

**THE GEOLOGICAL SURVEY OF WYOMING**  
**Gary B. Glass, State Geologist**

**FIFTY-NINTH ANNUAL REPORT**

**of the**

**GEOLOGICAL SURVEY OF WYOMING**

**For Fiscal Year 1992**  
**July 1, 1991 to June 30, 1992**

**by**

**Gary B. Glass and Susanne G. Bruhnke**



**Laramie, Wyoming**  
**October, 1992**

## THE GEOLOGICAL SURVEY OF WYOMING

Gary B. Glass, *State Geologist*

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The Geological Survey of Wyoming  
Box 3008, University Station  
Laramie, Wyoming 82071-3008  
(307) 766-2286 • FAX (307) 766-2605  
TDD RELAY OPERATOR: 1(800) 877-9975

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# INTRODUCTION

## STATUTORY AUTHORITY

The Constitutional position of State Geologist, which was established in 1890 (Art. 9, Sec. 6), was repealed by an amendment to the Wyoming State Constitution in 1990.

The Geological Survey of Wyoming was created by the Legislature in 1933. Its statutes have since been modified by legislative enactment in 1957, 1969, 1977, 1979, 1982, 1987, and most recently, 1991 (Chapter 122 and 204 of the Session Laws). The current statutes for the State Geologist and Geological Survey are W.S. 9-2-801 through 9-2-810 in Title 9, Ch. 2, Art. 8.

## AGENCY MISSION

The mission of the Geological Survey of Wyoming is to study and interpret the geologic, mineral, and energy resources of the State.

## AGENCY GOALS

The following goals of the Geological Survey of Wyoming link the Survey's activities and programs to the State's needs:

**INFORMATION DISSEMINATION — PROVIDE TIMELY, ACCURATE, AND ACCESSIBLE INFORMATION ABOUT THE STATE'S GEOLOGIC, MINERAL, AND ENERGY RESOURCES THAT HAS A PRACTICAL BEARING ON WYOMING'S CITIZENRY AND ECONOMY.**

This goal is achieved by publishing geologic maps and general interest, scientific, and technical reports on geologic, mineral, and energy resources; by making technical files available to the public; and by operating a public information service that provides answers to inquiries or enables inquirers to readily identify and obtain existing information.

**GEOLOGIC FRAMEWORK — INCREASE KNOWLEDGE OF THE GEOLOGIC STRUCTURE AND GEOLOGIC FORMATIONS IN THE STATE TO PROVIDE THE SCIENTIFIC FRAMEWORK FOR INVESTIGATIONS OF MINERAL RESOURCES AND GEOLOGIC HAZARDS AND TO MEET ANTICIPATED FUTURE RESPONSIBILITIES.**

This goal is achieved through geologic mapping; through structural, stratigraphic, and paleontologic field studies; through the testing of conceptual models; and through laboratory investigations of the petrologic, physical, and chemical properties of rocks and minerals.

**MINERAL AND ENERGY RESOURCE ASSESSMENT — INCREASE KNOWLEDGE OF THE DISTRIBUTION, RESERVES, AND QUALITY (PETROGRAPHIC, CHEMICAL, AND PHYSICAL CHAR-**

**ACTERISTICS) OF THE STATE'S MINERAL AND ENERGY RESOURCES TO PROMOTE THEIR DEVELOPMENT AS WELL AS TO PROVIDE FACTUAL INFORMATION FOR POLICY DECISIONS AFFECTING THE AVAILABILITY AND USE OF THE STATE'S LAND, MINERAL, AND ENERGY RESOURCES.**

This goal is achieved by using the techniques of resource evaluation including geologic mapping, reconnaissance exploration, and field and laboratory studies of rocks and minerals.

**MINERAL AND ENERGY RESOURCE PROCESSES — ENHANCE THE ABILITY TO DISCOVER HIDDEN OR AS YET UNRECOGNIZED MINERAL AND ENERGY RESOURCES BY DEVELOPING INFORMATION ON THE NATURAL PROCESSES BY WHICH MATERIALS IN THE EARTH ARE FORMED, TRANSPORTED, AND CONCENTRATED.**

This goal is achieved through field investigations, laboratory analysis, and the formulation and testing of conceptual models.

**HAZARDS IDENTIFICATION AND PREDICTION — IDENTIFY POTENTIAL GEOLOGIC HAZARDS AND IMPROVE THE SURVEY'S ABILITY TO PREDICT THE LOCATION, TIME, AND SEVERITY OF NATURAL AND MAN-MADE HAZARDS SO THAT LOSS OF LIFE AND PROPERTY IS MINIMIZED IF NOT ELIMINATED.**

This goal is achieved through geologic mapping, field investigations, aerial photographic interpretation, and the application of geologic principles related to dynamic Earth processes.

**TIMELY REPORTING OF EVENTS AND CONDITIONS** — PROVIDE FORECASTS OF MINERAL PRODUCTION AND PRICES AS WELL AS TIMELY REPORTS ON IMPORTANT HYDROLOGIC AND GEOLOGIC EVENTS AND CONDITIONS OF IMMEDIATE CONCERN TO THE PUBLIC AND TO GOVERNMENTAL BODIES.

This goal is accomplished by ongoing analysis of mineral- and energy-related activities, including man-related projects and the geologic conditions surrounding those projects, and the timely dissemination of relevant information to include warnings. Similarly, natural events are also monitored, particularly in regard to how they might affect the State's citizenry.

**COORDINATION** — IMPROVE THE COORDINATION OF EARTH-SCIENCE DATA COLLECTION, RESEARCH, AND MAPPING TO MINIMIZE DUPLI-

CATION OF EFFORT, INCREASE DATA ACCESSIBILITY, AND REDUCE COSTS.

Coordination is carried out by sharing and/or exchanging plans, technologies, and data bases with appropriate entities and by striving to standardize information formats.

**MISSION SUPPORT** — IMPROVE THE SURVEY'S ABILITY TO EFFECTIVELY CARRY OUT ITS MISSION.

This is accomplished by providing new training or continuing education opportunities for employees; by replacing and upgrading obsolete field, laboratory, and publication-related equipment; by acquiring computer software and/or hardware to enhance the operations and management of the Agency; and by implementing innovative ideas that increase output from available resources.

## AGENCY ACCOMPLISHMENTS

In FY92, the Geological Survey of Wyoming:

— provided data, advice, and assistance to both in-state and out-of-state inquiries, responding to more than 14,878 inquiries. Of these, 6,194 were related to geology and mineral and energy resources; 151 to the effective use of earth-science techniques, products, and information; and 8,533 to requests for Survey publications and/or information on publications.

— prepared 222 new reports or maps that communicate information on the State's geologic, mineral, and energy resources, and published those reports for dissemination through the Publications Sales Unit.

— maintained and expanded public files and data bases on the State's geologic, mineral, and energy resources.

— identified and evaluated geologic hazards in Wyoming associated with earthquakes, landslides, active faults, aquifer vulnerability, and naturally-occurring toxic elements (selenium, radon, lead, mercury, and arsenic).

— assessed mineral and energy resources, documented their occurrences, and determined their origins and manners of occurrence through more than 19 field, office, and/or laboratory investigations.

