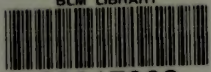


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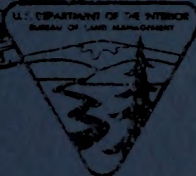


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1983 WORK PLAN of HYDROLOGIC STUDIES



U. S. GEOLOGICAL SURVEY & BUREAU OF LAND MANAGEMENT



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Preface

The Bureau of Land Management each year requires data collection and analysis and technical consulting services of its sister agency, the U.S. Geological Survey. For fiscal year 1983 services are requested of the GS's Water Resources Division.

The Work Plan includes both Federal Coal Management Program (abbreviated CMP in summaries) and non-CMP work items. Non-CMP work items are identified by a separate BLM appropriation code included in each work item description. Agency technical contacts for the 1983 BLM/GS contract are as follows:

Bureau of Land Management

Bruce Van Haveren (Supv. Hydrologist), Contracting Officer's Authorized Representative, Denver Service Center (FTS 234-2374).

U.S. Geological Survey

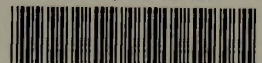
Water Resources Division

Donald A. Goolsby, Regional Energy Coordinator, Central Region (FTS 234-4118)

Donald L. Coffin, Regional Program Officer, Central Region (FTS 234-4118)

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New Mexico	37
North Dakota	43
Oklahoma	51
Utah	55
Virginia	63
West Virginia	66
Wyoming	70
Alabama	135,000
Colorado	77,000
Idaho	757,240
Montana	34,000
West Virginia	104,000
Wyoming	290,000
TOTALS	1,397,240

SUMMARY OF BLM FUNDS
WATER RESOURCES DIVISION
1983

State	CMP	Watershed (4340)	Total
Alabama	\$302,000		\$302,000
Colorado	550,000	\$ 96,740	646,740
Idaho		31,555	31,555
Montana	470,000		470,000
New Mexico	154,000		154,000
North Dakota	135,000		135,000
Oklahoma	77,000		77,000
Utah	757,260		757,260
Virginia	54,000		54,000
West Virginia	104,000		104,000
Wyoming	290,000		290,000
TOTALS	2,893,260	128,295	3,021,555

ANNUAL WORK PLAN

USGS WATER RESOURCES DIVISION AND BLM Fiscal Year 1983

AUTHORITY

The General Agreement between the Bureau of Land Management (BLM) and the Geological Survey (GS), dated August 15, 1974, is considered the basis for this Work Plan.

PURPOSE

The purpose of this Work Plan is to specify the nature and amount of assistance to be provided by the GS to BLM during FY 83.

SCOPE

This work plan includes all services to be provided by the GS under the CMP program to BLM in fiscal year 1983 in the States of Alabama, Colorado, Montana, New Mexico, North Dakota, Oklahoma, Utah, Virginia, West Virginia, and Wyoming. Also included are non-CMP work items for the states of Colorado, Idaho, Montana, and Utah.

The GS will provide the services, including personnel, equipment, supplies, and facilities, to conduct water resources investigations in areas designated by the BLM. Services will include installation, operation, and maintenance of surface-water gages, ground-water wells, and climate stations, as well as water-quality data collection and analysis.

PROCEDURE

Fiscal year 1983 is the ninth year of this cooperative effort. Some work that began in earlier fiscal years will be continued in fiscal year 1983, while some projects may be dropped. New studies will begin in fiscal year 1983, some of which will carry into fiscal year 1984 and beyond. These decisions will be made in joint meetings among the GS District and BLM State offices and the Denver Service Center. The annual work plan is developed by the Denver Service Center after negotiations with BLM field offices to determine needs and GS field offices to determine capabilities, recommended hydrologic procedures, and for coordination with other studies conducted by the GS in other programs. The development of budgets takes into account the program needs of both agencies and funds available to meet those needs. When mutual interests are strong, funds from both agencies are applied. Funds tabulated in the work order, however, represent only those from BLM.

Field investigative procedures will be standard GS water resources investigation techniques.

REPORTS

Reporting will generally be standard GS report procedures with some deviations that are detailed in the Annual Work Plan.

Semiannual progress reports will be prepared by each Water Resources Division district and routed through the Central Region to the Contracting Officer's Authorized Representative (BLM). Due dates for these reports will be April 30, 1983, and September 30, 1983. The GS will provide the appropriate BLM State Office with a copy of each progress report.

In addition, a separate report on the progress of the precipitation-runoff modeling efforts in all states, covering the status of the small watersheds calibration, will be prepared jointly by the Precipitation-Runoff Modeling Project (USGS) and the Denver Service Center (BLM) and submitted to BLM-Headquarters by September 30, 1983.

Prior to publishing any work involving BLM funds, the GS will forward copies of the report to the Contracting Officer's Authorized Representative and to the appropriate BLM State Office contact for review and approval.

FUNDING

The BLM will provide funds to the GS to cover all authorized work listed in this work plan, not to exceed \$3,021,555 in FY 83. Billing will be through Standard Form 1081, which will be current as of the beginning of the quarter during which the interagency agreement is signed. Subsequent bills will be issued at 3-month intervals except during the last quarter when bills will be submitted at 1- to 2-month intervals. An equivalency table relating BLM projects and GS projects will be provided quarterly by the GS as will an itemized listing of costs by GS project. The GS will consider this account a reimbursable account.

