the ability of each sector to provide a fair wage to its employees. Earnings are considered wage and salary disbursements, other labor earnings, and the net business earnings of individual proprietors.

LIBRARY CIRCULATION

The opportunity, and in a technological world, the necessity, to read and be informed is basic to life in a free society (142). As American society grows increasingly complex, more effort is required by citizens to maintain contact with the cultural mainstream. Television, newspapers and radio supply this contact to some degree, but in a transitory manner; thus, in-depth, thoughtful commentary is still dependent on the cumulated information in books and magazines.

Public libraries are a ready source of current books and magazines and offer educational and personal growth opportunities in addition to those offered by formal institutions of learning. *Circulation of public library holdings per capita* can be used as an indicator of access to these opportunities. It should be recognized, however, that access is two-way. The degree of use depends on the individual initiative and curiosity of library patrons as well as upon the size and quality of library collections, the accessibility of the library building and professional staffs to administer service. Another factor contributing to fuller use of libraries is participation by a small library in a larger unit of service. These larger units are called federations in Montana and provide a broader range of resources and services than individual libraries can offer alone.

In using circulation of public library holdings per capita in this study, it must be recognized that libraries often serve two environmental regions although circulation data are assigned only to one. For example, Park County is in both the Broad Valley Rockies and the Yellowstone Rockies and circulation figures for Livingston Public Library are assigned to the Broad Valley Rockies because Livingston is located in this region. Similarly, part of Rosebud County is in Rocky Mountain Foreland and part is in Big Dry Region. The circulation for Rosebud County Library, located at Forsyth, is assigned to the Rocky Mountain Foreland Region.

CHILD WELFARE

One indicator of social well-being is the *number of children added to the Child Welfare Services (CWS) case load,* including cases reopened. When a child is added to to the CWS case load, at least one, but more likely several, incidents have occureed indicating that the child's family cannot care responsibly for the child (at least at that time). Such families are not likely to provide the best environment for children or adults.

The decision to add a child to the CWS rolls is made by a county social worker after receiving a complaint from a neighbor, relative or family member or having the case referred from another social welfare or other government agency, including the police. Children are placed on CWS rolls if they are in danger of becoming "dependents" (an archaic phrase meaning they are begging, spending time in "houses of ill repute," etc.), physically or mentally endangered due to neglect or abuse, or are the children of unwed parents to be relinquished for adoption. Occasionally the children of single-parent households will be placed on the rolls so they can be cared for when the parent is temporarily incapacitated, i.e., when the parent has to go to the hospital.

RURAL ROAD SYSTEM

Highway transportation assumes great importance in Montana with its vast area and lightly diffuse population. There are large areas in the state which are remote from railroad lines and from the main network of highways. Service to residents in these areas is complicated by the fact that ranches are widely spaced and a road of considerable length may serve only a few places.

It is a public responsibility to provide road facilities for all residents, despite their isolation. To judge the adequacy of the transportation system, it is therefore necessary to look beyond the primary and secondary highway networks (the major arteries of the system) and consider the "capillary system" of county and local roads which provide the rural population with access to the main system. The indicator used in this report is *rural area and rural population served per mile of rural road.*

Rural roads include all rural mileage outside of the interstate, primary, secondary and other state and urban systems; in other words, only local rural systems are included (130). Rural population excludes all urban areas (population centers of 2,500 or more persons) (119). Rural area excludes all urban and built-up areas, which consist of cities and towns and other built-up areas of more than 10 acres such as highways, roads, railroads, cemeteries, airports, golf courses, shooting ranges, industrial sites (except strip mines and borrow pits) and institutional or public administrative sites (153).

BRIEF REVIEW OF OTHER INDICATOR EFFORTS

Environmental indicators are a product of the environmental movement of the late sixties and early seventies. They were developed to provide an environmental early warning system and to make sense out of a morass of data reflecting a very complex and rapidly changing world. Additionally, at a time when citizens expect a greater role in determining the livability of the environment, it is essential that objective and coherent environmental data be available.

Indicators or indexes, as they are sometimes called, were first popularized in 1969 with publication by the National Wildlife Federation (NWF) of its first National Index of Environmental Quality (104). An update has been published annually except 1972 (160) (161). These annual indexes report on conditions and trends in seven categories: wildlife, living space, soil, timber, minerals, water and air. Each category is assigned its own numbered index.

The scientific approach to developing national environmental indexes was pioneered in this country by the President's Council on Environmental Quality (CEQ). The Council's *First Annual Report* (1970) identified as "a major national objective" the development of "a comprehensive nationwide system of environmental monitoring, information, and analysis" including the development of indexes from measured parameters (80). The CEQ commissioned a study, released in 1971, which designed a system to monitor the nation's environment, described approximately 110 environmental indexes, and identified major data gaps in current monitoring programs (31). Subsequent CEQ annual reports have expanded on the indicators theme (80).

Late in 1971, a symposium on Indicators of Environmental Quality was held in conjunction with the American Association for the Advancement of Science meeting in Philadelphia. The proceedings of that symposium concluded as follows (188):

> The symposium emphasized the need for public participation in decisions concerning environmental quality, and all speakers agreed that indicators facilitate the required communication among public officials, scientists, and the public.
>
> Designing and testing indicators of environmental quality are not mere academic exercises — scientists have a responsibility to make "environment" comprehensible to all segments of society that justifiably demand a greater participatory role in determining the habitability of our planet.

In the period since the Montana Environmental Quality Council used an indicators approach in its 1972 *First Annual Report,* two other states, one local government, a region and a nation have used indicators in a systematic manner to varying degrees and for various purposes. In 1973, North Carolina distributed an informational indicators brochure covering 11 subject areas ranging from air quality to housing. It was the state's first environmental overview (162). Louisiana issued a much more comprehensive "State of the State"report in 1975, displaying current information on 16 indicators in three broad categories: economy, natural resources and the public sector (111). The County of San Diego initiated a program to develop environmental quality indexes "in the attempt to provide citizens and decision makers with a comprehensive, integrated view of their regional environment" (172). Emphasis was on biophysical indicators in the areas of air, water, noise, energy, solid waste and land use. The Commission on the Future of the South used indicators, mainly in social and economic areas, in order to arrive at a series of regional objectives and recommendations to the southern states (40). In a more scientific vein, Canada's Federal Department of the Environment has outlined a Canadian Environmental Quality Index, including an air quality index, water and land indexes, and a combined environmental quality index (98).

The fanfare of early environmental quality indexes was accompanied by the belief that the objective of indicators was to produce a single "quality of life" index, that somehow a methodology could be devised to aggregate all the individual factors into a single measure. Most practitioners have concluded that such a measure is unattainable and have, like the EQC *Fourth Annual Report* (1975), come to believe that the most feasible approach is to improve environmental data collection and reporting systems. Readers interested in reviewing efforts in this field are invited to consult U.S. Environmental Protection Agency, *The 'Quality of Life' Concept: A Potential New Tool for Decision Makers* (EPA, Washington, D.C. 1973) and O. W. Markley and Marilyn D. Bagley, *Minimum Standards In Quality of Life* (EPA — 600/5-75-012, Washington, D.C., May 1975).

ENVIRONMENTAL MONITORING IN MONTANA*

Environmental Monitoring in Montana is a general directory and guide for officials, technicians, researchers and citizens. The directory is a first in Montana and requires some explanation of its limitations and origins. It should be evident that the chart interprets "environmental" very broadly; it identifies regular measurements made of a range of factors not only in the biophysical environment but in the social and economic spheres as well.

"Monitoring" has also been construed broadly in that the chart includes regular tabulations of some resources, which can be seen as environmental "givens" not involved in the process of change except as their magnitudes respond symptomatically. Oil and gas reserves furnish one example. A monitored change here might be symptomatic of a change in the definition of "reserve," new discoveries, increased exploitation, or a combination of these. In the broadest sense, because of the ultimate interconnectivity of all things in the natural world, causes and effects intermingle and are most accurately viewed when seen as part of a total system.

The chart limits the definition of "monitoring" in one important way. Judgment has been exercised in deciding whether a monitoring activity qualifies as an environmental indicator for the state as a whole. In most cases, networks of data collection covering only limited portions of the state or for limited periods fail to qualify. This is so even though the data collected, as in the case of current Environmental Protection Agency air quality monitoring programs in the Colstrip region, will be important baseline references against which to measure subsequent changes over a large area. This includes current U.S. Geological Survey hydrologic studies and other federal and state environmental impact studies of specific projects. Failure to include limited monitoring activites should not be interpreted as belittling their importance. The chart also fails to address the extent of monitoring by private agencies, partly because private data collectors are less accountable than public agencies for bias and error and are not always accessible.

Environmental Monitoring in Montana was prepared as part of a comprehensive environmental indicator program by the Montana Environmental Quality Council (EQC). The program emphasizes additional uses for existing data, such as tailoring them to fit an analysis of Montana's diverse environmental regions, and strives to put environmental issues in their proper perspective by illuminating not only the biophysical implications of environmental changes but their social and economic aspects as well. Issues viewed in this holistic context will allow Montana citizens and their decision makers to choose wisely from among many competing uses of Montana's resources.