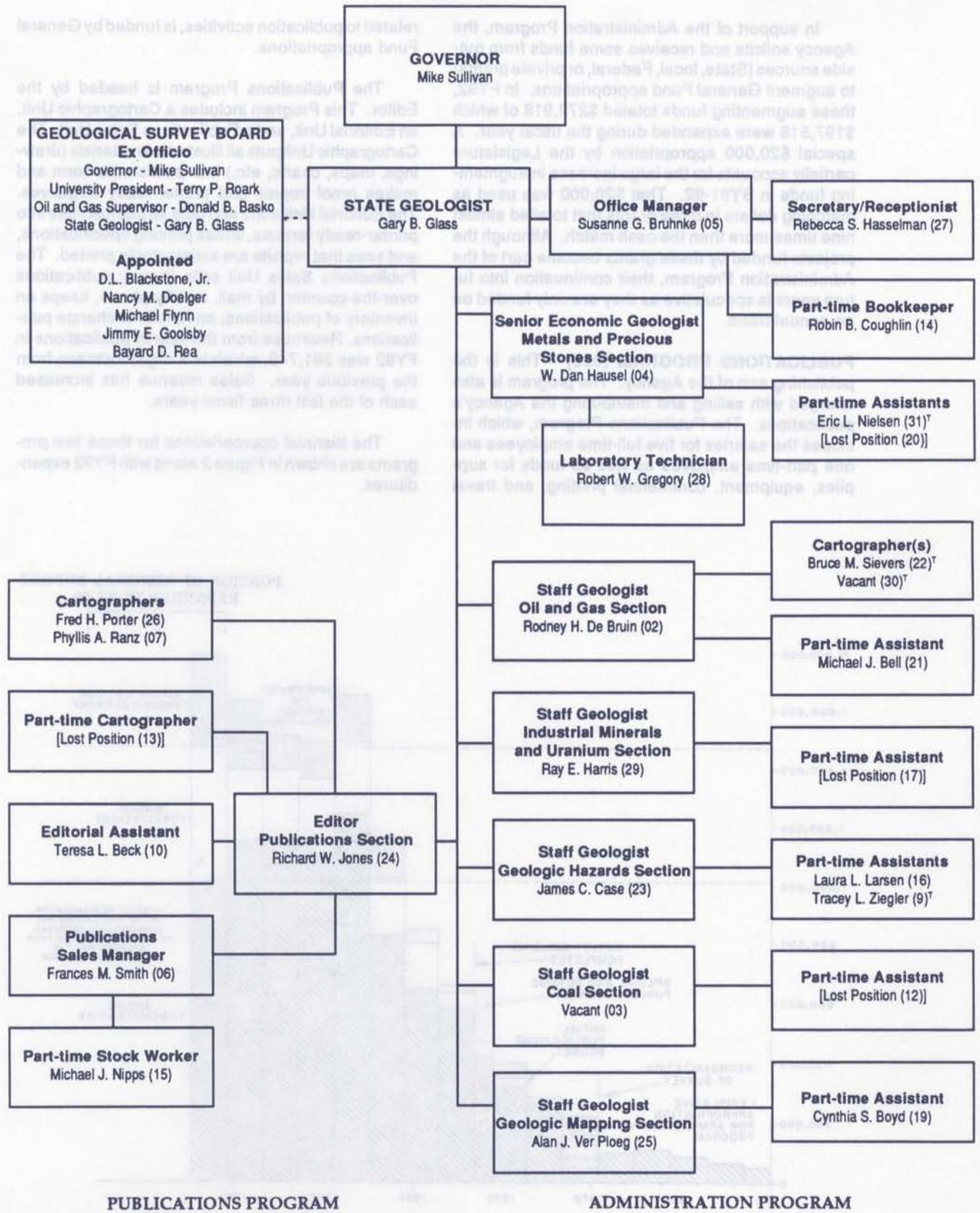
— increased knowledge of the State's stratigraphic framework through five geologic mapping and/or geologic investigations.

## ORGANIZATION

To accomplish its mission and achieve its goals, the Geological Survey operates under two programs (Figure 1):

**ADMINISTRATION PROGRAM (001)** - Since 1969, when the Agency was last reorganized and expanded, efforts of the Administration Program have been directed at geological factors that directly or indirectly affect the State's citizenry, State-owned lands, communities, new mineral discoveries, mineral development, items of scientific importance, and natural or man-induced geologic hazards.

In FY92, the staff of the Administration Program consisted of nine full-time and four part-time employees. The State Geologist, two full-time secretaries, and one half-time bookkeeper provided the truly administrative, budgetary, and fiscal support for the entire Agency. Six full-time geologists and three half-time geologic assistants comprised the scientific arm of the Agency and accomplished the Agency's major objectives. In addition, there were three temporary employees, who assisted three of the geologic sections. All of these temporary employees were funded by augmenting revenue sources.



<sup>T</sup>These were temporary positions paid out of augmenting grant funds.

Figure 1. Organization chart for the Geological Survey in FY92.

In support of the Administration Program, the Agency solicits and receives some funds from outside sources (State, local, Federal, or private grants) to augment General Fund appropriations. In FY92, these augmenting funds totaled \$273,918 of which \$197,518 were expended during the fiscal year. A special \$20,000 appropriation by the Legislature partially accounts for the large increase in augmenting funds in BY91-92. That \$20,000 was used as matching dollars in three grants that totalled almost nine times more than the cash match. Although the projects funded by these grants become part of the Administration Program, their continuation into future years is speculative as they are only funded on an annual basis.

**PUBLICATIONS PROGRAM (002)** - This is the publishing arm of the Agency. The program is also charged with selling and distributing the Agency's publications. The Publications Program, which includes the salaries for five full-time employees and one part-time employee as well as funds for supplies, equipment, commercial printing, and travel

related to publication activities, is funded by General Fund appropriations.

The Publications Program is headed by the Editor. This Program includes a Cartographic Unit, an Editorial Unit, and a Publications Sales Unit. The Cartographic Unit puts all illustrative materials (drawings, maps, charts, etc.) into publishable form and makes proof copies and printer-ready negatives. The Editorial Unit edits and puts all manuscripts into printer-ready formats, writes printing specifications, and sees that reports are satisfactorily printed. The Publications Sales Unit sells Survey publications over-the-counter, by mail, and by phone, keeps an inventory of publications, and mails exchange publications. Revenues from the sale of publications in FY92 was \$81,749, which is a slight increase from the previous year. Sales revenue has increased each of the last three fiscal years.

The biennial appropriations for these two programs are shown in Figure 2 along with FY92 expenditures.

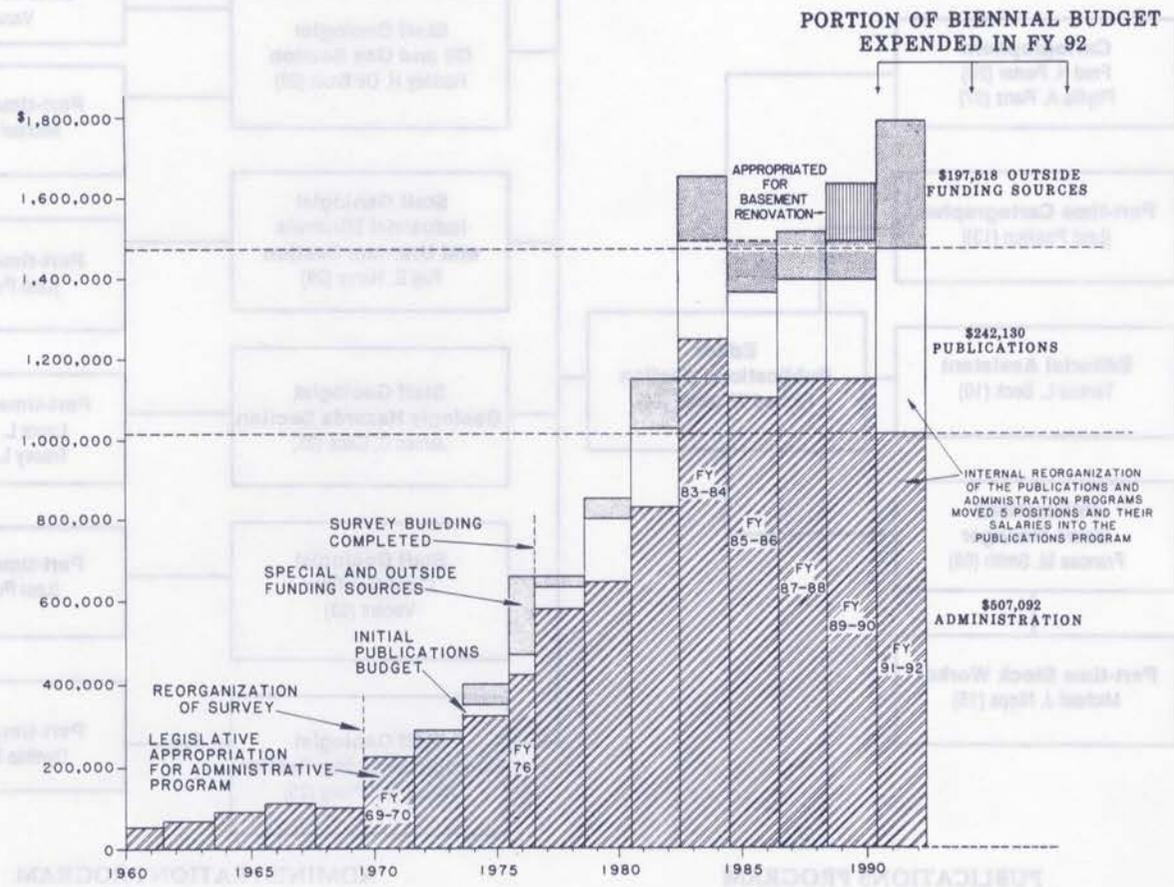


Figure 2. Biennial appropriations for the Geological Survey (expenditures for FY92 are annotated to the right of the biennial appropriations).