Alabama

ALABAMA

SUMMARY OF FUNDS (FY 83)
WATER RESOURCES DIVISION

Southern Appalachian Region

<u>Project</u>	<u>Funding</u>		
	<u>Data Collection</u>	<u>Analysis</u>	<u>Total</u>
Surveillance of Hydrologic Changes Resulting from Mining of Federal Coal in the Warrior Coal Field, Alabama	\$100,000	\$75,000	\$175,000
Watershed Modeling of Potential Federal Coal Mining Areas in North-Central Alabama		77,000	77,000
Surveillance of Hydrologic Changes in Lake Tuscaloosa Resulting from Mining	<u>25,000</u>	<u>25,000</u>	<u>50,000</u>
TOTALS	\$125,000	\$177,000	\$302,000

Total for State of Alabama: \$302,000

ALABAMA

Curt Jones, BLM, ESO Director (FTS-235-2833)
Jerry Coalgate, BLM, ESO Technical Investigations Coordinator
(FTS-235-3630)
C.A. (Jerry) Pascale, WRD District Chief (FTS 229-2957)

I. Surveillance of Hydrologic Changes Resulting from Mining of Federal Coal in the Warrior Coal Field, Alabama

Robert Kidd, WRD Project Chief (FTS 229-2976)

Since 1976, basic data on quality and quantity of water resources provided by this project have been used for direct input in BLM's coal-lease documents. The Tuscaloosa BLM office will use the data from this project for the E.I.S. which will be written in FY 1983. Information collected and analyzed will be used in "Descriptions of the Environment," "Environmental Consequences," and Site Specific Matrices. Methodology based on regression equations generated by the project will be used to estimate probable impacts for different leasing alternatives. The "Surveillance" project also provides basic data needed to drive the P.R.M.S. model.

- A. Location: The Warrior Coal Field in Tuscaloosa, Fayette, Walker, and Jefferson Counties, Alabama.
- B. Objective: Collect and interpret basic data on water resources to aid the Bureau of Land Management (BLM) in its responsibility for preparing Environmental Impact Statements (EIS).
- C. Procedures: Standard U.S. Geological Survey methods will be used to collect streamflow, water quality, ground water, and precipitation data.
 1. Surface Water
 - a. Collect streamflow and water quality data monthly at 20 sites.
 - b. Use regression equations to determine water quality impacts that will occur as a result of mining.
 2. Ground Water
 - a. Water-level measurements and water sample collections will be made in selected wells near concentrations of Federal mineral ownership.
 - b. Where wells are located near mines, a correlation between mining and ground water impacts will be made as data becomes available.

3. Sediment

- a. Sediment data will be collected at selected sites.
- b. Regression equations will be used to estimate the magnitude of impact sediment will cause as a result of mining.

4. General

- a. Maintain a network of rain gages for precipitation data.
- b. Tabulate and interpret on a current basis all data collected as a part of the project and similarly related projects in an effort to improve techniques for predicting effects of mining on the hydrology.
- c. Contract aerial photography to define degree of mining and land use changes in principal basins monitored and other land under Federal mineral ownership.
- d. Coordinate with other agencies to avoid data collection duplication and to inform them of project objectives and activities.

D. Report Products: All collected data will be placed in computer storage on an ongoing basis and will be published in the annual data reports entitled "Water Resources Data for Alabama." An interpretive report on the hydrology of the study area and covering the period of data collection from October 1981 through September 1983 will be written by September 30, 1984. The report will define present hydrologic conditions and effects of mining on hydrology. Where feasible, project findings will be incorporated into papers prepared for presentation to other government agencies, universities, and professional organizations.

E. Distribution of Funds:

Salaries	\$100,000
Travel	2,000
Aerial Photography	4,500
Data Processing	4,000
Laboratory Services	61,000
Equipment & Supplies	3,500
Total	<u>\$175,000</u>

II. Watershed Modeling of Potential Federal Coal Mining Areas in North-Central Alabama

Robert Kidd, WRD Project Chief (FTS 229-2976)

Small basin watershed modeling in the Warrior Coal Field has been in progress since September 1979. The objective of the modeling project is to provide BLM field hydrologists with a tool that will permit transfer of data from gaged basins to ungaged basins and that will also assist in making predictions about the hydrologic impacts of surface mining. The BLM hydrologist will then be in a position to make interpretations and supportable recommendations to the land managers.

Recent national emphasis on developing new sources of energy has resulted in an acceleration of the coal leasing program in Alabama. This acceleration emphasizes the basic problem of developing sufficient information upon which to base reclaimability and related hydrologic decisions with very limited time and money.

- A. Location: The Warrior Coal Field in Tuscaloosa, Fayette, and Walker Counties.
- B. Objectives: The objectives of this project are: (1) to test the transferability of the calibrated rainfall-runoff model to watersheds underlain chiefly by the Coker Formation, (2) to calibrate the rainfall-runoff model for simulating streamflow in basins underlain primarily by the Pottsville Formation, and (3) to apply the model to actual coal-lease tracts for the next EIS (FY 83).
- C. Procedures:
 1. To test model transferability in a "Coker Type" hydrological environment, a site in the Turkey Creek basin will be monitored during FY 1983.
 2. To calibrate the model for basins underlain chiefly by the Pottsville Formation, monitoring will continue as part of the Surveillance Project in Bear Creek basin, representing an unmined area, and in Blue Creek basin, representing a mined area.
 3. The Hydrologic Surveillance Project will supplement these stations with 3 continuous surface water sites and 10 recording rain gages.
 4. Apply the model in daily and unit modes to selected BLM coal-lease tracts for the FY 83 EIS.