The monitoring directory project revealed the need for a coordinated environmental monitoring system. Channels of communication among data collectors are poorly defined, as are channels of communication to the public. Increased public access to monitored data is a chief goal of the monitoring directory.

Important information that could be collected as part of routine agency activities is being ignored. The Department of Community Affairs, for example, could record and tabulate subdivision encroachment on wildlife habitat and agricultural lands as part of its day-to-day administration of the Montana Subdivision and Platting Act. At a minimum, these impacts should be included in the statewide subdivision inventory being conducted by the department and should be updated on a regular basis.

On the other hand, useful interpretation of data already collected has been foresaken. The Department of Health and Environmental Sciences, for instance, has abandoned publishing an analysis of trends and conditions in Montana air quality, and data used for enforcement are not extended to the public. The most recent such analysis was the 1970 booklet, *Status of Air Pollution Control in Montana.* The Health Department's Bureau of Records and Statistics also has abandoned preparation of an annual health index, based on records of vital statistics, that once served to focus public attention on county health care and health status. Other abandoned, but potentially useful analyses include 1950s studies by the Department of Highways on rural road improvement and on travel distances to haul Montana farm products to trade centers. Regular statistical analysis of the road network could serve to indicate changes in transportation efficiency, an important factor in the quality of life and in energy conservation.

The quality of data gathered always can be improved, but certain areas appear to need immediate attention, especially data on natural gas reserves, uranium reserves,

* The purpose of this section is to explain the origin and purpose of the chart inserted as a supplement to this report.

changes in employment and unemployment, land use, and accurate measures of crime.

Citizen attention to government data gathering has too often had to focus on one of its negative aspects, namely invasion of privacy. The tremendous amount of information being gathered about the biophysical, social and economic systems can be used to improve social conditions and to help guide public priorities. Combining and organizing the data into general indicators of environmental quality is one goal of the current EQC program and is only one of many possible uses of the information that is being gathered by all state agencies, at public expense. Citizen groups can use the monitoring directory to help find the information they need for private studies and investigations. Accelerated and coordinated use of environmental monitoring data by executive branch agencies also would have benefits in the preparation of environmental impact statements, for example. The Environmental Indicators Interagency Advisory Committee (EIIAC), whose members reviewed preparation of EQC's environmental indicators, could continue its work by devising new uses for monitored data and supervising the refinement of monitoring techniques.

Legal justification can be given for the latter suggestion. The Montana Environmental Policy Act (Section 69-6501 *et seq.*, R.C.M., 1947) directs executive branch agencies to "use all practicable means" to "improve and coordinate" programs and achieve the environmental goals stated in the Act. Agencies are specifically directed to "utilize a systematic interdisciplinary approach" in planning, to make information available that is "useful in restoring, maintaining and enhancing the quality of the environment," and to "initiate and utilize environmental information in the planning and development of resource-oriented projects" (Section 69-6504(b)). If new techniques and methods of data gathering and publishing are necessary to enhance and coordinate agency environmental programs, ample justification can be found in the Montana Environmental Policy Act.

GLOSSARY

Agricultural Land in Farms: See **Land in Farms.**

Avian Diversity: The ratio of different kinds of birds in an area to the total number of birds present. In this report avian diversity = (m-1)/ln N where m is the number of species and N is the number of individual birds observed.

Civilian Labor Force: Unemployed plus the non-military employed working in industries covered by unemployment insurance as well as estimates of those in industries not covered by unemployment insurance (primarily agriculture).

Commercial Forestland: Lands producing or capable of producing 20 cubic feet per acre of annual growth, suitable for management to grow crops of industrial wood, and not withdrawn from timber utilization by statute or administrative regulation.

Condition: An attribute of the environment that affects at least some people's quality of life, e.g., air quality, the economy, open space, crime, wildlife.

Conservation Treatment Need: A management technique required on agricultural or forestland to maintain productivity with minimal loss of soil due to erosion.

County Health Status Index: A composite health index based on a county's rank with regard to 12 health variables.

Data: Numbers resulting from the measurement of parameters; always accompanied by a unit of measurement.

Degradation: A reduction in quality of air or water affecting some beneficial use; does not necessarily mean a violation of standards.

Dewatering: The removal of water from a river or stream, either temporarily or permanently, usually by diversion.

Earnings: Wage and salary disbursements, other labor earnings, and individual proprietors' net business earnings.

Economically Recoverable Coal Reserves: 60 percent of potentially recoverable coal reserves.

Employment Ratio: Percent of the population aged 18 to 64 employed.

Environment: The mix of all economic, social, aesthetic, cultural and biophysical factors comprising the arena in which Montana people live.

Eutrophication: The process of lake aging, usually accompanied by obnoxious algal blooms.

Fecal Coliform Bacteria: Benign bacteria of the intestinal tract of warm blooded animals; in large numbers may indicate water contamination by human waste and the presence of pathogenic bacteria.

Forestland: Lands formerly or currently at least 10 percent stocked by forest trees of any size capable of producing timber; not currently developed for non-forest use.

Groundwater Diversion: The act of removing water from a subterranean aquifer.

Income: Earnings plus property, interest, and dividend income and the difference between transfer payments and personal contributions of social security.

Index: A number whose value provides a measure of the overall status of an environmental condition; arrived at by combining a number of indicator values in a prescribed manner.

Indicator: A parameter that has a high correlation to an important environmental condition which is less easily measurable.

Land in Farms: A rather broad interpretation of agricultural land, including farmland not under direct cultivation, federal land leased on a per acre basis, and all private and Indian-owned farmland.

Monitoring: The systematic and continuing observation of environmental parameters.

Net Migration: The change in population of a region equal to the difference between the influx and exodus of people over a given period of time.

Non-point Source Pollution: Waste originating over a broad area as a result of some land use or cultural activity, e.g., agriculture, timber harvesting, road building.

Nonreserved Commercial Forestland: See **Commercial Forestland.**

Non-stocked Commercial Forestland: Commercial sites requiring timber establishment or reinforcement.

Offenses Known to Police: The total number of crimes reported to police.

Parameter: An easily measured and quantifiable characteristic of the condition analyzed, e.g., felonies, sulfur dioxide, unemployment.

Perinatal Death Rate: The number of infant deaths per 100 live births from 0 to 28 days of life.

Point Source Pollution: Waste discharged from a single pipe or smokestack.

Potentially Recoverable Coal Reserves: Eighty percent or fifty percent of original coal reserves in the ground for surface mineable and underground mineable coal, respectively.

Primary Standard: An ambient air quality standard established to protect human health. (Ambient refers to the surrounding air.)

Proven Recoverable Natural Gas Reserves: Remaining discovered natural gas feasible to extract under current technology and market prices.

Proven Recoverable Oil Reserves: Remaining discovered oil feasible to extract under current technology — both primary and secondary recovery techniques — and current market prices.

Range Condition: The relative position of a range with regard to an attainable standard determined by resource managers on the basis of site potentials.

Range Trend: The change in range condition as measured every two to six years on BLM range allotments throughout the state.

Reforestation: Any of a number of techniques — establishment, reinforcement, improvement — required to bring a forest site to its full productive potential.

Reserved Lands: Forest lands reserved for purposes other than commercial timber harvest, including wilderness preservation.

Resource Index: The ratio of reserves to annual production for any non-renewable natural resource; measures years of expected supply.

Rural Non-Farm: People living outside of incorporated towns or in towns of less than 2,500 persons and not engaged in agriculture.

Saline Seeps: Recently developed saline soils in non-irrigated areas that are wet some or all of the time, often with white salt crusts, and where crop or grass production is reduced or eliminated.

Secondary Standard: An ambient air quality standard established to protect property from injury.

Stocking: See **Reforestation.**

Timber Establishment: Regenerating a crop of trees on land previously harvested for timber.

Timber Reinforcement: Bringing a forest site containing a thin stand of immature trees up to its full productive potential, usually by planting.

Timber Stand Improvement: Improving the productive potential of a forest site containing a stand of trees approaching maturity, usually by thinning.

Unemployed: Persons filing for unemployment benefits and statistical estimates of persons not filing, unemployed persons ineligible for unemployment benefits, and labor force entrants.

Unemployment Rate: The unemployed divided by the civilian labor force.

Urban Areas: Population centers with 2,500 or more persons.

Wastewater Recycling: The direct reuse of wastewater following minimal treatment, e.g., irrigation of agricultural crops with domestic sewage.

Water Consumption: See **Water Depletion.**

Water Depletion: The total amount of water withdrawn, consumed and not returned to the ground or surface water system .

Water Withdrawals: The amount of water purposefully taken from a surface or groundwater source for human use.