# MAJOR ACCOMPLISHMENTS OF THE ADMINISTRATION PROGRAM

## OBJECTIVES

The Administration Program is implemented by the State Geologist, six geologic sections (Coal, Geologic Hazards, Geologic Mapping, Industrial Minerals and Uranium, Metals and Precious Stones, and Oil and Gas) and the Laboratory unit. To accomplish the Agency's mission and goals as listed ear-

lier, this program has three major objectives: (1) provide geologic information, advice, and assistance, (2) prepare geologic reports and maps based on office, field, and laboratory investigations, and (3) maintain records on geologic, mineral, and energy resources.

## ACCOMPLISHMENTS

For each of these three major objectives, the activities and accomplishments of the Administration Program in FY92 are described below:

**SERVICES:** Provide information, advice, and assistance for all inquiries on the State's geologic, mineral, and energy resources.

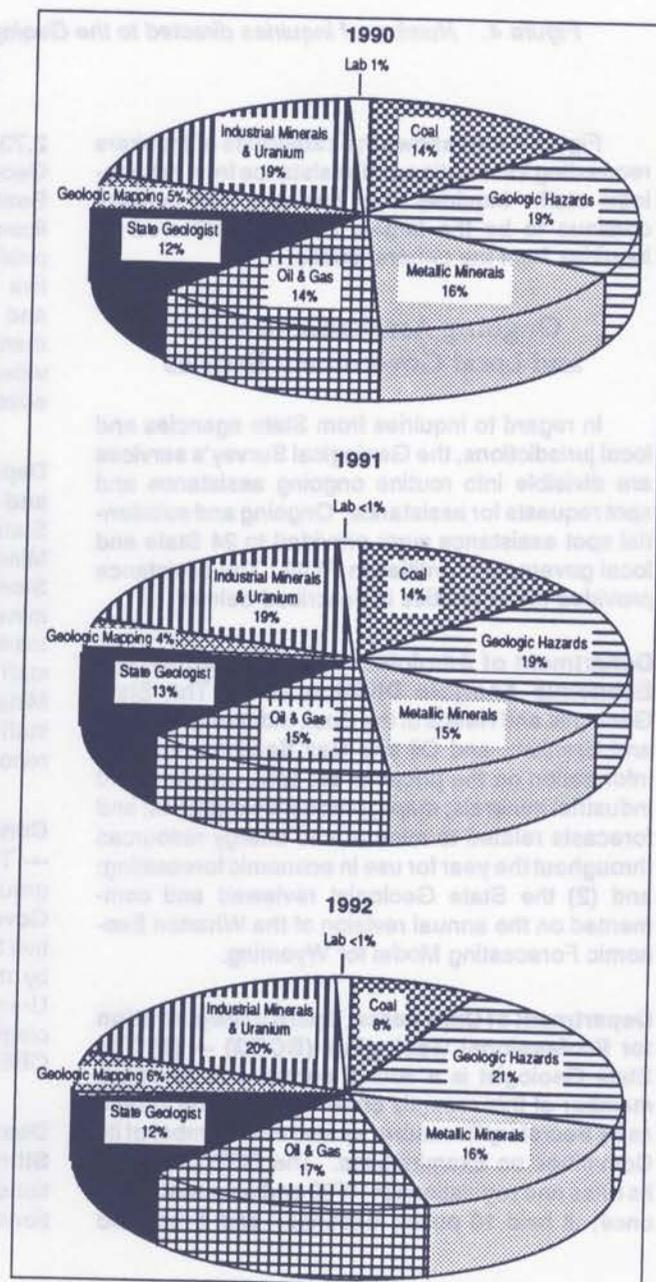
### General

Because the Geological Survey is primarily a service-oriented organization, its geologic staff responds to many thousands of requests for information and assistance each year. Figure 3 illustrates the percentages of these inquiries received by the different Geologic Sections of the Survey over the last three fiscal years. The Geologic Hazards and Industrial Minerals and Uranium Sections had the most inquiries in FY92. This has been the case for the last four years.

Since at least FY81, inquiries directed to the geologic staff had increased every year. In FY92, however, inquiries decreased about 5 percent (from 6,509 in FY91 to 6,194 in FY92); this level equates to 3.0 inquiries per geologist per work day (254 work days in a year). This current level of inquiry is still 227 percent greater than it was in FY81 (Figure 4).

The decline in inquiries between FY91 and FY92 was a direct consequence of not having a Staff Coal Geologist on board. A hiring freeze prevented the filling of this vacant position until early in FY93.

Figure 3. Percentage of inquiries directed to each of the Geologic Sections (FY90 through FY92).



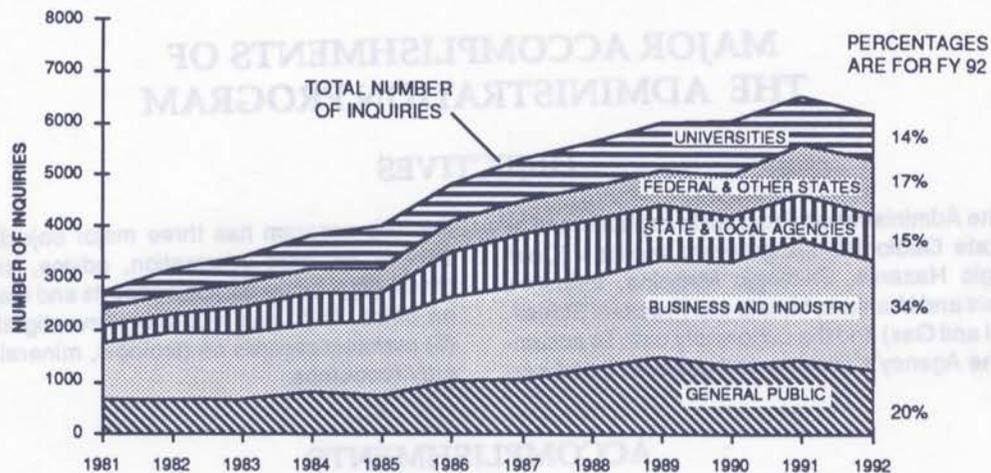


Figure 4. Number of inquiries directed to the Geologic Sections by category and fiscal year.

Figure 4 also shows the categories of inquirers requesting information and assistance from the geologic staff. Inquiries from business and industry continue to be the largest category, followed by inquiries from the general public.

### Ongoing Assistance to State and Local Government Entities

In regard to inquiries from State agencies and local jurisdictions, the Geological Survey's services are divisible into routine ongoing assistance and spot requests for assistance. Ongoing and substantial spot assistance were provided to 24 State and local government entities in FY92. The assistance provided these entities is described below:

**Department of Administration and Information, Economic Analysis Division** — (1) The State Geologist and Heads of the Coal, Industrial Minerals and Uranium, and Oil and Gas Sections provided information on the prices of oil, coal, uranium, and industrial minerals; maps; production statistics; and forecasts related to mineral and energy resources throughout the year for use in economic forecasting; and (2) the State Geologist reviewed and commented on the annual revision of the Wharton Economic Forecasting Model for Wyoming.