D. Report Products: Data collected through this project will be placed in computer storage and be available to other agencies and organizations. An administrative report will be prepared by September 30, 1983. Modeling results of BLM tracts will be used in the EIS (FY 83).

E. Distribution of Funds:

Salaries	\$ 60,000
Travel	3,000
Data Processing	13,000
Equipment and Supplies	1,000
Total	<u>\$ 77,000</u>

III. Surveillance of Hydrologic Changes in Lake Tuscaloosa Resulting from Mining

A. Location: Lake Tuscaloosa drainage basin in Tuscaloosa and Fayette Counties, Alabama.

B. Objective: Collect and interpret basic data on water resources to aid the Bureau of Land Management in its responsibilities for determining existing hydrological conditions and potential mining impacts on Lake Tuscaloosa.

C. Procedures: Standard U.S. Geological Survey methods will be used to collect streamflow and water-quality data.

1. Collect streamflow and water quality data twice a year at 8 to 10 partial record sites near points of inflow to the lake.
2. Evaluate significance of historic sedimentation near points of inflow by use of fathometer traverses.
3. Define baseflow zones in the basin by constructing an isopach map of Cretaceous sediments.
4. Review and compile existing data on Lake Tuscaloosa.
5. Coordinate work with officials of the city of Tuscaloosa to avoid data collection duplication and to inform them of project objectives and activities.

D. Report Products: All data collected will be placed in computer storage on an ongoing basis and will be published in the annual data reports, "Water Resources Data for Alabama." Data collected will be used in BLM's FY 83 EIS if available. An interpretive report on the hydrology of the lake and covering the period of data collection will be written in FY 1983. The report will define present hydrologic conditions and effects of mining on Lake Tuscaloosa based on the data collected.

E. Distribution of Funds:

Salaries	\$ 35,000
Travel	9,500
Data Processing	1,500
Equipment and Supplies	4,000
Total	\$50,000

Colorado

COLORADO

SUMMARY OF FUNDS
WATER RESOURCES DIVISION

Project No.	CMP	Watershed (4340)	
		Salinity	Other
Hydrologic Modeling (CO-113)			
Data Collection - Foidel & Sage Creeks	\$25,000		
Model Application	20,000		
Model Spoil Pile Flow Paths	50,000		
Hydrology of the Durango Coal Field	60,000		
Hydrology of Spoil Piles (CO-114)	100,000		
Hydrologic Characterization			
North Park (CO-117)	50,000		
Hydrologic Characterization			
Yoast Area (CO-138)	70,000		
Regionalized Flow Characteristics (CO-171)	50,000		
Yampa River Synoptic Water Quality (CO-113)	60,000		
Arkansas River Model (CO-169)	15,000		
Modeling Dissolved Solids - Yampa River	30,000		
North Fork Gunnison (CO-118)	20,000		
Salt Creek Salinity Control Project		\$ 20,550	
Operation of BLM Stations - San Luis Valley	---	---	\$ 37,700
Hydrologic Investigation of Badger Creek	---	---	16,340
Flow and Water Quality Characteristics of Selected Western Colorado Streams			22,150
	Totals	\$ 20,550	\$76,190
Total for the State of Colorado:	\$646,740		

COLORADO

George C. Francis, BLM State Director (FTS-837-4325)
Rhio Jackson, BLM Technical Investigations Coordinator (FTS 327-4888)
James F. Blakey, WRD District Chief (FTS 234-5092)

I. Hydrologic Modeling (CO-113)

Randolph S. Parker, WRD Project Chief (FTS 234-3487)

A. Data Collection

1. Location: Routt and Moffat Counties, Colorado
2. Objective: The objective is to maintain gaging stations in areas where hydrologic monitoring was initiated while watersheds were in a natural condition and where mining is now active or will commence soon. Data collected at these stations can be used to compare the hydrologic environment in pre- and post-mining.

For FY 83 the monitoring program will continue for two basins. This will allow uninterrupted data collection for the two watersheds of Foidel Creek and Sage Creek. Data on surface water quantity and quality and area climate will continue to be collected.

Discharge, water temperature, and specific conductance will be continuously monitored at the two gaging stations. In the Foidel watershed, the climate station, and two precipitation stations will be maintained and snow courses continued near the precipitation stations.

3. Report Products: Streamflow and water-quality data will be published in the annual "Water Resources Data for Colorado."
4. Distribution of Funds:

Operation and Maintenance of Gages (including data storage)	\$ 8,000
Water Quality Collection and Analysis	10,900
Operation and Maintenance of Climate Station, Precipitation Stations, and Snow Courses	6,100
Total	<u>\$25,000</u>

B. Model Applications

1. Location: Primary emphasis will be Routt and Moffat Counties, but other areas of the state may be included.

2. Objectives: The objectives are (1) to provide model application where feasible for areas of interest to the BLM and (2) to continue to scenarios of mining activities within the model framework.

As particular site studies are needed by the BLM, the model will be run to provide estimates of natural hydrologic conditions on ungaged areas. The model can be used in this fashion in the Williams Fork Mountain area in watersheds sufficiently like the basins that have already been calibrated.

Model development will continue on introducing mines and mine reclamation areas within natural watersheds that have been calibrated to the model. Although exact model parameters are unknown at this time for reclaimed areas, this analysis can help to focus on sensitivity of model parameters and direction for data collection. In addition, subjective analysis of mine impacts within particular watersheds can be estimated.