Wildlands: Lands without appreciable evidence of man's intrusion; includes acreage classified under the 1964 Wilderness Act as well as back-country zones in national parks and undeveloped roadless tracts of national forests and other public lands.

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APPENDIX A

Biographies

Members of Environmental Quality Council and Executive Director

Thomas O. Hager, chairman of the Environmental Quality Council (EQC), was born in Minneapolis, Minnesota. He attended public schools in Billings, Montana and was graduated with a degree in accounting from Montana State University. Hager, an egg rancher in Billings, is a Republican state representative and served in the 1973-74 session as a member of the Agriculture, Livestock and Irrigation and the Fish and Game Committees. In the 1975 session, he represented District 60 in the Montana House and served on the Judiciary and Taxation Committees. He is a member of the Montana Egg Council, the Northwest Egg Producers, and the United Egg Producers.

Margaret S. Warden, vice chairman of the EQC, was born in Glasgow, Montana. Ms. Warden is a graduate of Great Falls High School and attended Great Falls Commercial College. She was a delegate to the Montana Constitutional Convention in 1971-72. She has long been active in library affairs throughout the state and, among other activities, currently serves on an advisory committee planning a White House Conference on Libraries. Ms. Warden, a Democrat, represents District 18 in the Montana Senate.

L. M. (Larry) Aber was born in Colgate, North Dakota. He has lived in Montana since 1927. Aber was graduated from Reed Point (Mt) High School and Eastern Montana Normal College. He has done graduate work at Greeley, Colorado and Rocky Mountain College and Eastern Montana College in Billings. Aber taught school for twelve years, eleven of which he served as principal. He was in the automobile and farm machinery business for 27 years. Aber resides in Columbus, where he is active in community affairs. He is a Republican and represents District 36 in the Montana Senate.

G. Steven Brown, the Governor's designated representative on the EQC, was born in Corvallis, Montana. He was graduated from the University of Montana and received his law degree (with honors) from George Washington University. Brown was awarded an Environmental Law Fellowship at George Washington University in 1972. He served two years as a legislative assistant to Senator Mike Mansfield. Brown was legal counsel on the governor's staff before becoming chief legal counsel for the Department of Health and Environmental Sciences in May, 1975.

William M. Day is a rancher-farmer in Glendive, Montana. He was born in Hendrix, Oklahoma and has lived in Montana since 1951. Day is active in Glendive civic activities, serving as Chamber of Commerce president for 1975-76. He has a special interest in eastern Montana water issues and was a founder and first president of the Yellowstone Basin Water Use Association. A Democrat, Day represents District 54 in the Montana House.

G. W. (Por) Deschamps is a native and life-long resident of Missoula, Montana, where he ranches. Deschamps attended both Montana State University and the University of Montana. He served in the U.S. Marine Corps during World War II, having the rank of captain. Currently, a citizen member of the EQC, Deschamps, a Republican, served in the Montana House in the 1963 session and in the Montana Senate from 1967 through 1974.

Charles W. Doheny was born in Twin Falls, Idaho and came to Montana two weeks later. He ranches near Dutton, Montana. Doheny served with the Army Air Corps from 1942 to 1945. He is active in the Montana Farmers Union. A citizen member of the EQC, Doheny is a Democrat.

Gary Niles Kimble was born at the Ft. Belknap Agency near Harlem, Montana. He resides in Missoula, where he practices law and teaches in the American Indian Studies Program at the University of Montana. He received a B.A. degree in journalism from the University of Montana in 1966 and obtained his law degree from the University of Montana in 1972. From 1966 to 1968, Kimble was with the U.S. Army. He served in the Montana House in the 1973-74-75 sessions. A Democrat, he represents District 94.

Harriet Marble was born in Petersburg, Virginia. She has been in Montana since 1964 and lives in Chester. She earned her B.S. degree from Muskingum College and obtained a M.S. degree in wildlife management from the University of Montana. Ms. Marble is active in the League of Women Voters, the Wilderness Society, and the Montana Wilderness Association. Ms. Marble is a Democrat and has served as an EQC citizen member since 1971.

Terry Murphy was born in Butte, Montana. He attended schools in Gallatin County and farms near Cardwell, Montana. Murphy is active in the Montana Farmers Union and is currently serving as vice president. He was a member of the Montana House in the 1971-72 session. In the 1974 session, Murphy was a member of the Agriculture, Livestock and Irrigation Committee and vice chairman of the State Administration Committee. A Democrat, Murphy represents District 40 in the Montana Senate.

A. Thomas Rasmussen was born in Plentywood, Montana. He attended Montana State University and Pacific University, where he earned a doctorate in optometry. Rasmussen, a Helena optometrist, is past president of the Montana Optometric Association, and a member of the American Optometric Assocation, the Northern Plains Resource Council, and the Friends of the Earth. During the 1974-75 session, Rasmussen represented District 31 in the Montana House as a Republican.

Jark D. Rehberg is a native of Billings, Montana. A former executive director of the Montana Petroleum Association, he currently is vice president of a Billings savings and loan association. Rehberg was educated in Billings public schools and earned a B.S. degree in agriculture from Montana State University in 1951. Rehberg served as a Republican member of the Montana House in 1963-65 and of the Montana Senate in 1967, 1969, and 1971. He is a citizen member of the EQC.

Ed B. Smith was born in Dagmar, Montana, where he still lives and engages in farming and ranching. He has served as vice president of the National Wool Growers Association. Smith was the Republican candidate for Governor in 1972. He served in the Montana House in the 1967, 1969, and 1971 sessions. In 1975, he represented District 1 in the Montana Senate. Smith also serves on the Legislature's Interim Finance Committee and the Consumer Council.

John W. Reuss, EQC executive director, was born in San Bernardino, California, and holds B.A. and M.A. degrees in history from the University of California (Riverside), where he also worked toward a Ph.D. in political science. From 1968 to 1971, he was an instructor in the Science, Technology and Public Policy Program at Purdue University. In 1971, he came to Bozeman, Montana to become an assistant professor in the government program at Montana State University, where he taught and conducted research in the areas of science and public policy, environmental politics, and public administration with emphasis on natural resources management. In 1972, Reuss was appointed principal investigator of the National Science Foundation-sponsored Gallatin Canyon Study. Reuss has been at the EQC since July, 1974. He is a member of the American Association for the Advancement of Science and the Policy Studies Organization.

APPENDIX B

Montana Environmental Policy Act

PUBLIC HEALTH AND SAFETY
CHAPTER 65 — MONTANA ENVIRONMENTAL POLICY ACT

Section
69-6501. Short title.
69-6502. Purpose of act.
69-6503. Declaration of state policy for the environment.
69-6504. General directions to state agencies.
69-6505. Review of statutory authority and administrative policies to determine deficiencies or inconsistencies.
69-6506. Specific statutory obligations unimpaired.
69-6507. Policies and goals supplementary.
69-6508. Environmental quality council.
69-6509. Term of office.
69-6510. Meetings.
69-6511. Appointment and qualifications of an executive director.
69-6512. Appointment of employees.
69-6513. Term and removal of the executive director.
69-6514. Duties of executive director and staff.
69-6515. Examination of records of government agencies.
69-6516. Hearings by council — enforcement of subpoenas.
69-6517. Consultation with other groups — utilization of services.
69-6518. Fee may be imposed.

69-6501. Short title. This act may be cited as the "Montana Environmental Policy Act."

History: En. Sec. 1, Ch. 238, L. 1971
Title of Act
An act to establish a state policy for the environment and to establish an environmental quality council and setting forth its powers and duties and providing an effective date.

69-6502. Purpose of act. The purpose of this act is to declare a state policy which will encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the state; and to establish an environmental quality council.

History: En. Sec. 2, Ch. 238, L. 1971.

69-6503. Declaration of state policy for the environment. The legislative assembly, recognizing the profound impact of man's activity on the interrelations of all components of the natural environment, particularly the profound influences of population growth, high-density urbanization, industrial expansion, resource exploitation, and new and expanding technological advances and recognizing further the critical importance of restoring and maintaining environmental quality to the overall welfare and development of man, declares that it is the continuing policy of the state of Montana, in cooperation with the federal government and local governments, and other concerned public and private organizations, to use all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can coexist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Montanans.

(a) In order to carry out the policy set forth in this act, it is the continuing responsibility of the state of Montana to use all practicable means, consistent with other essential considerations of state policy, to improve and coordinate state plans, functions, programs, and resources to the end that the state may —

(1) fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;

(2) assure for all Montanans safe, healthful, productive, and esthetically and culturally pleasing surroundings;

(3) attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences;

(4) preserve important historic, cultural, and natural aspects of our unique heritage, and maintain, wherever possible, an environment which supports diversity and variety of individual choice;

(5) achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities; and

(6) enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

(b) The legislative assembly recognizes that each person shall be entitled to a healthful environment and that each person has a responsibility to contribute to the preservation and enhancement of the environment.

History: En. Sec. 3, Ch. 238, L. 1971.