**Department of Commerce, Board of Registration for Professional Geologists (BOPG)** — (1) The State Geologist is a voting, permanent, ex officio member of this recently created Board and served as its Secretary/Treasurer as well as a member of its Committee on Examinations. The BOPG adopted its rules and regulations in FY92 and amended them once; it held 10 public meetings; and it received

2,735 applications for licensing as a Professional Geologist in Wyoming. Of these applications, the Board was only able to review and approve 344 for licensing in FY92. In addition to attending nine of the public meetings, the State Geologist spent at least five days each month on BOPG-related matters; and (2) in the first year of operation, the office manager, bookkeeper, and editorial assistant provided considerable administrative, bookkeeping, editorial, graphic, and word-processing assistance.

**Department of Commerce, Division of Economic and Community Development (DECD)** — (1) The State Geologist and Heads of the Coal, Industrial Minerals and Uranium, and Metals and Precious Stones Sections provided information on mines, mineral-related projects, production trends, and markets for mineral and energy resources to the staff of the DECD; and (2) the Head of the Industrial Minerals and Uranium Section worked with the DECD staff in preparing and publishing the Section's new report on decorative stone in Wyoming.

**Consensus Revenue Estimating Group (CREG)** — The State Geologist is a member of CREG, a group that makes revenue estimates for use by the Governor and the Legislature, prior to each Legislative Session. With advice and information provided by the Heads of the Coal, Industrial Minerals and Uranium, and Oil and Gas Sections, the State Geologist provided forecasts and continually apprised CREG of the minerals situation throughout FY92.

**Department of Environmental Quality, Industrial Siting Division** — The Heads of the geologic sections and the State Geologist review siting applications when they are submitted.

**Department of Environmental Quality, Land Quality Division (DEQ-LQD)** — (1) The Heads of the Coal, Industrial Minerals and Uranium, and Metals and Precious Stones Sections periodically reviewed and made recommendations on Abandoned Mined Land Reclamation Projects (AML); (2) the Head of the Industrial Minerals and Uranium Section participated as a member of the DEQ-LQD's Selection Committee for Procurement in the AML Program; and (3) under a Memorandum of Understanding with the DEQ-LQD, the Head of the Geologic Hazards Section reviews paleontologic surveys included in new mining applications.

**Department of Environmental Quality, Water Quality Division** — The Geologic Hazards Section participated in a study of aquifer vulnerability and contamination in Goshen County. This is a cooperative study with the DEQ-LQD, the Wyoming Water Research Center, and the Department of Geology and Geophysics at the University of Wyoming.

**Department of Health (DOH)** — The Geologic Hazards Section started work on a grant to study the reliability of soil-gas measurements of radon. This grant is partially funded by the U.S. Environmental Protection Agency through the DOH.

**Department of Transportation (DOT)** — The Head of the Geologic Mapping Section assisted in placing signs in Ten Sleep Canyon and Shell Canyon in a cooperative effort with the Geology Department at Sheridan College and the Wyoming Geological Association.

**Governor's Clearing House** — The State Geologist and Heads of the six geologic sections reviewed 163 documents for the Governor's Clearing House in FY92 and submitted written comments on 36.

**Governor's Office** — (1) The State Geologist served as a member of the Governor's Coalbed Methane Task Force, and he represented the Governor's Office on the U.S. Bureau of Land Management's Coal Lease Sale Review Group; and (2) the Head of the Geologic Hazards Section served as a member of the Governor's Multi-hazard Task Force.

**Town of Guernsey** — The Head of the Industrial Minerals and Uranium Section assisted the Town of Guernsey in the completion of its block grant from the Department of Commerce's Division of Economic and Community Development. Pursuant to the grant, the Section helped Sunrise Stone locate and test decorative rock in the Guernsey area.

**Legislative Service Office** — In September, the State Geologist and the Heads of the Coal, Industrial Minerals and Uranium, and Oil and Gas Sections estimated production and prices for minerals produced in the State. The Survey's estimates and those of several other State agencies were used to reach a consensus on future mineral production and prices. Later these consensus estimates were used by the Consensus Revenue Estimating Group to provide a forecast of mineral revenue for use by both the Governor and the Legislature.

**Lincoln County** — The Head of the Geologic Hazards Section provided the county with another set of Preliminary Landslide Maps of the county.

**Town of Lovell** — The Head of the Industrial Minerals and Uranium Section completed an open file report on the John Blue Canyon silica sand deposit for the Town of Lovell. This project had been funded in part by a grant from the Division of Economic and Community Development of the Department of Commerce.

**Natrona County Planning Office** — The Head of the Geologic Hazards Section provided Natrona County with copies of the Preliminary Landslide Maps that the Section generated for that county.

**Oil and Gas Conservation Commission (OGCC)** — (1) Wyoming Statute 30-5-103 makes the State Geologist one of the Commissioners of this regulatory agency. Monthly hearings were routinely 1.0-1.5 days long in FY92. The State Geologist also served as the Acting Chairman of the Commission when the Governor was not present. Matters related to the OGCC, in addition to the hearings, routinely required another two or more days of effort by the State Geologist each month; (2) the Geologic Mapping and Oil and Gas Sections continued to provide geologic information to assist the Commission's field personnel in evaluating applications for underground water disposal or injection sites as well as sites for disposal pits; and (3) in support of this latter effort, the Geologic Hazards Section acquired new software from Petroleum Information (PI) which makes editing of PI's oil and gas data base for Wyoming much easier.

**Secretary of State's Office** — The Head of the Metals and Precious Stones Section and the Laboratory Unit assisted the Secretary of State's Office in the investigations of some mineral-related fraud cases in cooperation with the U.S. Postal Inspection Service, the U.S. Attorney General, the Federal Bureau of Investigation, and the U.S. Securities and Exchange Commission.

**State Crime Laboratory** — When requested, Survey personnel continued to provide technical and laboratory assistance to investigators from the State Crime Lab.

**State Land and Farm Loan Office** — (1) The Oil and Gas Section provided (a) weekly reports of oil and gas activities on or near State lands, (b) oil and gas tract evaluations to assist with selecting tracts for the State's lease auctions, and (c) an updated computerized listing of oil and gas potential and sale results on State lease tracts; (2) the State Geologist reviewed and made recommendations on 11 commercial or scientific fossil-collecting permits; (3) the Geologic Mapping Section conducted field inspections of seven fossil quarries on State lands as well as two privately owned fossil quarries adjacent to State lands; and (4) the State Geologist and the Head of the Industrial Minerals and Uranium Section each provided some information regarding proposed land exchanges involving State lands.

**State Engineer** — The State Geologist or the Head of the Geologic Hazards Section routinely attend the Water Forum and the State Geologist is a member of the State Mapping Advisory Council, which is chaired by the State Engineer.

**State Planning Coordinator (SPC)** — The Head of the Geologic Hazards Section continued to participate in the SPC's Selenium Work Group.

**University of Wyoming** — (1) The State Geologist and several of the Survey's Section Heads continued to provide quarterly minerals outlook articles for publication in the Survey Research Center's *Wyoming quarterly update*; (2) the Metals and Precious Stones Section continued field and laboratory research into diamond-bearing kimberlite deposits in Wyoming, partially funded by a cooperative agreement with the University's Mining and Mineral Resources Research Institute; (3) the Head of the Geologic Hazards Section participated in the Wyoming Water Research Center's study group investigating the vulnerability of aquifers to contamination, and he also reviewed research proposals for the Center as well as for the University of Wyoming's Office of Research, (4) the Geologic Mapping Section started a cooperative program with the University's Geology Library whereby customized bibliographies can be prepared for inquirers; (5) The Publications Section provided editorial and word processing assistance for a treatise on the geology of Wyoming that is being prepared by the Department of Geology and Geophysics. Some members of the Geological Survey's professional staff have written articles for the treatise and the Survey will bid and publish the volume when it is completed; (6) the Geologic Hazards Section provided information on

naturally occurring lead, mercury, and arsenic to assist in the Department of Molecular Biology's study of leonardite; and (7) ongoing assistance and information was provided to faculty and students from many departments of the University.