3. Report Products: Short memorandum reports presenting model analysis results in specific basins will be produced in response to requests from BLM District hydrologists.

4. Distribution of Funds:

Salaries	\$15,000
Travel	1,000
Computer (including data storage and retrieval)	4,000
Total	<u>\$20,000</u>

C. Modeling Spoil Pile Flow Paths

1. Location: Routt County, Colorado
2. Objective: The objective of this study is to collect and analyze data for the water draining and routed through a coal spoil pile, to the stream channel. Preliminary investigations have introduced a coal spoil pile into the model calibrated for a natural watershed. This work has shown that model routing components can be modified to reflect observed flow paths of water through the coal spoil piles. However, the rates of water migration and the amounts of water in various storage components are unknown. This results in model output in which the magnitude of change from pre- to post-mining is poorly defined.

Using the data collected under project CO-114 (Hydrology of Spoil Piles), the rates of movement and quantity of water in the spoil piles can be monitored. Additional streamflow data are necessary to facilitate model calibration in areas

where significant drainage is through spoil piles. This project will install three surface water stations to complete the monitoring of the water balance in the area.

In addition to the data collection, this project will: (1) calibrate and run the model for the area to test the completeness of the data collection system with respect to model components, (2) develop, conduct, and analyze injection tests in the well field to establish flow rates from the coal spoil to the stream, and (3) provide overall coordination for the data collection to insure model compatibility.

3. Report Products: Report on data analysis and application to the model will be written in FY 85.

4. Distribution of Funds:

Salaries	\$17,000
Gage Construction and O&M	18,000
Water Quality Collection and Analysis	10,000
Tracer Study	5,000
Total	<u>\$50,000</u>

II. Hydrology of the Durango Coal Field

Tom Brooks, WRD Project Chief (FTS 322-0302)

- A. Location: The study area is the Know Coal Resource Leasing Area (KCRLA) inclusive of the Durango field in parts of Archuleta, La Plata, and Montezuma Counties, Colorado.
- B. Objective: The general objective is to define the existing ground water and surface-water conditions in the study area. Specific objectives are:
1. Research all available ground water related data from U.S. Geological Survey, State Engineer's Office, and mining company records.
 2. Select wells and boreholes in the study area to obtain water level data and water quality samples and to conduct aquifer tests.
 3. Conduct seepage runs to obtain gain-loss data to define ground/surface-water relationships.
 4. If adequate data can be compiled, develop water-table and potentiometric-surface maps for the Cliff House and Pictured Cliffs Sandstones.

5. Interpret ground water and seepage-run data to define areas of recharge and discharge and to estimate probable impacts of expanded coal mining on ground- and surface-water regimes.
6. Evaluate potential impacts of subsidence on ground-water hydrology.

C. Report Products: Data will be collected and analyzed in FY 83 and 84. An interpretive report will be written in FY 84.

D. Distribution of Funds:

Salaries	\$46,000
Travel	8,000
Equipment	500
Computer	1,500
Laboratory	4,000
Total	<u>\$60,000</u>

III. Hydrology of Coal Spoil Piles (CO-114)

Robert S. Williams, WRD Project Chief (FTS 234-3815)

A. Location: Routt County, Colorado

B. Objectives: The quality, quantity, and timing of water movement through the spoil piles will continue to be of prime interest. These facets of spoil pile hydrology will be evaluated in the unsaturated zone with drainage type lysimeters and in the saturated zone with wells.

The continued evaluation of spoil pile water quality is important since it appears that the salt load (total dissolved solids) is increasing each year at a slight, but statistically significant level. It is of value to determine if this trend continues or if an equilibrium condition is reached so that the long-term impacts of spoil piles can be assessed. The quantity and timing of water movement is being monitored by the lysimeters and the soil water access tubes which measure soil water content. These results are extremely important for defining the quantity of recharge to the spoil pile aquifer since the water may eventually become surface flow. The timing of water movement through the spoil pile is also very important since this helps define the availability of water for evapotranspiration. This water availability is important both for plant use and for determining the water balance.

The data collection in the study will focus on defining spoil pile unsaturated and saturated water storage. In addition to the storage component of the hydrologic cycle, the rate of flow between the storage components will also be defined.

This information will then be used to model subsurface routing and storage in the USGS snowmelt runoff model. This aspect is described under Project CO-113 (Hydrologic Modeling - part 3)

The results of the model simulations with the spoil pile data will help evaluate the impacts of surface mining on watersheds in northwestern Colorado in an accurate and timely manner.

C. Report Products: An interpretive report on the unsaturated spoil zone and the saturated spoil zone (the spoil pile aquifer) will be available for review by BLM in September of FY 85.

D. Distribution of Funds:

Salaries	\$70,000
Travel	5,000
Computer	5,000
Equipment	5,000
Laboratory	15,000
Total	\$100,000

IV. Hydrologic Characterization of North Park (CO-117)

Gerhard Kuhn, WRD, Project Chief (FTS 234-4061)

A. Location: Jackson County, Colorado

B. Objective: The primary objective of this project is to define the study area's hydrologic system including surface and ground water interactions as influenced by precipitation and climatic variations. The availability and quality of surface water will also be defined. Ground water data, available from the ground water level monitoring program, will be related to present and future mining operations to assess the effects of mining on basin hydrology.

An intense data collection program at two sites on the Canadian River is obtaining continuous records of streamflow, sediment, discharge, water temperature, and specific conductance.