69-6504. General directions to the state agencies. The legislative assembly authorizes and directs that, to the fullest extent possible:

(a) The policies, regulations, and laws of the state shall be interpreted and administered in accordance with the policies set forth in this act, and

(b) all agencies of the state shall

(1) utilize a systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts in planning and in decision making which may have an impact on man's environment;

(2) identify and develop methods and procedures, which will insure that presently unquantified environmental amenities and values may be given appropriate consideration in decision making along with economic and technical considerations;

(3) include in every recommendation or report on proposals for projects, programs, legislation and other major actions of state government significantly affecting the quality of the human environment, a detailed statement on —

(i) the environmental impact of the proposed action,

(ii) any adverse environmental effects which cannot be avoided should the proposal be implemented,

(iii) alternatives to the proposed action,

(iv) the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and

(v) any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.

Prior to making any detailed statement, the responsible state official shall consult with and obtain the comments of any state agency which has jurisdiction by law or special expertise with respect to any environmental impact involved. Copies of such statement and the comments and views of the appropriate state, federal, and local agencies, which are authorized to develop and enforce environmental standards, shall be made available to the governor, the environmental quality council and to the public, and shall accompany the proposal through the existing agency review processes.

(4) study, develop, and describe appropriate alternatives to recommend courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources;

(5) recognize the national and long-range character of environmental problems and, where consistent with the policies of the state, lend appropriate support to initiatives, resolutions, and programs designed to maximize national co-operation in anticipating and preventing a decline in the quality of mankind's world environment;

(6) make available to counties, municipalities, institutions, and individuals, advice and information useful in restoring, maintaining, and enhancing the quality of the environment;

(7) initiate and utilize ecological information in the planning and development of resource-oriented projects; and

(8) assist the environmental quality council established by section 8 (69-6508) of this act.

History: En. Sec. 4, Ch. 238, L. 1971.

69-6505. Review of statutory authority and administrative policies to determine deficiencies or inconsistencies. All agencies of the state shall review their present statutory authority, administrative regulations, and current policies and procedures for the purpose of determining whether there are any deficiencies or inconsistencies therein which prohibit full compliance with the purposes and provisions of this act and shall propose to the governor and the environmental quality council not later than July 1, 1972, such measures as may be necessary to bring their authority and policies into conformity with the intent, purposes, and procedures set forth in this act.

History: En. Sec. 5, Ch. 238, L. 1971.

69-6506. Specific statutory obligations unimpaired. Nothing in section 3 (69-6503) or 4 (69-6504) shall in any way affect the specific statutory obligations of any agency of the state

(a) to comply with criteria or standards of environmental quality,

(b) to co-ordinate or consult with any other state or federal agency, or

(c) to act, or refrain from acting contingent upon the recommendations or certification of any other state or federal agency.

History: En. Sec. 6, Ch. 238, L. 1971.

69-6507. Policies and goals supplementary. The policies and goals set forth in this act are supplementary to those set forth in existing authorizations of all boards, commissions, and agencies of the state.

History: En. Sec. 7, Ch. 238, L. 1971.

69-6508. Environmental quality council. The environmental quality council shall consist of thirteen (13) members to be as follows:

(a) The governor or his designated representative shall be an ex-officio member of the council and shall participate in council meetings as a nonvoting member.

(b) Four (4) members of the senate and four (4) members of the house of representatives appointed before the fiftieth legislative day in the same manner as standing committees of the respective houses are appointed. A vacancy on the council occurring when the legislature is not in session shall be filled by the selection of a member of the legislature by the remaining members of the council. No more than two (2) of the appointees of each house shall be members of the same political party.

(c) Four (4) members of the general public; two (2) public members shall be appointed by the speaker of the house with the consent of the house minority leader, and two (2) shall be appointed by the president of the senate with the consent of the senate minority leader.

In considering the appointments of (b) and (c) above, consideration shall be given to their qualifications to analyze and interpret environmental trends and information of all kinds; to appraise programs and activities of the state government in the light of the policy set forth in section 69-6503 of this act; to be conscious and responsive to the scientific, economic, social, aesthetic, and cultural needs and interests of the state and to formulate and recommend state policies to promote the improvement of the quality of the environment.

History: Amd. Sec. 1, Ch. 492, L. 1975, eff. April 21, 1975.

69-6509. Term of Office. (1) The terms of office of all council members shall be two (2) years and shall terminate upon appointment of a new council before the fiftieth legislative day. Council members may be reappointed; however, in no case shall a member serve more than six (6) years.

(2) The council shall elect one of its members as chairman and such other officers as it deems necessary. Such officer shall be elected for a term of two (2) years.

History: Amd. Sec. 2, Ch. 492, L. 1975, eff. April 21, 1975.

69-6510. Meetings. The council may determine the time and place of its meetings but shall meet at least once each quarter. Each member of the council shall, unless he is a full-time salaried officer or employee of this state, be paid twenty-five dollars ($25) for each day in which he is actually and necessarily engaged in the performance of council duties, and shall also be reimbursed for actual and necessary expenses incurred while in the performance of council duties. Members who are full-time salaried officers or employees of this state may not be compensated for their service as members, but shall be reimbursed for their expenses.

History: En. Sec. 10, Ch. 238, L. 1971.

69-6511. Appointment and qualifications of an executive director. The council shall appoint the executive director and set his salary. The executive director shall hold a degree from an accredited college or university with a major in one of the several environmental sciences and shall have at least three (3) years of responsible experience in the field of environmental management.

He shall be a person who, as a result of his training, experience, and attainments, is exceptionally well qualified to analyze and interpret environmental trends and information of all kinds; to appraise programs and activities of the state government in the light of the policy set forth in section 3 (69-6503) of this act; to be conscious of and responsive to the scientific, economic, social, esthetic, and cultural needs and interests of the state; and to formulate and recommend state policies to promote the improvement of the quality of the environment.

History: En. Sec. 11, Ch. 238, L. 1971.

69-6512. Appointment of employees. The executive director, subject to the approval of the council, may appoint whatever employees are necessary to carry out the provisions of this act, within the limitations of legislative appropriations.

History: En. Sec. 12, Ch. 238, L. 1971.

69-6513. Term and removal of the executive director. The executive director is solely responsible to the environmental quality council. He shall hold office for a term of two (2) years beginning with July 1 of each odd-numbered year. The council may remove him for misfeasance, malfeasance or nonfeasance in office at any time after notice and hearing.

History: En. Sec. 13, Ch. 238, L. 1971.

69-6514. Duties of executive director and staff. It shall be the duty and function of the executive director and his staff

(a) to gather timely and authoritative information concerning the conditions and trends in the quality of the environment both current and prospective, to analyze and interpret such information for the purpose of determining whether such conditions and trends are interfering, or are likely to interfere, with the achievement of the policy set forth in

section 3 (69-6503) of this act, and to compile and submit to the governor and the legislative assembly studies relating to such conditions and trends;

(b) to review and appraise the various programs and activities of the state agencies in the light of the policy set forth in section 3 (69-6503) of this act for the purpose of determining the extent to which such programs and activities are contributing to the achievement of such policy, and to make recommendations to the governor and the legislative assembly with respect thereto;

(c) to develop and recommend to the governor and the legislative assembly, state policies to foster and promote the improvement of environmental quality to meet the conservation, social, economic, health, and other requirements and goals of the state;

(d) to conduct investigations, studies, surveys, research, and analyses relating to ecological systems and environmental quality;

(e) to document and define changes in the natural environment, including the plant and animal systems, and to accumulate necessary data and other information for a continuing analysis of these changes or trends and an interpretation of their underlying causes;

(f) to make and furnish such studies, reports thereon, and recommendations with respect to matters of policy and legislation as the legislative assembly requests;

(g) to analyze legislative proposals in clearly environmental areas and in other fields where legislation might have environmental consequences, and assist in preparation of reports for use by legislative committees, administrative agencies, and the public;

(h) to consult with, and assist legislators who are preparing environmental legislation, to clarify any deficiencies or potential conflicts with an overall ecologic plan;

(i) to review and evaluate operating programs in the environmental field in the several agencies to identify actual or potential conflicts, both among such activities, and with a general ecologic perspective, and to suggest legislation to remedy such situations;

(j) to transmit to the governor and the legislative assembly annually, and make available to the general public annually, beginning July 1, 1972, an environmental quality report concerning the state of the environment which shall contain

(1) the status and condition of the major natural, manmade, or altered environmental classes of the state, including, but not limited to, the air, the aquatic, including surface and ground water, and the terrestrial environment, including, but not limited to, the forest, dryland, wetland, range, urban, suburban, and rural environment;

(2) the adequacy of available natural resources for fulfilling human and economic requirements of the state in the light of expected population pressures;

(3) current and foreseeable trends in the quality, management and utilization of such environments and the effects of those trends on the social, economic, and other requirements of the state in the light of expected population pressures;

(4) a review of the programs and activities (including regulatory activities) of the state and local governments, and nongovernmental entities or individuals, with particular reference to their effect on the environment and on the conservation, development and utilization of natural resources; and

(5) a program for remedying the deficiencies of existing programs and activities, together with recommendations for legislation.