**Wyoming Emergency Management Agency (WEMA)** — (1) The Head of the Geologic Hazards Section is the Survey's liaison to WEMA. He is also the State's representative to the Western States' Seismic Policy Council (WSSPC) where he is a member of the Executive Board and also the Chairman of the Building Codes Committee. In addition, he organized a workshop on the Uniform Building Code and seismic zone changes, which will be held in FY93, and he has helped organize the 1993 Annual Meeting of WSSPC, which will be held in Jackson, Wyoming; and (2) the Geologic Hazards Section is evaluating computer applications for geologic hazards in a cooperative project with WEMA. In FY92, WEMA provided two software packages for the analysis of seismic hazards, one software package for the analysis of slope stability, and a CD-ROM player for viewing earthquake records from Wyoming.

### Spot Assistance to State and Local Government Entities

In addition, spot requests for information or other assistance were received from 53 other State and local government entities in FY92 as well as inquiries from 131 Federal, foreign, or government entities and universities in other states.

### Talks and Briefings

As an extension of this service-related function, the State Geologist and Section Heads collectively presented 28 talks, field trips, or briefings on mineral resources, geology, or geologic hazards to the following 18 different groups:

American Institute of Professional Geologists, Casper  
Bald Mountain Mining Company, Shell  
Federal Emergency Management Agency, Denver and Thermopolis (3 talks)  
Fort Collins Gem and Mineral Show, Fort Collins  
KUWR radio talk show, Laramie  
Laramie Chamber of Commerce, Laramie  
Society of Exploration Geologists, Denver  
Society of Mining Engineers, Casper  
Texchem, Medicine Bow Mountains  
U.S. Bureau of Land Management, Cheyenne  
U.S. Forest Service, Minneapolis, Minnesota  
University of Wyoming, Department of Geography, Laramie  
Western States Seismic Policy Council, Santa Fe, New Mexico  
Wyoming Children's Museum and Nature Center, Laramie (3 talks)

Wyoming Conference of Building Officials, Casper  
Wyoming Emergency Management Agency, Riverton  
(2 talks)  
Wyoming Geological Association (6 talks)  
Wyoming Mining Association, Casper

**INVESTIGATIONS: Conduct office, field, and laboratory investigations and prepare geologic reports and maps that (a) increase understanding of the geologic, mineral, and energy resources of the State and (b) have a practical bearing on Wyoming's communities and people.**

Arranged by Geologic Section, the following investigations, projects, or studies were ongoing or completed in FY92:

### Coal Section

- **National Coal Resources Data System** (ongoing; compiled coal data for inclusion in a computerized national data base; partially funded by a grant from the U.S. Geological Survey's Branch of Coal Resources).
- **Characterization of Wyoming coals** (ongoing; data on the chemical composition and physical properties of strippable coals were tabulated for entry into a computerized data base).
- **Demonstrated reserve base (DRB) of coal in Wyoming** (ongoing; a one-year project for revising the existing coal quality categories assigned to the current DRB for Wyoming; partially funded by the U.S. Department of Energy's Energy Information Administration (EIA); a final report on the project was submitted to the EIA in FY92; and an open file report will be published by the Survey in FY93).

### Geologic Hazards Section

- **Selenium** (ongoing; the Head of the Section continued as a member of the State Planning Coordinator's Selenium Work Group; data and reports on selenium were provided to the U.S. Geological Survey, the Wyoming Department of Environmental Quality, the State Planning Coordinator's Office, the City of Casper-Natrona County Health Department, and the Natrona County Cooperative Extension Service).
- **Landslide mapping and classification** (ongoing; completed landslide maps of 50 (1:24,000-scale) remaining quadrangles; published 197 Preliminary Landslide Maps (1:24,000-scale); and provided preliminary landslide maps to Teton County, Jackson, Casper, Natrona County, Lincoln County,

Bridger-Teton National Forest, Shoshone National Forest, Medicine Bow National Forest, and the U.S. Bureau of Land Management).

- **Earthquakes and seismicity** (ongoing; the Head of the Section represented Wyoming on the Western States Seismic Policy Council (WSSPC) and is a member of the Executive Board and Chairman of the Building Codes Committee; a workshop on the Uniform Building Code and seismic zone changes in the western U. S was organized for early FY93; with the assistance of the Wyoming Emergency Management Agency, arrangements were made for the 1993 Annual Meeting of the WSSPC in Jackson; a bibliography on earthquake information that was originally prepared in FY91 was updated; and a contract for work on the Teton fault was completed. This contract was partially funded by the National Park Service).

- **Goshen County aquifer vulnerability study** (ongoing; this is a joint effort with the University of Wyoming's Department of Geology and Geophysics, the Wyoming Water Research Center, and the Wyoming Department of Environmental Quality; the Section prepared a bibliography and index map of geologic reports and maps of Goshen County, a geologic map of the county, and a surficial materials map of a selected four-township area within the county).
- **Soil-gas radon research** (ongoing; this project is partially funded by the Wyoming Department of Health and the U.S. Environmental Protection Agency and is also a cooperative effort with the U.S. Geological Survey and U.S. Bureau of Mines; the study is designed to see if the relative radon relationships that are observed at 12 different sites during one sample period are repeatable over time).

- **Earth Science Information Center** (ongoing; in cooperation with the U.S. Geological Survey, the Section continued to operate the Earth Science Information Center (ESIC) in Wyoming; collected, maintained, and disseminated cartographic, hydrologic, geologic, and remote sensing data to include microfiche indices for all Federal aerial and space imagery; and began to catalogue maps and publications available at the Geological Survey of Wyoming. These will be put into a CD-ROM format by the U.S. Geological Survey and distributed to all the other ESICs).

### Geologic Mapping Section

- **Geologic mapping in the southern Big-horn Mountains** (ongoing; two more 1:24,000-scale geologic maps were field checked and an earlier map was published as an open file report).

- **Index maps depicting geologic mapping in Wyoming** (ongoing; initiated the compilation of an index map showing thesis and dissertation maps of Wyoming done by students at out-of-state universities).

- **1:100,000-scale geologic maps** (ongoing; the Nowater Creek Quadrangle was published).

- **Atlas of major Rocky Mountain gas reservoirs** (ongoing; a joint effort with the Oil and Gas Section; see Oil and Gas Section for details).

- **Stratigraphic Nomenclature Chart** (ongoing; joint project with the U.S. Geological Survey; a second draft was published as a black and white open file report; and a colored version should be available in FY93).

### Industrial Minerals and Uranium Section

- **Industrial minerals and construction materials bulletin and map** (ongoing; information for most commodities has been gathered; emphasis has shifted to limestone deposits).

- **Geology, industrial minerals, and construction materials of the Guernsey 7 1/2-minute Quadrangle** (ongoing; mapped the geology, industrial minerals, and construction materials in a 2.5-square mile area in the southeastern portion of the quadrangle).

- **John Blue Canyon silica sand deposit** (completed; assisted the Town of Lovell in an evaluation of this silica sand deposit; prepared an open file report on the results of that investigation for publication by the Survey).

- **Radioactive mineral occurrences in Wyoming** (ongoing; submitted five open file reports on uranium mines and uranium occurrences in Wyoming for publication by the Survey; phosphate-related uranium anomalies were examined in the Cokeville area and anomalies in volcanic ash were examined in eastern Wyoming; acquired additional company drilling records for uranium properties in the Red Desert and other areas in southern Wyoming).

- **Decorative stones of Wyoming** (completed; the final report for this study was published as a colored public information circular; funding for the layout, color separations, and printing of this report were provided by the Wyoming Department of Commerce's Division of Economic and Community Development).

- **Mineral resources of the Powder River Basin** (completed; this was a project partially funded by the U.S. Geological Survey; maps of the oil and gas, coal, metals, and other minerals of the Powder River Basin have already been published by the Geological Survey of Wyoming; the text has been submitted to the U.S. Geological Survey for inclusion in a report they will publish in FY93).

### Metals and Precious Stones Section

- **Gold, silver, and iron resources in banded iron formations** (ongoing; continued to evaluate the potential for these three metals in the State's banded iron formations).