A site-specific study was begun in April 1979, in the McCallum lease area, where the first lease will be let. The site-specific study will be continued to assess any hydrologic changes associated with the mining. A streamflow station and two rain gages installed and operated on Williams Draw will be continued. Snow courses are also being run.

A climatological station operated in the Canadian River Study area will be continued. Data collected are temperature, soil moisture, accumulated daily wind speed, and precipitation.

C. Report Products: All surface water data will be published annually in "Water Resources Data for Colorado."

D. Distribution of Funds:

Salaries	\$ 20,000
Travel	7,000
Vehicles	3,000
Equipment	1,000
Laboratory Analyses	7,000
Operation and Maintenance of Gages (including data storage)	12,000
Total	\$ 50,000

V. Hydrologic Characterization of the Yost Area, Yampa River Valley, Colorado (CO-138)

Robert S. Williams, WRD Project Chief (FTS 234-3815)

A. Location: Routt County, Colorado

B. Objective: The study will define and interpret the undisturbed natural hydrologic regime of an area which is to be strip mined at some later date.

The purpose of the study is to define the hydraulic and the hydrologic characteristics of overburdened aquifers, underburdened aquifers, coal aquifers, and the interaction of these aquifer systems to each other and to surface water.

C. Approach: The proposed mine is located 8 miles south of Hayden, Colorado, within the Sage Creek drainage. Twenty-eight bedrock wells have been drilled at the study site. Each well will be monitored for water level. Two sites have continuous recorders. Water samples will be analyzed for major cations, major anions, and trace metals.

Soil-water tubes are installed in different soil and vegetation ecological units within the mine site. A neutron probe will be used to measure the soil-water content.

A stream-gaging station with a flume is installed near the mine boundary where Sage Creek flows from the mine property. Water quality samples and sediment samples are being obtained at this location.

A climate station is established in the basin to be mined. Precipitation, maximum, minimum, and mean daily temperature, relative humidity, solar radiation, and wind speed are being monitored at this site. Two recording precipitation gages are installed at a low and high elevation in the basin. Snow courses are being run at these sites.

All data collection associated with alluvial aquifers has been discontinued. The frequency of field data gathering trips has also been reduced.

D. Report Products: A basic data report has been approved and will be published in FY 82. An interpretive report is scheduled for FY 84.

E. Distribution of Funds:

Salaries	\$ 54,500
Travel	4,700
Equipment	1,700
Computer	3,000
Laboratory	6,100
Total	<u>\$ 70,000</u>

VI. Regionalized Flow Characteristics (CO-171)

James E. Kircher, WRD, Project Chief (FTS 234-3487)

A. Problem: Potential for additional coal and oil shale leasing in northwestern Colorado is increasing the demand on the area's available water resources and consequently the need for quick reliable methods of predicting streamflow conditions in ungaged basins. At present, only floodflow characteristics can be predicted with fairly reliable results (Manual for Estimating Flood Characteristics of Natural Flow Streams in Colorado, Colorado Water Conservation Board, Tech. Manual No. 1, J. F. McCain and R.D. Jarrett, 1976) but a method for predicting low and medium flows has not been established. This information is essential in the preparation of EIS's for the formulation of lease stipulations, and to the establishment of legal streamflow characteristics and water quality standards. Present U.S. Geological Survey programs to provide information on flow characteristics are aimed at hydrologic modeling and long-term data collection. Hydrologic modeling will provide water managers with flow characteristics; however, they will only provide information for specific areas rather than the broad geographic area. Long-term data collection and subsequent analyses of these data will provide accurate information on flow characteristics, but a number of more years of data collection is required. Therefore, there is an urgent need to have a short-term study of existing data based on simplistic, but acceptable, techniques to provide information on streamflow characteristics.

B. Objectives: The purpose of this study is to provide methods for predicting low-, mean-, and flood-flow conditions in gaged and ungaged basins. The method will be applicable to any natural flow basin in northwestern Colorado north of the Colorado River, and designed for use by the field hydrologist

without access to a sophisticated computer. The technique will be easy to use and only require a few hours to compute the streamflow characteristics for a watershed analysis. The techniques used for this study can be applied to other energy development areas as demand necessitates.

C. Approach: The approach of this two-year study will involve multiple regression and regionalization techniques. The major tasks of the study include:

1. Develop flow characteristics from observed streamflow at active and discontinued natural-flow gaging stations. This would also include nearby gaging stations not within the study area. The flow characteristics would include, but are not limited to, low flow characteristics such as 7-day, 10-year low flow and a flow duration curve from which the mean annual discharge can be obtained.
2. Determine easily measured basin and climatic characteristics, such as drainage area and mean annual precipitation for the gaged basins.
3. Perform multiple regression analyses and other statistical analyses to develop relations between the respective streamflow characteristic and the basin and climatic parameters. The results will be expressed as regression equations for the selected streamflow characteristics for the study area. These equations will probably be presented based on an ephemeral- or perennial-stream classification.
4. Prepare a user-oriented technical manual with examples of applications of the regression equations to estimate the flow characteristics. Presently, available techniques to obtain flow characteristics will be incorporated into the manual.