History: En. Sec. 14, Ch. 238, L. 1971.

69-6515. Examination of records of government agencies. The environmental quality council shall have the authority to investigate, examine and inspect all records, books and files of any department, agency, commission, board or institution of the state of Montana.

History: En. Sec. 15, Ch. 238, L. 1971.

69-6516. Hearings by council—enforcement of subpoenas. In the discharge of its duties the environmental quality council shall have authority to hold hearings, administer oaths, issue subpoenas, compel the attendance of witnesses, and the production of any papers, books, accounts, documents and testimony, and to cause depositions of witnesses to be taken in the manner prescribed by law for taking depositions in civil actions in the district court. In case of disobedience on the part of any person to comply with any subpoena issued on behalf of the council, or any committee thereof, or of the refusal of any witness to testify on any matters regarding which he may be lawfully interrogated, it shall be the duty of the district court of any county or the judge thereof, on application of the environmental quality council to compel obedience by proceedings for contempt as the case of disobedience of the requirements of a subpoena issued from such court on a refusal to testify therein.

History: En. Sec. 16, Ch. 238, L. 1971.

69-6517. Consultation with other groups—utilization of services. In exercising its powers, functions, and duties under this act, the council shall

(a) consult with such representatives of science, industry, agriculture, labor, conservation organizations, educational institutions, local governments and other groups, as it deems advisable; and

(b) utilize, to the fullest extent possible, the services, facilities, and information (including statistical information) of public and private agencies and organizations, and individuals, in order that duplication of effort and expense may be avoided, thus assuring that the commission's activities will not unnecessarily overlap or conflict with similar activities authorized by law and performed by established agencies.

History: En. Sec. 17, Ch. 238, L. 1971.

69-6518. Fee may be imposed. (1) Each agency of state government charged with the responsibility of issuing a lease, permit, contract, license or certificate under any provision of state law may adopt rules prescribing fees which shall be paid by a person, corporation, partnership, firm, association, or other private entity when an application for a lease, permit, contract, license, or certificate will require an agency to compile an environmental impact statement as prescribed by section 69-6504, R. C. M. 1947, of the Montana Environmental Policy Act. An agency must determine within thirty (30) days after a completed application is filed whether it will be necessary to compile an environmental impact statement and assess a fee as prescribed by this section. The fee assessed under this section shall only be used to gather data and information necessary to compile an environmental impact statement as defined in the Montana Environmental Policy Act. No fee may be assessed if an agency intends only to file a negative declaration stating that the proposed project will not have a significant impact on the human environment.

(2) In prescribing fees to be assessed against applicants for a lease, permit, contract, license, or certificate, as specified in subsection (1), an agency may adopt a fee schedule which may be adjusted depending upon the size and complexity of the proposed project. No fee may be assessed unless the application for a lease, permit, contract, license, or certificate will result in the agency incurring expenses in excess of two thousand five hundred dollars ($2,500) to compile an environmental impact statement. The maximum fee that may be imposed by an agency shall not exceed two per cent (2%) of any estimated cost up to one million dollars ($1,000,000); plus one per cent (1%) of any estimated cost over one million dollars ($1,000,000) and up to twenty million dollars ($20,000,000); plus one-half of one per cent (½ of 1%) of any estimated cost over twenty million dollars ($20,000,000) and up to one hundred million dollars ($100,000,000); plus one-quarter of one per cent (¼ of 1%) of any estimated cost over one hundred million dollars ($100,000,000) and up to three hundred million dollars ($300,000,000); plus one-eighth of one per cent (⅛ of 1%) of any estimated cost in excess of three hundred million dollars ($300,000,000). If an application consists of two (2) or more facilities, the filing fee shall be based on the total estimated cost of the combined facilities. The estimated cost shall be determined by the agency and the applicant at the time the application is filed.

(3) No fee as prescribed by this section may be assessed against any person, corporation, partnership, firm, association, or other private entity filing an application for a certificate under the provisions of the Montana Utility Siting Act, Title 70, chapter 8, R. C. M. 1947.

(4) In adopting rules prescribing fees as authorized by this section, an agency shall comply with the provisions of the Montana Administrative Procedure Act, Title 82, chapter 42, R. C. M. 1947.

(5) All fees collected under this section shall be deposited in the state earmarked revenue fund as provided in section 79-410, R. C. M. 1947. All fees paid pursuant to this section shall be used as herein provided and each agency upon completion of the necessary work will make an accounting to the applicant of the funds expended and refund all unexpended funds without interest.

(6) In cases where a combined facility proposed by an applicant requires action by more than one (1) agency or multiple applications for the same facility, the governor shall designate a lead agency to collect one (1) fee pursuant to this section, to co-ordinate the preparation of information required for all environmental impact statements which may be required, and to allocate and disburse the funds necessary to the other agencies which require funds for the completion of the necessary work.

(7) Each agency shall review and revise its rules imposing fees as authorized by this section at least every two (2) years. Furthermore, each agency shall provide the legislature with a complete report on the fees collected prior to the time that a request for an appropriation is made to the legislature.

History: En. 66-6518 by Sec. 1, Ch. 329, L. 1975.

APPENDIX C

UNIFORM RULES

For Environmental Impact Statements (EIS) Required by the Montana Environmental Policy Act of 1971

Adopted by the Environmental Quality Council, May 29, 1975

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I. INTRODUCTION AND POLICY (1) The legislature in 1971 adopted the Montana Environmental Policy Act (Sections 69-6501 through 69-6518, Revised Codes of Montana, 1947). The Act declares a state policy to achieve and maintain environmental quality and provides a general procedural framework for state agency decision making that will give appropriate consideration to environmental values.

(2) Section 69-6504 directs that all agencies of the state shall:

"(1) utilize a systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts in planning and decision making which may have an impact on man's environment;

(2) identify and develop methods and procedures which will insure that presently unquantified environmental amenities and values may be given appropriate consideration in decision making along with economic and technical considerations;

(3) include in every recommendation or report on proposals for projects, programs, legislation and other major actions of state government significantly affecting the quality of the human environment, a detailed statement on —

(i) the environmental impact of the proposed action,

(ii) any adverse environmental effects which cannot be avoided should the proposal be implemented,

(iii) alternatives to the proposed action,

(iv) the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity, and

(v) any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented."

(3) Section 69-6503 of the Act "declares that it is the continuing policy of the state of Montana . . . to use all practicable means and measures . . . in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can coexist in productive harmony, and fulfill the social, economic and other requirements of present and future generations of Montanans."

(4) Anticipating the impacts of proposals and alternatives is a necessary tool that must be utilized by all agencies of the state so that the state may "fulfill the responsibilities of each generation as the trustee of the environment for succeeding generations," according to Section 69-6503(a) (1). Section 69-6504(b) (1) states that these efforts must "utilize a systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts in planning and decision making which may have an impact on man's environment."

(5) As early as possible and in all cases prior to any agency decision concerning major action or recommendation on a proposal for legislation that significantly affects the environment, state agencies shall, in consultation with other appropriate agencies and individuals, in both the public and private sectors, assess in detail the potential environmental impact so that adverse effects are avoided and environmental quality is maintained, enhanced, or restored to the fullest extent practicable. In particular, it is especially important that alternative actions that will minimize adverse impacts be explored, and both the long and short range effects on the human environment and on nature be evaluated in order to avoid, to the fullest extent practicable, undesirable consequences for the environment as a whole.

(6) The language in Section 69-6504 is intended to insure that all agencies of the state shall comply with the

directives set out in that section "to the fullest extent possible" under their statutory authorizations and that no agency shall utilize an excessively narrow construction of its existing statutory authorizations to avoid compliance. In deciding whether or not to approve the action under consideration, the agency should consider the broad range of environmental factors covered by the environmental impact statement in addition to the specific factors indicated by the statute or regulation authorizing the agency action.

II. DEFINITIONS (1) "Agency of the state" means any agency of state government as defined in Title 82A, R.C.M., 1947.

(2) "Agency listing" is a listing of all state agencies with environmental expertise or jurisdiction compiled by the Environmental Quality Council and the Commission on Environmental Quality. The listing will indicate the areas of environmental expertise and jurisdiction of each agency, and will be distributed to assist agencies in conducting preliminary environmental reviews and preparing draft environmental impact statements, and in determining whether a joint impact statement is appropriate.

(3) "Emergency actions" are:

(a) projects undertaken, carried out, or approved by an agency to maintain, repair, or restore property or facilities damaged or destroyed as a result of disaster in a disaster-stricken area in which a state of emergency has been declared by the governor or other appropriate government official;

(b) emergency repairs to public service facilities necessary to maintain service;

(c) projects undertaken as emergency action necessary to prevent or mitigate immediate threats to public health or safety.