- **Guide to the geology, mining districts, and ghost towns of the Medicine Bow Mountains including the Snowy Range scenic highway** (completed; submitted a manuscript for publication by the Survey in FY93).

- **Economic geology of the Seminoe Mountains mining district** (ongoing; mapping and other field work were completed; petrographic, assay, and geochemical data are being compiled for the final report).

- **Economic geology of the Cooper Hill mining district** (completed; the district was mapped at 1:12,000-scale and mines and prospects sampled for metals; a final report was submitted for publication by the Wyoming Geological Association in FY93).

- **Kimberlite and lamprolite investigations** (ongoing; continued exploring for potentially diamond-bearing kimberlite pipes through the collection and examination of stream-sediment samples in the Laramie and Medicine Bow Mountains; partially funded through a cooperative agreement with the University of Wyoming's Mining and Mineral Resources Research Institute; investigated lamproites in the Leucite Hills for diamonds and gem-quality peridot; partially funded by a grant from Union Pacific Resources).

- **Economic geology of the Rattlesnake Hills-Barlow Gap supracrustal belt** (ongoing; began field investigations and geologic mapping at 1:24,000-scale).

- **Precious metal occurrences in southern Wyoming** (ongoing; continued field investigations for gold and silver anomalies; initial results were made available in an unpublished mineral report (MR92-1); partially funded by a grant from Union Pacific Resources).

## Oil and Gas Section

- **Characterization of oil and gas composition and properties** (ongoing; data for more than 100 of the largest gas reservoirs in the State were entered into a computerized data base).

- **Coalbed methane resources and activities in Wyoming** (ongoing; summary articles on the development of coalbed methane in Wyoming were prepared for *Wyoming Geo-notes* each of the four quarters of FY92).

- **Tight gas sands in the Frontier Formation of Wyoming** (ongoing; provided geologic and engineering parameters for several hundred Frontier Formation wells in the Greater Green River Basin in support of a cooperative project with the Texas Bureau of Economic Geology (TBEG); editing a manuscript on the geologic controls on reservoir properties of low-permeability sandstones in the Frontier Formation, prior to submittal for publication by the Survey; was partially funded by a grant from TBEG).

- **Regional oil and gas fields maps of Wyoming** (ongoing; maps of oil and gas fields of the Bighorn Basin and southeastern Wyoming were submitted for publication by the Survey).

- **Atlas of major Rocky Mountain gas reservoirs** (ongoing; the Oil and Gas and Geologic Mapping Sections in cooperation with Barlow and Haun, Inc. continued preparing an atlas of major Wyoming gas reservoirs as part of a larger atlas of major gas reservoirs in the Rocky Mountain region; the project is partially funded by the Gas Research Institute; this multistate cooperative effort between the Wyoming, New Mexico, Colorado, and Utah geological surveys is coordinated by the New Mexico Bureau of Mines and Mineral Resources).

- **Estimations of oil and gas resources and reserves** (ongoing; published a report on the resources and reserves of carbon dioxide in Wyoming).

## Miscellaneous

- **Rock and mineral identifications and analyses** (ongoing; the geologic sections and the Laboratory Unit provided rock and mineral identifications for at least 50 persons; and the Laboratory Unit conducted 510 analyses and tests on 184 samples in support of in-house geologic investigations).

- **Special publication efforts in FY92** (ongoing; the Publications Section remains heavily involved in the preparation of a large volume on the geology of Wyoming, which will be jointly published by the Geological Survey and the Department of Geology and Geophysics).

- **Articles written for publication by outside publishers** (ongoing; in FY92, the State Geologist and Section Heads prepared 35 papers or articles for outside publication).

**PUBLIC FILES: Gather and continuously update and maintain files and libraries on all available reports, records, maps, and other data relating to the surface and subsurface geologic, mineral, and energy resources of the State.**

In FY92, the Agency (1) enlarged its geologic hazards files, particularly in regard to landslides, earthquakes, seismicity, radon, lead, mercury, and arsenic; (2) expanded its geologic, mineral, and energy resource files; (3) added several thousand entries to its computerized data bases; and (4) prepared additional information for future inclusion in the Earth Science Information Center (ESIC). The Survey also maintains a "Confidential" file of drilling records from holes drilled on State mineral leases, pursuant to Wyoming Statute 36-6-102.

With the exception of the "Confidential" drilling records mentioned above, files and libraries of the Survey are available to the public. A public-use area is provided on the second floor of the Wyoming Geological Survey Building. This area hosts microfiche, microfilm, and paper copies of many oil and gas well logs; aerial photographs; unpublished geologic and mineral reports; open file reports of the U.S. Geological Survey and the U.S. Bureau of Mines; the U.S. Department of Energy's uranium reports for Wyoming, and the Earth Science Information Center (ESIC). The Survey's extensive collection of Environmental Impact Statements, Industrial Siting Applications, and numerous other government documents are now kept in the Survey's first floor reference library.

In a concerted effort, the Coal, Industrial Minerals and Uranium, and Oil and Gas Sections continued to enter mineral resource data into the Survey's personal computers for easier management and manipulation of data. While the initial goals of these computerization efforts were the input of mineral production, market, and price information, the Sections are now entering data on coal, oil, and gas composition.

# MAJOR ACCOMPLISHMENTS OF THE PUBLICATIONS PROGRAM

## OBJECTIVES

Publications are an essential part of the Survey's overall service function as mandated by law (W.S. 9-2-805, part a, subsections iv and v). The Publications Program, which is synonymous with the Publications Section, is both the publishing and sales arm of the Survey and performs an essential role in the sale and distribution of information to the public. This program contains the funds for preparing and printing geological information collected and interpreted by Survey personnel or outside authors. There are now five full-time positions and one part-time position in this program.

The major objectives of the Publications Program are three-fold: (1) to make information about Wyoming's geologic, mineral, and energy resources available in standard publication format, (2) to sell and distribute Survey publications, and (3) to provide technical support to the State Geologist, Section Heads, other Survey staff, and occasionally to outside entities.

## ACCOMPLISHMENTS

For each of these major objectives, the activities and accomplishments of the Publications Program in FY92 are described below:

### **PUBLISHING: Make information about Wyoming's geologic, mineral, and energy resources available in standard publication format.**

The Editor and the State Geologist establish publishing priorities. The two graphs in Figure 5 summarize the general subject matter of Survey publications and the number of new publications completed each decade. In FY92, the Editorial Unit prepared bid specifications for 12 printing jobs. The Editor also attended the press runs for these jobs to assure the printed quality of these publications met Survey standards.

The 222 new titles published by the Survey in FY92 is second only to the record number of publications completed in FY93 (Figure 6). The increased numbers of publications completed each year since FY82 are the result of a concerted effort to increase the number of new publications each year.

Relatively level funding, inflation, and the loss of a position have necessitated some adjustments. In recent years, the Section has sought and been given funds to upgrade its photographic and computer equipment. It currently has an excellent

desktop publishing system and it will acquire the capability of computerized drafting in FY93.

However, because of the larger volume of manuscripts submitted by the geologic sections, a backlog of unpublished manuscripts has been getting larger each year. For this reason, an increasing number of publications are prepared as open file reports or preliminary maps rather than preparing them for commercial printing. An open file report or preliminary map is one that is prepared in a repro-

TECHNICAL AND POPULAR GEOLOGY	924 REPORTS AND MAPS	80%
MINERAL RESOURCES	230 REPORTS AND MAPS	20%

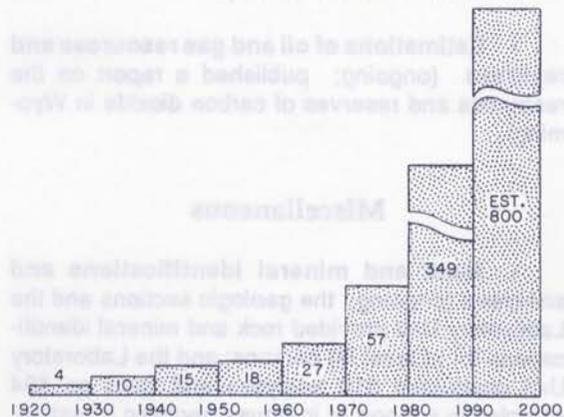


Figure 5. General content of Survey publications since FY20 (excludes publications lists and posters) and number of new titles by decade.