D. Distribution of Funds:

This study is part of a larger project to evaluate the USGS data-collection network in western Colorado. BLM's share of the funding requirement of this part of the study is as follows:

Salaries	\$43,000
Travel	1,000
Computer	6,000
Total	<u>\$50,000</u>

VII. Yampa River Synoptic Water Quality (CO-113)

Randolph S. Parker, WRD Project Chief (FTS 234-3487)

A. Location: Routt and Moffat Counties, Colorado

B. Objectives

1. To collect streamflow and dissolved chemistry data for approximately 20 small watersheds throughout the area south of the Yampa River.
2. To compare water-chemistry relationships already developed for the areas south of the Yampa River.
3. To identify regions, if they exist, of homogeneous water chemistry for dissolved constituents, based on comparisons made in objective 2.
4. To evaluate the instantaneous discharges obtained at the sampling sites in order to identify homogeneous area of surface water characteristics (mean and low flows) and to aid in determining the need for a continuous gaging program.

Intensive water quality monitoring has been done south of the river in the Yampa Valley. General water quality relations are being derived for this area. There is now interest in coal mining north of the river. In addition, the Bureau of Land Management is now evaluating the whole Green River-Hamsfork Coal Area for potential coal leasing. At present, there is little water quality data available to evaluate the water quality north of the river or to compare with relations derived for the south valley of the Yampa. Reconnaissance sampling is needed to provide the necessary data.

- C. Approach: Data collected will be instantaneous discharge, field parameters, and the major dissolved ions. Sampling will be repeated at each site to obtain approximately eight samples at various discharges. Regression relations between specific conductance and each dissolved constituent for each site will be developed. These relations will be used to characterize the temporal and spatial variations of water quality within the study region. By combining with available data south of the Yampa River, the regression relationships will be regionalized, possibly as a function of geology, climate, and land use. This regionalization approach will allow BLM and other land or water managers to estimate ranges of water quality concentrations for ungaged watersheds.

Low flow measurements at the miscellaneous sites will be correlated to flows from a long-term gaging record in the region. Statistical tests will be made to determine if flow characteristics can be transferred from the gaging station to the miscellaneous sites. Based on this analysis, the need for additional gaging stations in the region can be assessed.

D. Report Products: A data report will be written at the completion of data collection in December 1983. An interpretive report on the water quality characteristics of the area will be completed by the end of FY 1984.

E. Distribution of Funds:

Salaries	\$26,000
Travel	6,000
Vehicles	5,000
Equipment	3,000
Laboratory	18,000
Computer	2,000
Total	<u>\$60,000</u>

VIII. Arkansas River Model (CO-169)

A. Location: The Arkansas River Basin in Colorado.

B. Objective: The original proposal for the project "Arkansas River basin comprehensive modeling" included modeling stream-aquifer interactions for all significant irrigation developments along the main stem of the Arkansas River and the two main tributaries (from a water use perspective)--the Purgatorie River and Fountain Creek. When sources to fund the total project could not be found during FY 82, the scope of the project was diminished to eliminate Fountain Creek and the Purgatorie River and to model only the surface water aspects in the upper basin. The contributions of the BLM for the remainder of the project will enable the USGS to include all of the surface water aspects (which includes runoff computations, diversions, and water quality) of the Purgatorie River and Fountain Creek. This informatin will be used by the BLM District Office in Canon City for making management decisions regarding water resources available for use on BLM land.

C. Approach: The combined cooperative and OFA project will develop an interactive, stream-network digital computer mode to simulate all the major components of the hydrologic system of the Arakansas River Basin in Colorado. The model will be a planning-type model using a monthly time-step. Streamflow will be generated from precipitation data. Stream-aquifer interactions will be simulated for all reaches where significant aquifers are adjacent to the stream. A generalized non-reactive mixing-type simulation of water quality will be included. Operating rules for all reservoirs and irrigation ditches will be included based on Colorado water law.

D. Report Products: There are six scheduled reports during this study, three due during FY 83.

1. Selected hydrographs and statistical analyses characterizing the water resources of the Arkansas River Basin, Colorado, by Alan W. Burns.
 2. Monthly precipitation-runoff relationships for the Arkansas River Basin, Colorado, by P.O. Abbott.
 3. Relationship of monthly streamflow to specific conductance dissolved solids and general water quality in the Arkansas River Basin, Colorado, by Doug Cain.
- E. Distribution of Funds: Total funds for the combined project are expected to total \$115,000 of which \$15,000 is being contributed by BLM. These funds will be distributed as follows:

Salaries	\$10,000
Computer	5,000
Total	\$15,000

IX. Modeling Impacts of Surface Mining on Dissolved Solids in the Yampa River, Colorado

- A. Location: Routt and Moffat Counties, Colorado
- B. Objective: The objectives of this study are: (1) to modify and calibrate the relationship of existing dissolved solids with discharge for the tributary system of the Yampa River above Maybell, Colorado, and (2) to assess, through model simulation, potential increases in dissolved solids of streams as a result of increasing levels of mining.
- C. Approach: The model to be used routes an input quantity of streamflow and dissolved solids from the upstream end to the downstream end of each stream reach while algebraically accounting for gains and losses of streamflow and dissolved solids within the stream reach. As such, the model is basically an accounting scheme used to identify the water and chemical balance in a downstream direction through the tributary system. The model approach has been previously used in assessments on the Tongue River in southeastern Montana.

Primarily, existing data will be used to modify and calibrate the model to existing conditions. However, if the initial data collation and model runs indicate a lack of data for specific land uses, miscellaneous discharge and water quality measurements will be made to obtain necessary information. In the simulation, all or portions of Federally-owned coal in the study area will be considered potentially available for mining. Existing data will be analyzed and any additional data collected during FY 83.

D. Report Products: A report will be completed in FY 84 detailing the model and the results of predicting cumulative impacts of mining on dissolved solids.