(4) "Major actions of state government" include, but are not limited to:

(a) **Facilities development;** planning, designing, or constructing physical facilities to be owned and operated by state agencies.

(b) **Rule making;** development and promulgation of rules and standards.

(c) **Policy making;** development and formal recommendation of state policy.

(d) **Legislation;** agency recommendations or formal reports relating to legislation, including appropriations. This includes agency recommendations on their own proposals, and agency reports on proposals initiated elsewhere. In the latter case, only the agency which has primary responsibility for the subject matter involved will be required to conduct an environmental review.

(e) **Individual projects;** the development of state programs, proposed projects within state programs, and continuing activities undertaken by state agencies and supported in whole or in part by state funds or involving a state lease, permit, license, certificate, or other entitlement.

(f) any agency action for which a hearing is normally required by statute or regulation.

(g) any agency action having one or more of the following characteristics:

(i) The action under consideration is the first or only governmental decision to be taken on the project;

(ii) The action may generate additional or secondary impacts which outweight the initial impacts;

(iii) The action is expected to have direct or indirect local, statewide, or regional implications;

(iv) The action may affect environmental attributes recognized as being endangered, fragile, or in severely short supply;

(v) The action is growth-inducing;

(vi) The action may substantially alter environmental conditions in terms of quality or availability;

(vii) The action may have irreversible environmental effects;

(viii) The action is likely to be precedent setting or controversial;

(ix) The action is one of a number of smaller actions which have a substantial impact collectively.

(5) "Major actions of state government" do not include, and an environmental review is not necessary for, agency actions which are not included in paragraphs (4) (a) through (4) (f) of this section, and which have none of the characteristics listed in paragraph (4) (g), and which fall into one of the following categories:

(a) **Ministerial actions;** actions in which the agency exercises no discretion, but rather acts upon a given state of facts in a prescribed manner pursuant to statutory or regulatory mandate. In such actions, the responsible official must act without regard to his own judgment or opinion as to the wisdom or propriety of the action. Such actions are in the nature of routine, clerical or similar actions.

(b) **Existing facilities;** minor repairs, operation or maintenance of existing equipment or facilities involving no expansion of capacity or use beyond that already existing. Such actions might include interior alteration or repair of buildings, installation of safety or health protection devices, minor highway maintenance or repair.

(c) **Investigation and enforcement;** data collection, inspection of facilities, enforcement of environmental standards.

(6) "Human environment" is broadly construed to include the bio-physical, social, economic, cultural, and aesthetic factors that inter-relate to form the environment in which Montanans live.

(7) "Lead agency" is the agency of the state that has primary authority for committing the government to a course of action with significant environmental impact, or the agency chosen to supervise the preparation of a joint environmental impact statement where more than one agency is involved in the action. The Environmental Quality Council and the Commission on Environmental Quality will assist, on request, in resolving questions of lead agency determination.

(8) "Environmental impact statement" is the "detailed statement" required by Section 69-6504(b) (3), and can take several different forms:

(a) "Draft environmental impact statement" is the initial environmental impact statement prepared in accordance with section IV. (2) of these rules, and distributed to the appropriate agencies and the public for comment prior to filing the final environmental impact statement.

(b) "Final environmental impact statement" is a document summarizing or if necessary including the major

conclusions and supporting information of a draft environmental impact statement and specifically including the lead agency's response to all substantial comments or objections raised by the public or other agencies since issuance of the draft environmental impact statement.

(c) "Joint environmental impact statement" is an environmental impact statement prepared by more than one agency in cooperation when such agencies are involved in the same or closely related proposed actions.

(d) "Programmatic environmental impact statement" is an environmental impact statement covering several related actions, or discussing initiation or continuance of a broad policy or program which may involve a series of future actions.

(9) "Agency impact determination" is the report or recommendation by an agency, after completion of the preliminary environmental review, that serves public notice of the results of the preliminary environmental review. Specifically, the agency impact determination announces the determination whether the proposed action will or might significantly affect the quality of the human environment. A determination in the negative serves to announce that a draft environmental impact statement will not be prepared. A determination in the affirmative announces that a draft environmental impact statement will be prepared and serves the additional function of notifying agencies and individuals who have an interest in the forthcoming draft environmental impact statement.

(10) "Preliminary environmental review" (PER) is the initial review of a proposed action to determine whether the action might significantly affect the quality of the human environment and therefore require a draft environmental impact statement. Report of the completed PER is an agency impact determination.

III. PRELIMINARY ENVIRONMENTAL REVIEW (PER) CHECKLIST. Once an action is identified as not categorically exempt from environmental review requirements, a preliminary environmental review (PER) must be conducted to determine if the action will have a significant effect on the environment and therefore require a detailed impact statement. The PER is to be conducted concurrently with preliminary economic, technical and other review procedures which normally go into the agency review process. In order to facilitate this review, a checklist is to be developed.

(1) **Development of PER Checklist:**

(a) Each agency shall identify those actions typically undertaken by the agency which do not require an environmental review, in accordance with section II(5). No category of action may be formally designated as exempt from the requirements of the Montana Environmental Policy Act except pursuant to the rule making procedures of the Montana Administrative Procedure Act, Section 82-4201 *et seq.*, R.C.M., 1947.

(b) Each agency shall identify the types of actions which it typically undertakes which require environmental review.

(c) For each type of action identified in paragraph (b), the agency shall identify the environmental considerations usually involved in that type of action (e.g. SO^2 emissions, water pollutant discharges, etc.).

(d) For each such environmental consideration, the agency shall identify the type of information or data which must be obtained in order to determine the extent of the impact which the action will have on the environment.

(e) Based on the information gathered pursuant to paragraphs (b) through (d), the agency shall prepare a checklist format for conducting the PER. The agency may develop one general checklist which applies to all its actions, or it may develop a separate format for each of its major types of actions.

(f) The checklist shall include, at a minimum:

(i) an adequate description of the proposed action, including maps and graphs if appropriate;

(ii) a listing and brief description of alternative actions;

(iii) a listing of other agencies or groups that may have been contacted, or which may have overlapping jurisdiction; a summary of the comments or information obtained from such agencies or groups;

(iv) an evaluation section which consists of specific questions which must be considered. These questions shall reflect the criteria for defining "significant effect on the quality of the human environment," set out in sectin III(2) of these rules, *infra*.

(v) a recommendation by the responsible official whether an environmental impact statement is required;

(vi) identification of the person or persons conducting the PER.

(g) Agencies shall submit their proposed checklist formats for comment and critique to the Environmental Quality Council, the Commission on Environmental Quality, and to other agencies with relevant expertise or jurisdiction, and shall revise their formats where appropriate in accordance with the comments received.

(h) Each agency shall submit a list of activity categories and associated areas of environmental jurisdiction and concern to the Environmental Quality Council and the Commission of Environmental Quality for use in compiling an agency listing.

(i) Each agency shall designate and identify an official or officials who are responsible for the content and preparation of preliminary environmental reviews and draft environmental impact statements, coordinating impact statement investigatory research with other agencies, and establishing a "fund file" of available expertise from the public and private sectors.

(2) **Evaluation of Significance of Impact on the Environment:** The determination of whether an agency action will have a significant effect on the quality of the human environment necessarily involves careful judgment on the part of the responsible agency officials.

(a) The PER checklist must consider the effect of the proposed action on the following factors, where appropriate:

(i) Terrestrial and aquatic life and habitats;

(ii) Water quality, quantity, and distribution;

(iii) Soil quality, stability, and moisture;

(iv) Vegetation cover, quantity, and quality;

(v) Natural beauty and aesthetics;

(vi) Access to and quality of recreational and wilderness experiences;

(vii) Historical and archeological sites;

(viii) Unique, endangered, fragile, or limited environmental resources;

(ix) Air quality;

(x) Social structures and mores;

(xi) Cultural uniqueness and diversity;

(xii) Local and state tax base and tax revenues;

(xiii) Agricultural production;

(xiv) Demands on environmental resources of land, water, air, and energy;

(xv) Quantity and distribution of community and personal income;

(xvi) Human health;

(xvii) Transportation networks; traffic flows;

(xviii) Quantity and distribution of employment;

(xix) Distribution and density of population and housing;

(xx) Demands for government services, i.e. water, waste disposal, schools, police, fire, health, streets;

(xxi) Industrial and commercial activity;

(b) In addition, the evaluation section of the PER checklist shall address the following questions:

(i) Would the proposed action conflict with any environmental plans or goals that have been adopted by the community where the project is to be located?

(ii) Would the action substantially affect rare or endangered animal or plant species, or the habitat of such a species?

(iii) Would the project breach any state, national, or local standards relating to solid waste or litter control?

(iv) Might the project cause substantial flooding, erosion, or siltation?

(v) Are there substantial differences of opinion among experts or affected citizens as to the extent of adverse impacts on the human environment?