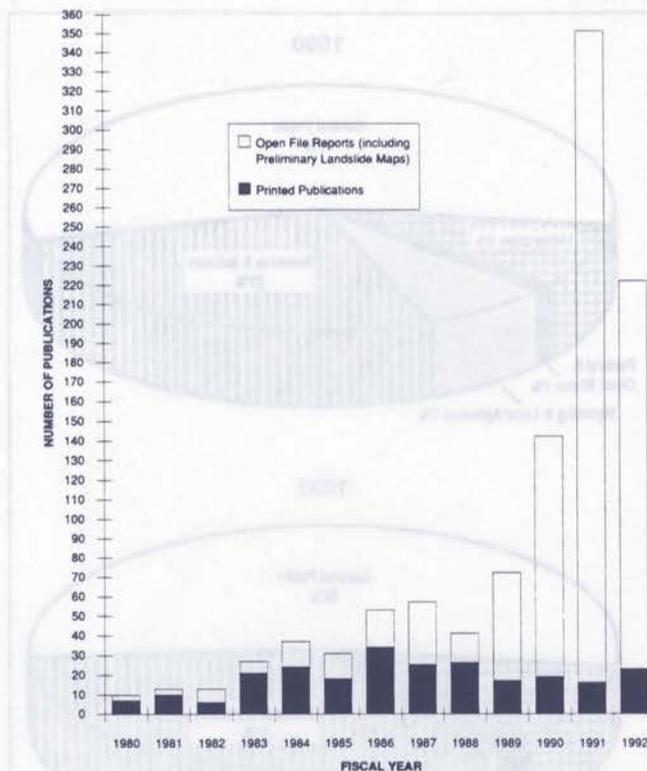


Figure 6. Number of new titles published each fiscal year (FY80 through FY92).

ducible format and is reproduced only as requested. The disadvantages with these types of publications are the often inferior reproduction; the inability to adequately illustrate the reports with photographs, color, and other special methods; and the sometimes high cost of reproduction on an individual basis, particularly if there are a number of large illustrations. While an initial advantage to open file reports was the timeliness of their release, this advantage is disappearing due to the growing numbers of submitted open file manuscripts and the lack of adequate editing resources.

The 222 publications listed below represent the combined efforts of the Publications Section and the geologic sections toward meeting the primary objective of the Publications Program:

#### ANNUAL REPORT

Fifty-eighth annual report of the Geological Survey of Wyoming for Fiscal Year 1991, July 1, 1990 to June 30, 1991, by G.B. Glass and S.G. Bruhnke (1991).

#### BULLETIN

Fossils of Wyoming (fourth printing): B-54, by M.W. Hager, 1970 (1992).

#### INFORMATION PAMPHLETS

Geology of Wyoming (third printing): IP-2, by G.B. Glass and D.L. Blackstone, Jr., (1992).

Organization, mission, goals, and authorities of the Geological Survey of Wyoming (revised and updated): IP-4, (1992).

#### MAP SERIES

Oil and gas fields of the Wind River Basin: MS-37, by R.H. De Bruin and S.D. Hostetler (1991).

Geologic map of the Miners Delight Quadrangle, Fremont County, Wyoming: MS-38, by W.D. Hausel (1992)

Geologic map of the Nowater Creek 30' x 60' Quadrangle, north-central Wyoming: MS-39, by A.J. Ver Ploeg (1992).

#### MISCELLANEOUS

Publications available from the Geological Survey of Wyoming: (September, 1991).

Index to U.S. Geological Survey topographic maps available from the Geological Survey of Wyoming: (1992).

Publications available from the Geological Survey of Wyoming: (April, 1992).

*Knightsia* postcard (second printing): (1992).

#### OPEN FILE REPORTS

Wyoming's carbon dioxide resources: OFR 91-6, by R.H. De Bruin (1991).

Preliminary geologic map of the Packsaddle Canyon Quadrangle, Johnson County, Wyoming: OFR 92-1, by A.J. Ver Ploeg and P.L. Greer (1992).

#### PRELIMINARY LANDSLIDE MAPS

197 quadrangles were completed in FY92, by J.C. Case and others (1991 and 1992).

#### PUBLIC INFORMATION CIRCULAR

Geologic tours of western Wyoming and parts of adjacent Idaho, Montana, and Utah (second printing): PIC-29, edited by Sheila Roberts, 1990 (1992).

Decorative stones of Wyoming: PIC-31, by R.E. Harris (1991).

#### REPRINTS

Coal fields and coal beds of Wyoming: R-47, by G.B. Glass and R.W. Jones, 1991 (1992).

Field guide to the Seminoe Mountains: R-48, by D.L. Blackstone, Jr. and W.D. Hausel, 1991 (1992).

Field guide to the geology and mineralization of the South Pass region, Wind River Range, Wyoming: R-49, W.D. Hausel and J.D. Love, 1991 (1992).

Industrial minerals and construction materials of Wyoming: R-50, by R.E. Harris, 1991 (1992).

Form, distribution, and geology of gold, platinum, palladium, and silver in Wyoming: R-51, by W.D. Hausel, 1991 (1992).

Geology and mineralization of the Wyoming Province: R-52, by W.D. Hausel, B.R. Edwards, and P.J. Graff, 1991 (1992).

### WYOMING GEO-NOTES

No. 31: by G.B. Glass, R.H. De Bruin, R.W. Jones, R.E. Harris, W.D. Hausel, A.J. Ver Ploeg, and J.C. Case (1991).

No. 32: by G.B. Glass, R.H. De Bruin, R.W. Jones, R.E. Harris, W.D. Hausel, A.J. Ver Ploeg, and J.C. Case (1991).

No. 33: by G.B. Glass, R.H. De Bruin, R.W. Jones, R.E. Harris, W.D. Hausel, A.J. Ver Ploeg, and J.C. Case (1992).

No. 34: by G.B. Glass, R.H. De Bruin, R.W. Jones, R.E. Harris, W.D. Hausel, A.J. Ver Ploeg, and J.C. Case, (1992).

### SALES AND DISTRIBUTION: Sell and distribute Survey publications.

In FY92, the Publications Sales Manager and Editorial Assistant responded to 1,802 written inquiries about publications, answered an average of 26.5 telephone inquiries and inquiries from visitors to the sales desk per work day, and received 4,278 sales of publications.

Figure 7 shows a percentage breakdown of revenues derived from the sale of publications over the last three fiscal years, arranged by customer category. The revenues from sales to the general public have exceeded 50 percent of the total since FY86.

Table 1 shows the volume of receipted sales in each customer category and the revenues derived from that customer category.