E. Distribution of Funds:

Salaries	\$ 22,000
Travel	2,000
Water quality lab analysis	2,000
Modeling (including data storage and retrieval)	4,000
Total	<u>\$ 30,000</u>

X. North Fork Gunnison Subsidence (CO-118)

Tom Brooks, WRD, Project Chief (FTS 322-0302)

A. Location: The study area is part of the North Fork Gunnison River between Paonia and Cedaredge in eastern Delta County, Colorado. The area includes lease tract 1 in parts of Camp and Oak Creek drainages and lease tract 2 in parts of East Roatcap, Stevens Gulch, and Terror Creek drainages.

B. Objective: The U.S. Bureau of Land Management (BLM) is responsible for leasing mineral tracts to mining interests and must consider potential mining impacts associated with leasing areas. This study would be concerned with proposed coal mining between Paonia and Cedaredge, in which possible effects may be the interruption of springs and other water flow systems by subsidence and related environmental impacts.

The general objective of this study would be to provide baseline data and limited interpretation of surface and ground water flow systems as the available data permits.

C. Approach:

1. Provide baseline data to support future interpretation of changes within the surface or ground water systems. This will include the following information:

- a. Compile all existing data relating to water resources of the study area.
- b. Conduct a field inventory and verification of springs and wells.
- c. Collect samples for chemical-quality analyses of selected springs and wells.
- d. Conduct a gain/loss study of Terror, Stevens Gulch, East Roatcap, Camp and Oak Creeks.

- e. Describe local geology as it relates to the water resources of the area.
- 2. Provide limited interpretation on local hydrology as data permits. This may include, as data are available:
 - a. Potentiometric maps.
 - b. Inference of direction of flow of the ground water system.
 - c. Determination of recharge and discharge areas for the ground water flow system.
 - d. Description of effects of potential subsidence on the ground water flow system.
- 3. Suggest future studies that would further the understanding of the water resources system in coal lease tract areas of Delta County, Colorado.
- D. Report Products: A final open file report will be written and available for BLM review by December 1982.
- E. Distribution of Funds: All data collection will be completed in FY 82. Data analysis and preparation of a report will be completed in FY 83.

Salaries	\$ 20,000
Total:	\$ 20,000

XI. Salt Creek Salinity Control Project

Daniel L. Collins, WRD, Project Chief (FTS 322-0302)

- A. Location: One gaging station will be operated to provide streamflow and water quality information on Salt Creek, which flows out of Sinbad Valley in Colorado. Six stations--two on Potter Creek, one on West Gypsum Creek, one on Vermillion Creek, and two on Onion Creek--which flow out of Fisher Valley in Utah, were discontinued October 1, 1981.
- B. Objectives: The station consists of a digital water level recorder to measure stream stage and a Manning sampler to obtain water quality and sediment samples. The stage-discharge relationship will be verified by periodic current meter and slope-area measurements. The station will be inspected bi-weekly with streamflow measurements and water quality samples

obtained at least monthly. This station will provide data on streamflow quantity and the chemical character of the water in this stream. Daily maximum and minimum specific conductance and stream temperature data are available from a two-parameter mini-monitor. Additionally, a recording rain gage is operated in the watershed.

C. Report Products: Provide BLM with copies of all tabulated data as they are completed. All discharge and water quality data will be published annually in "Water Resources Data for Colorado."

D. Distribution of Funds:

Salaries	\$ 8,950
Travel	1,350
Equipment (includes rental costs)	4,350
Computer	600
Laboratory	5,300
Total	<u>\$20,550</u>

XII. Operation of BLM Stations in San Luis Valley

Jerry L. Hughes, WRD, Project Chief (FTS 323-9345)

A. Location: Eight study sites in San Luis Valley: two reservoir sites--change in contents; four reservoir sites--inflow; and two daily streamflow sites on San Luis Creek. Automatic sediment samplers are operated on San Luis Creek sites during spring and summer months. Recording rain gages are operated at seven sites.

B. Objective: To determine effects of changes in land use on the runoff from the small drainage areas. Daily flow and rainfall will be tabulated for the six reservoir sites. Two streamflow sites and one rainfall site are located on San Luis Creek to monitor runoff in this area.

C. Distribution of Funds (CO-050-4340-5225):

Salaries	\$26,000
Travel	4,670
Equipment	1,630
Computer	2,200
Laboratory	3,200
Total	<u>\$37,700</u>

XIII. Hydrologic Investigation of Badger Creek

Jerry L. Hughes, WRD, Project Chief (FTS 323-9345)

- A. Location: Badger Creek, tributary to Arkansas River.
- B. Objective: Determine surface water quantity and quality characteristics of Badger Creek watershed at two data collection sites.
- C. Distribution of Funds (CO-050-4340-5225):

Salaries	\$ 8,200
Travel	2,100
Equipment	570
Computer	570
Laboratory	4,900
Total	<u>\$16,340</u>

XIV. Flow and Water Quality Characteristics of Selected, Western Colorado Streams

Daniel Collins, WRD, Project Chief (FTS 322-0302)

- A. Location: The following three gaging stations will be operated to provide data necessary to define high- and low-flow characteristics of western Colorado streams:
 - a. 09118450--Cochetopa Creek below Rock Creek near Parlin, Colo.
 - b. 09123400--Lake Fork below Mill Gulch near Lake City, Colo.
 - c. 09060950--Big Alkali Creek below Castle Creek near Burns, Colo.

Additionally, BLM employees will collect water samples at selected, miscellaneous sites for submission to the U.S. Geological Survey Central Laboratory.