(c) The possibility of a significant effect on any of the factors listed in subsection (2) (a), or a "yes" answer to any of the questions in subsection (2) (b) indicates that a detailed environmental impact statement is required. The lists in subsections (2) (a) and (2) (b) are not necessarily exhaustive, but indicate the range of considerations which must be addressed during the PER. In addition, the following factors will influence the weight to be assigned to the impacts of a proposed action:

(i) The significance of an action may vary with the setting. For example, an activity which may not be significant in an urban area may be significant in a rural setting.

(ii) Primary and secondary effects must be considered. Secondary, or indirect, effects such as residential or commercial expansion encouraged by highway or sewer construction, often may have more significant environmental impacts than the project itself.

(iii) The significance of an action may depend on its relationship to other agency decisions. If the action is the first or only state agency decision to be made on the project, it is likely to be more significant than if other decisions must be made which do not depend on the outcome of the present decision.

(iv) The statutory clause "major actions of state government significantly affecting the quality of the human environment" shall be construed by agencies from the perspective of the overall impact of the action proposed and the cumulative impacts of further actions contemplated. Such actions may be localized and seemingly insignificant in their individual impacts, but if there is a potential that the environment may be significantly affected as the actions accumulate, the environmental impact statement shall be prepared.

(v) When an agency responsible for the issuance of a lease, permit, license, certificate, or other entitlement can foresee that the the issuance of a large number of such entitlements will, cumulatively, have a significant impact on the environment, a programmatic environmental impact statement should be prepared which addresses these cumulative impacts.

(vi) In any situation where cumulative impacts of a series of related actions may be significant, the agency should consider the appropriateness of preparing a programmatic impact statement, as described in Section IV (2) (e).

IV. ENVIRONMENTAL REVIEW PROCEDURES. To guide environmental review of proposed actions, agencies shall adopt the following procedures:

(1) **Preliminary Environmental Review (PER).** Concurrent with preliminary technical, economic and other review procedures which normally go into the agency review process, the agency shall conduct a preliminary environmental review sufficient to make a determination whether the action may have a significant effect on the human environment. The evaluation should be explicit enough to make clear to other agencies and the public the basis for the agency's recommendation whether to prepare an environmental impact statement. In conducting a PER, the agency shall proceed as follows:

(a) determine whether the proposed action is a major action as defined in section II(4) and as identified in section III(1) of these rules;

(b) if the proposed action is not a major action, no further environmental review is necessary;

(c) if the proposed action is an emergency action as defined in Section II(3) of these rules, the agency may proceed with the action immediately, as the emergency dictates. In this case, however, the agency shall continue with the environmental review procedures concurrent with or subsequent to the action, in order to inform other agencies and the public of the environmental impacts caused by the action.

(d) if the proposed action is a major action, fill out the appropriate PER checklist to determine whether the action would have a significant effect on the human environment;

(e) in filling out the PER checklist, the agency may utilize information submitted to it by the applicant. The agency must take responsibility for the accuracy and adequacy of the information used to determine the extent of environmental impact;

(f) the agency may consult with other agencies or groups in conducting the PER and filling out the checklist. Where the agency listing indicates other agencies with relevant expertise or overlapping jurisdiction, such consultation is required;

(g) after completing the PER, the agency shall circulate the checklist to all agencies with relevant expertise and jurisdiction, and to the Environmental Quality Council and Commission on Environmental Quality, and to any individuals or groups which have been identified as interested in or affected by the proposed action. All such

agencies and groups will have fifteen (15) days to submit comments to the agency. The agency will take no action towards approval of the proposed action during that period;

(h) commenting agencies should indicate the need for a joint or programmatic impact statement where appropriate. Where a joint statement is necessary, the agencies involved shall confer to determine the lead agency, or shall make plans to coordinate preparation of a joint statement;

(i) if the agency's completed checklist indicates there will be no significant effect on the human environment, the checklist will serve as an agency impact determination and the agency's normal decision making process with respect to the proposed action may continue;

(j) if the agency's completed checklist indicates there will or may be a significant effect on the human environment, the checklist will serve as an agency impact determination giving notice of intent to prepare an environmental impact statement. The agency shall then proceed to prepare a draft environmental impact statement. Until the environmental impact statement procedure is completed, the agency will take no further action towards approval of the proposed action;

(k) agencies shall maintain a listing of all agency impact determinations. This listing shall be available to the public.

(2) **Preparation of Draft Environmental Impact Statements.**

(a) Once it has been determined that an environmental impact statement is required, the agency shall, at the earliest feasible time, consult with other agencies with relevant expertise or jurisdiction with respect to the contemplated action and its impacts. The agency should also seek comments from appropriate federal and local agencies, public and private organizations, groups, and individuals whose interests are likely to be significantly affected by the action. In order to facilitate this consultation process, agencies should develop "fund files" of expertise available from the public and private sectors. This consultation need not be considered formal. An interdisciplinary approach to the preparation of draft environmental impact statements is the chief goal of agency consultation.

(b) Where the lead agency or another state or federal agency has already prepared an environmental impact statement on a project which is related geographically or functionally to the project under consideration, portions of such an environmental impact statement may be utilized by the agency. The agency must be careful to insure that all conditions and impacts peculiar to the action under consideration are adequately dealt with. The Environmental Quality Council will assist agencies, on request, in determining whether such related impact statements are available.

(c) **Fees.** Under Section 69-6518 of the Act, in any action involving an application for a lease, permit, license, certificate or other entitlement, the agency should determine, after the initial consultations with other agencies, whether the expected cost of preparing a draft and final environmental impact statement will exceed two thousand five hundred dollars ($2,500.00). If this is the case, the agency may require the applicant to pay a fee to cover such costs, up to two percent (2%) of the total projected cost of the proposed project. The agency may adopt rules to determine how such fees will be assessed.

(d) **Joint Impact Statements.** Where more than one agency (inlcuding federal agencies) directly sponsors an action, or is directly involved in an action through funding, licensing, or permits, or where more than one agency is involved in a group of actions directly related to each other because of their functional interdependence and geographical proximity, consideration should be given to preparation of one environmental impact statement for all the state actions involved. Agencies in such cases should consider the possibility of joint preparation of an environmental impact statement by all agencies involved, or designation of a single lead agency to assume supervisory responsibility over the preparation of the environmental impact statement. Where a lead agency prepares the statement, the other agencies involved should provide assistance with respect to their areas of jurisdiction and expertise. In either case, the environmental impact statement should assess the total impact of the full range of state actions involved, should reflect the views of all participating agencies, and should be prepared before major or irreversible actions have been taken by any of the participating agencies. Factors relevant in determining an appropriate lead agency include the time sequence in which agencies become involved, the magnitude of their respective involvements, and their relative expertise with respect to the project's environmental effects.

(e) **Programmatic Impact Statements.** Where the cumulative effects of several related actions are significant, a programmatic impact statement may be appropriate. Individual actions that are related either geographically (e.g., several proposed subdivisions within a particular area), or as logical parts within a contemplated series of actions (e.g., several segments of a proposed highway) may be more appropriately evaluated in a single programmatic statement. Such a programmatic statement may also be appropriate in the development of rules or policies or other criteria which will govern the conduct of a continuing program, or in the development of a new program that contemplates a number of subsequent actions.

A programmatic statement will not satisfy the requirements of the Act if it is superficial or limited to generalities. The programmatic statement should satisfy all the requirements for the content of individual project statements, but should emphasize cumulative impacts, and alternative policies or courses of action.

The programmatic statement will serve as an analytical foundation for subsequent individual project statements, but subsequent individual projects may require further analysis where conditions or expected impacts have changed, or where specific impacts peculiar to the individual project were not treated in sufficient detail in the programmatic statement. Where appropriate, subsequent individual project statements may take the form of addenda to programmatic statements already issued.

(f) On request, the Environmental Quality Council will advise agencies concerning the appropriateness of joint or programmatic statements, and will assist in the determination of lead agency.

(3) **Distribution of the Draft EIS — Comment Procedures.**

(a) One copy of the draft environmental impact

statement shall be transmitted to the office of the executive director of the Environmental Quality Council. The lead agency shall also circulate the draft environmental impact statement to other appropriate agencies and selected public and private groups and individuals, including, at a minimum, those parties who have already supplied information and comments to the agency on the proposed action. The listed transmittal date to the Environmental Quality Council shall not be earlier than the date of the draft environmental impact statement mailing to the other agencies, organizations, and individuals. Agencies seeking comments shall establish time limits of not less than thirty (30) days for reply, after which it may be presumed, unless the commenting agency requests an extension of time not to exceed fifteen (15) days, that the agency consulted has no comment to make. All agencies shall make available for public inspection all reports, studies, and other documents that underlie the draft and final environmental impact statements.