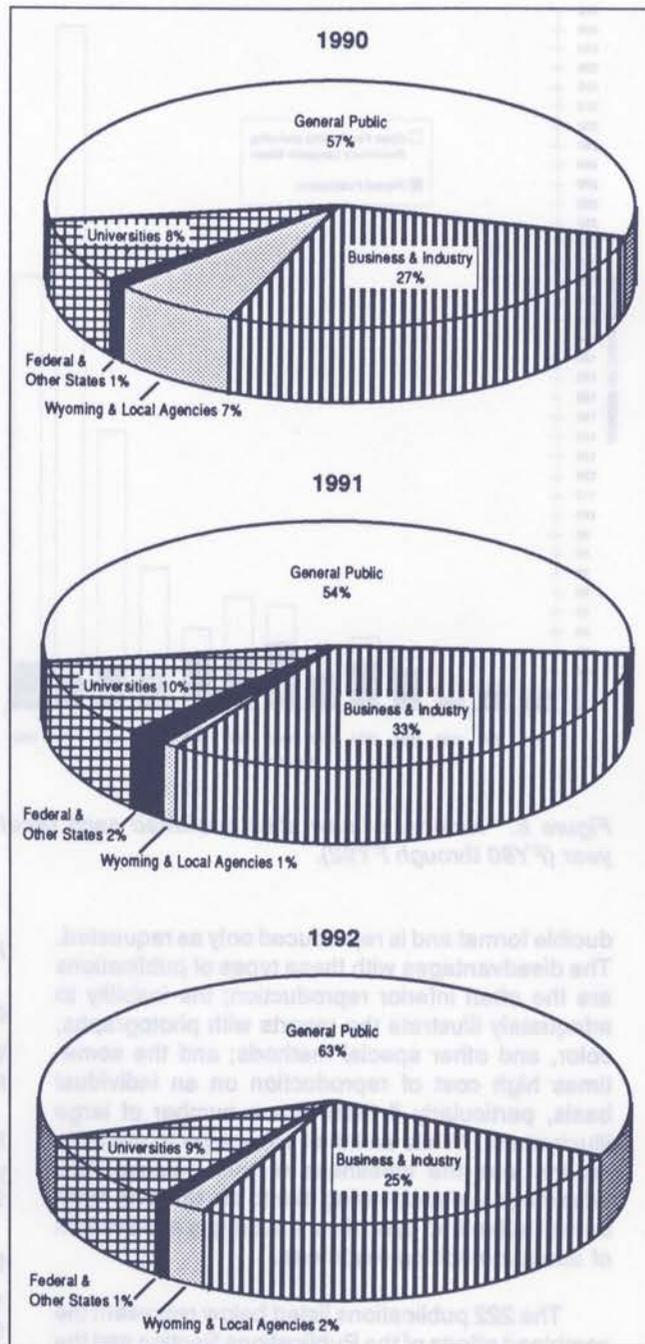


Figure 7. Percentage of publication revenue arranged by customer category (FY90 through FY92).

Table 1. Breakdown of publication sales by customer category and by sales revenue for FY92.

Category	Percent of Customers	Sales Revenue	Percent of Revenue
General Public and(or) unidentified	63%	\$46,489	57%
Business and Industry	25%	24,611	30%
Universities	9%	7,915	10%
Wyoming and Local Agencies	2%	1,769	2%
Federal, Other States and Foreign	1%	965	1%
	100%	\$81,749	100%

Revenues generated from the sale of publications are deposited in the General Fund. Table 2 summarizes the breakdown of revenue from publication sales by publication type for FY92.

Table 2. Breakdown of revenue from publication sales by publication type for FY92.

29.31%	Topographic maps (all scales)	\$23,956.50
21.52%	Bulletins	17,594.50
11.82%	Map Series	9,660.00
6.83%	Reports of Investigations	5,584.00
4.02%	Open File Reports	3,286.75
3.51%	Public Information Circulars	2,871.50
2.02%	Educational Series	1,650.00
1.98%	Geologic Map of Wyoming	1,620.60
1.57%	Memoirs	1,281.00
1.42%	Unpublished Mineral Reports	1,158.45
1.41%	Geologic Highway Map	1,152.00
1.29%	Wyoming Geo-notes	1,053.50
1.01%	Reprints	825.50
0.86%	Postcards	700.00
0.63%	Preliminary Reports	514.00
0.26%	County Resource Series	215.00
89.46%	Subtotal	\$73,123.30
5.40%	Miscellaneous publications	4,419.50
2.96%	Postage & tube charges	2,422.05
2.18%	Sales Tax collections	1,783.70
100.00%*	Grand Total	\$81,748.55

\* Total may not equal 100% because of independent rounding.

As a general rule, sales income had been increasing until the peak year of FY81 (Figure 8). With the subsequent recession, sales declined substantially, dropping to \$48,878 in FY84. Although slumping sales jumped back up in FY85, they resumed a steady one percent a year decline until FY90. That year sales took a dramatic 10 percent increase, to \$75,709, followed by a 7.5 percent increase to \$81,359 in FY91, and a slight increase to \$81,749 in FY92.

The Publications Program has continued to look for new and inexpensive ways to make the public aware of valuable earth-science publications available from the Geological Survey of Wyoming. In addition to mailing press releases describing new items, new Survey publications are listed in each issue of the Survey's quarterly newsletter, *Wyoming Geo-notes*. Subscriptions to *Wyoming Geo-notes* have increased through promotional mailings. Topographic map sales have continued to rise since FY90 because of increased public awareness of that service and because the Survey is selling maps by mail and phone orders as well as over-the-counter.

Publications of the Geological Survey are distributed free-of-charge to libraries and archives throughout the State. Limited numbers of each publication are also provided to other State agencies and branches of government and to elected officials on request. In addition, the Survey participates in publication exchange programs with nearly all other state geological surveys, numerous foreign geological surveys, the U.S. Geological Survey, the U.S. Department of Energy, the U.S. Bureau of Mines, and other entities. These distributions do not add directly to sales revenue, but they provide an important service to the State and allow acquisition of publications from out-of-state agencies without direct charge. The publications acquired through the Survey's exchange agreements are subsequently donated to the University of Wyoming's Geology Library. In FY92, more than 1,300 publications were received in exchange for Survey publications.

**TECHNICAL SUPPORT: Provide technical advice and support to the State Geologist, Section Heads, other Survey staff, and occasionally to outside entities.**

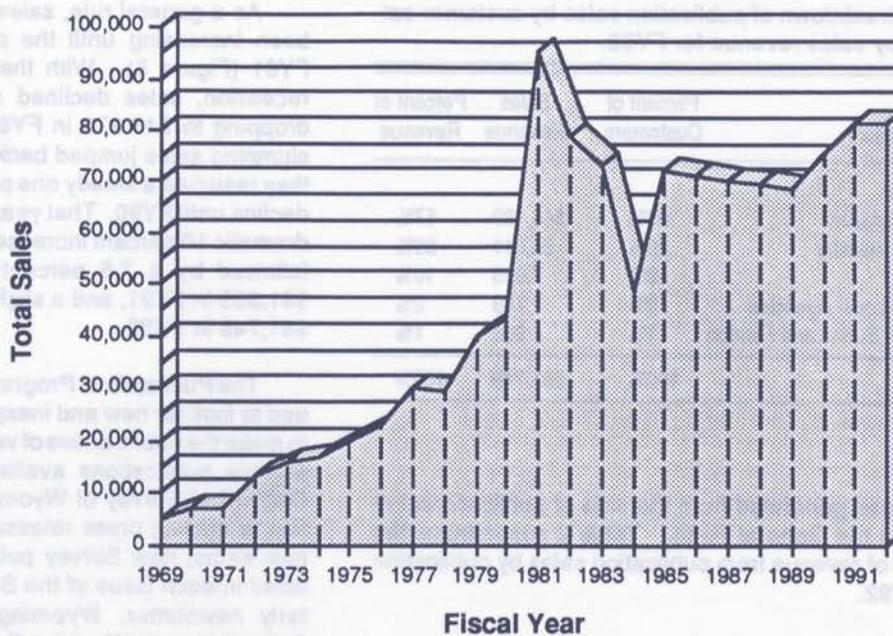


Figure 8. Fiscal year income to the General Fund from the sale of publications.

The Publications Section provides editing and drafting for maps and reports published by the Survey, creates illustrations for talks and displays, and generally assists in publication-related activities. The Editor also answers requests for information about Survey editing techniques, policies, and procedures from agencies, organizations, and consultants.

The Editorial Assistant provides advice and technical support regarding personal computers and software applications used throughout the agency.

The cartographers frequently advise University of Wyoming faculty, staff, and students on drafting techniques. They also occasionally provide advice to consultants and members of the general public as well as other State and Federal agencies.

## SUMMARY OF PERMANENTLY ASSIGNED VEHICLES

The following list of motor vehicles is provided in accordance with Section 9-2-1014 revised:

License Number	Assigned To	Reason For Assignments
S-86	Alan J. Ver Ploeg	1984 Blazer for off-road field work.
S-528	Ray E. Harris	1990 pick-up for off-road field work.
S-656	W. Dan Hausel	1987 pick-up for off-road field work.
S-799	James C. Case	1981 station wagon for light field work.
S-1330	Richard W. Jones	1988 station wagon for press runs.
S-1347	W. Dan Hausel	1988 Ramcharger for grant-related, off-road field work.