(b) At this point, lead agencies may decide to hold a public hearing on the draft environmental impact statement. In deciding whether a public hearing is appropriate, the agency should consider:

(i) the magnitude of the proposal in terms of foreclosing future options; geographic area involved; irreversible commitment of resources; the amount and types of energy required; the uniqueness of the required resources;

(ii) the degree of interest in the action partly evidenced by requests for a hearing from the public and from state and local authorities;

(iii) the complexity and potential precedent-setting aspects of the proposed action and the likelihood that information will be presented at the hearing which will be of assistance to the agency in fulfilling its responsibilities under the Act.

(c) Agencies which hold hearings shall mail or otherwise transmit the draft environmental impact statement to interested parties at least twenty (20) days prior to the time of the hearings. Hearings shall be preceded by adequate public notice.

(d) If an agency action for which a draft environmental impact statement has been prepared normally requires a public hearing, the draft environmental impact statement should be prepared and transmitted at least twenty (20) days in advance of such hearing.

(e) No action subject to Section 69-6504 (b) (3) of the Act shall be taken sooner than sixty (60) days after the transmittal date to the Environmental Quality Council of the draft environmental impact statement.

(f) If the lead agency has given full and good faith consideration to the environment in its plans, if this is reflected in favorable comments from reviewers, and if the draft environmental impact statement represents the fullest possible compliance with the Act, the draft environmental impact statement may be seen as satisfying the requirement for a detailed statement. If the draft environmental impact statement is sufficient, the lead agency must submit to the Environmental Quality Council one copy of all comments received on the draft environmental impact statement and at public hearings, together with agency responses to comments, and formal notification of the final agency decision on the proposed action. Lead agencies must furnish the same information to all commenting parties.

(g) The lead agency shall determine, taking into account all comments received on the draft environmental impact statement or at public hearings, whether a final environmental impact statement is required for compliance to the fullest extent possible with the Act.

(4) **Final Environmental Impact Statement.**

(a) A final environmental impact statement shall include, at minimum:

(i) a summary of major conclusions and supporting information based on the draft environmental impact statement and on agency responses to comments received on the draft environmental impact statement, stating specifically where such conclusions and information were changed from those which appeared in the draft.

(ii) a list of all sources of written and oral comments, including those obtained at public hearings, and unless impractical, shall include the text of comments received by the agency. In all cases, the text of a representative sample of comments shall be included.

(iii) agency responses to these comments. These responses shall include a good faith evaluation of the comments received, and a substantive disposition of the issues involved.

(iv) new data, information, and explanations derived or obtained subsequent to circulation of the draft.

(b) No agency action shall be taken towards approval of the proposed project sooner than thirty (30) days after the final environmental impact statement has been transmitted to the Environmental Quality Council and concerned parties. The listed transmittal date to the Environmental Quality Council shall not be earlier than the date of the final environmental impact statement mailing to other appropriate agencies, organizations, and individuals.

(c) Where emergency circumstances or conflicting statutory requirements make it necessary, the lead agency may take an action having significant environmental impacts without observing the provisions of these regulations concerning time requirements for agency review and advance availability of environmental impact statements. The lead agency shall provide the Environmental Quality Council with a precise, factual statement detailing the nature of the emergency or statutory conflict, and the reasons for departing from normal procedures.

(d) Draft and final environmental impact statements must state the source material used in preparation of the impact statement, and identify the persons contributing to the impact statement.

V. CONTENT OF ENVIRONMENTAL IMPACT STATEMENTS. Each environmental impact statement shall be prepared in accordance with the precept in Section 69-6504(b) (1) of the Act that all agencies shall "utilize a systematic, interdisciplinary approach . . . in planning and decision making . . ." In addition, the Act should be seen as a "full disclosure" law. This means that environmental impact statements must describe *all* environmental impacts of a proposed action, even where the impacts are beyond the control or realm of expertise of the lead agency. It must be remembered that the environmental impact statement will be used as a source of information not only for the lead

agency's decision makers, but also for other agencies and for the public.

The cover of the environmental impact statement should include, at a minimum, the name of the lead agency (with the name of the operating division, where appropriate), whether the statement is a draft or a final, and the date of transmittal to the Environmental Quality Council.

Environmental impact statements should cover the following:

(1) a description of the nature and objectives of the proposed action;

(2) a description of current environmental conditions in the area affected by the action, including maps and charts where appropriate;

(3) a description of alternative actions which could accomplish some or all of the objectives of the proposed action. These might include alternative engineering techniques, alternative design or location, or fundamental institutional alternatives (such as floodway management programs instead of dam construction.) The description should include alternatives which are beyond the authority of the lead agency to implement on its own. The purpose is to avoid precluding viable alternatives which might have less severe environmental impacts, and to allocate responsibility among the agencies for achievement of the stated objectives with minimal adverse impacts. Other agencies should be consulted in describing such alternatives.

(4) descriptions of the impacts on the human environment of the proposed action and the listed alternatives including the alternative of taking no action. The descriptions should include the economic, social, cultural, aesthetic, and biophysical factors listed in section III(2) of these rules. The number of factors actually analyzed in an environmental impact statement is subject to the lead agency's discretion, and primarily depends on the type and magnitude of the proposed action. Primary and secondary impacts should be described. The descriptions should include:

(a) adverse and beneficial impacts of each alternative;

(b) potential growth-inducing aspects of each alternative;

(c) irreversible commitments of environmental resources including land, air, water and energy resulting from each alternative;

(d) economic and environmental benefits and costs resulting from the proposed action and each alternative. Agencies should attempt to balance the results of their environmental assessments with their assessments of the net economic, technical, and other benefits of the proposed action and alternatives, and use all practicable means to avoid or minimize undesirable consequences for the environment;

(e) a comparison of short-term costs and benefits from the proposed action and alternatives, with the effects on maintenance and enhancement of the long-term productivity of the environment.

(5) source material used in the preparation of the draft; agency personnel contributing to the impact statement and the names of lead agency officials responsible for the environmental impact statement contents and distribution.

VI. USE OF THE ENVIRONMENTAL IMPACT STATEMENT IN AGENCY DECISION MAKING. Section 69-6504(a) of the Act requires that "the policies, regulations and laws of the state shall be interpreted and administered in accordance with the policies set forth in [MEPA]" After reviewing the environmental effects disclosed in the impact statement, the agency must carefully weigh the environmental costs against the expected benefits of the proposed action. The agency's final decision whether to procede with the project must reflect this balancing analysis. Wherever adverse environmental effects are found to be involved in the proposed action, the agency must indicate in its final recommendation that interests and considerations of state policy justify those effects.

APPENDIX D

Documents Submitted in Compliance with MEPA

July 1, 1974 to June 30, 1975

Lead Agency	Environmental Impact Statements	Agency Impact Determinations*
Department of Fish and Game	0	2
Department of Health and Environmental Sciences	15	69
Department of Highways	5	74
Department of State Lands	3	1
Department of Livestock	1	1
Department of Natural Resources and Conservation	6	1

*New terminology referring to a written document in support of a determination that, if the proposed action were taken, the anticipated effects on the human environment would not be significant (formerly called a negative declaration).

APPENDIX E

Environmental Quality Council

Program Cost Summary

July 1, 1974 - June 30, 1975

General Fund:			
Salaries	90,112.97		
Other Compensation	1,525.00		
Employee Benefits	10,855.76		
		102,493.73	
Contracted Services	17,441.36		
Supplies	1,282.11		
Postage & Telephone	3,953.40		
Travel	6,867.23		
Repair & Maintenance	674.67		
Other Expense	2,633.65		
		32,852.42	
Equipment		197.96	
Total General Fund Expense			$ 135,544.11
Ford Foundation Grant:			
Salaries	19,799.29		
Employee Benefits	1,841.69		
		21,640.98	
Contracted Services	7,385.98		
Supplies	21.37		
Postage & Telephone	249.48		
Travel	776.40		
Repair & Maintenance	177.00		
Other Expense	308.98		
		8,919.21	
Total Grant Expense			$ 30,560.19
Grand Total			$ 166,104.30

READER RESPONSE AND EVALUATION

We need your help. No one knows better than yourself what makes your surroundings pleasant and meaningful. The usefulness of future EQC efforts to update conditions and trends of the Montana environment will depend on how well it reflects your needs and values in your surroundings. You can assist us by filling out this brief response form and mailing it back to us. We can't guarantee your environment will be better for doing it, but hopefully your understanding of it will be enhanced.

1. What indicator(s) did you find most helpful in evaluating the quality of your environment?

   Most helpful _____

   2nd most helpful _____

   3rd most helpful _____

2. What indicator(s) did you find least helpful in evaluating the quality of your environment?

   Least helpful _____

   2nd least helpful _____

   3rd least helpful _____

3. What improving or declining environmental trends in your region are not covered by any indicator in this report?

4. What indicators not used in this report would you like to see used in future ones?

5. Are the environmental regions appropriate for reporting indicators?

   _____Yes

   _____No

   Why or why not?

6. What comments on the indicators report do you have?

THANK YOU. PLEASE TEAR OUT AND MAIL TO:

EQC Indicators Project
Box 215
Capitol Station
Helena, Montana 59601

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