- B. Objectives: Each gaging station contains a water-stage recorder to measure stream stage which is related to discharge measurements to develop a stage-discharge relationship. Periodic current meter or indirect measurements are made to check for deviations in the stage-discharge relationship. Stream-stage record coupled with the stage-discharge relationship is used to compute the following flow characteristics: minimum daily, maximum daily, annual peak discharge, and mean daily. These characteristics, if available for a period of above- and below- normal climatic (precipitation) conditions, can be used to describe recurrence frequencies of low- and

high-flow events as well as the stream's flow-duration characteristics. Additionally, a water-quality data base will begin to be established for streams sampled by BLM personnel and samples submitted for analyses by the USGS Central Laboratory.

C. Report Products: Copies of tabulated data will be provided to BLM and records will be published annually in "Water Resources Data for Colorado."

D. Distribution of Funds:

1. Object Class:

Salaries	\$ 9,480
Travel	870
Equipment (includes rental)	1,650
Computer	150
Laboratory	10,000
Total	<u>\$22,150</u>

2. Work Element

Gaging Stations (3 @ \$4,050)	\$12,150
Laboratory	10,000
Total	<u>\$22,150</u>

Idaho

IDAHO

SUMMARY OF FUNDS
WATER RESOURCES DIVISION

<u>Project</u>	<u>CMP</u>	<u>Other (4340)</u>
O & M Gaging Stations		
Herd Creek		\$ 4,535
Lolo Creek	---	4,535
Saw Mill Creek		3,630
Bruneau River near Hot Springs		4,535
North Fork Big Lost River		4,535
Lower Cedar Creek		4,535
O & M ground water observation wells		<u>5,250</u>
	Total	\$ 31,555

Total for the State of Idaho: \$31,555

IDAHO

Clair Whitlock, BLM State Director (FTS 554-1401)

Karl Gebhardt, BLM Technical Investigations Coordinator (FTS 554-1484)

Ernest F. Hubbard, Jr., WRD District Chief (FTS 554-1750)

I. Operation and Maintenance of Six Gaging Stations

Herman A. Ray, WRD Project Chief (FTS 554-1750)

A. Location

1. Herd Creek
2. Lolo Creek
3. Saw Mill Creek
4. Bruneau River near Hot Springs
5. North Fork Big Lost River
6. Lower Cedar Creek

B. Data Collection: Began January 1980 and to continue for a five-year period.

C. Reports: To be published in the USGS "Water Resources Data for Idaho."

D. Funding (ID-930-4340-5273):

Five stations @ 4,535	\$22,675
One station @ 3,630	3,630
Observation wells	5,250
Total:	<u>\$31,555</u>

Montana

MONTANA

SUMMARY OF FUNDS
WATER RESOURCES DIVISION

<u>PROJECT</u>	<u>CMP</u>
Hydrologic Characterization	
A. Streamflow	15,000
B. Surface-Water Quality	\$109,000
B. Ground-Water Levels	18,000
Hydrologic Site Studies	113,000
Salinity Modeling of Redwater River	18,000
Streamflow Characteristics	15,000
Hydrologic Modeling	71,000
Small Basin Sediment Yields	17,000
Impacts of Mining on Water Quality	<u>94,000</u>
	Total: \$470,000
Total for State of Montana:	\$470,000

MONTANA

Michael J. Penfold, BLM State Director (FTS 585-6462)
Mike Whittington, BLM Technical Investigations Coordinator
(FTS 585-6474)
George M. Pike, WRD District Chief (FTS 585-5302)

I. Hydrologic Characterization of Eastern Montana Coal Areas

A. Network Maintenance of Streamflow

George M. Pike, WRD, Project Chiefs (FTS 585-5302)

1. Objectives: Collect streamflow data at key locations to supplement other programs. The data is essential in defining runoff from potential impact areas, determining streamflow characteristics, and providing a data base from which future changes can be analyzed.
2. Procedure: Standard U.S. Geological Survey methods of surface-water and water-quality data collection will be used to obtain data at the following stations:

Beaver Creek near Wibaux
Hanging Woman Creek near Birney
Otter Creek near Ashland

3. Report Products: Basic records from streamflow sites will be submitted to BLM annually or as mutually agreed upon. Records will be published by the USGS in an annual report, "Water Resources Data for Montana." The data will be used by the USGS in preparing interpretive reports described in other parts of the work plan.
4. Relationship to Other USGS Studies: This program will supplement and be correlated with other USGS programs of streamflow data collection. Numerous other stations are operated in this area.
5. Distribution of Funds:

Salaries	\$ 9,000
Travel	4,000
Supplies	1,000
Data Processing	1,000
Total	<u>\$15,000</u>

B. Network Maintenance of Surface-Water Quality Monitoring Sites

J. Roger Knapton, WRD Project Chief (FTS 585-5263)

1. Objectives: Collect water quality data at selected locations to monitor seasonal and long-term fluctuations in surface water quality. The data is needed to define variability of water quality spatially and temporally over the regions, to provide baseline data from which future changes can be documented, and to develop conceptual models of surface-water quality.
2. Procedures: Standard U.S. Geological Survey methods of water quality monitoring will be used to obtain data at the following stations:

- * Armell's Creek near Forsyth
- * Rosebud Creek near Colstrip
- * Rosebud Creek at mouth near Rosebud
- * Tongue River at Tongue River Dam near Decker
- * Pumpkin Creek near Miles City
- Hardscrabble Creek near Culbertson
- East For Sary Creek near Colstrip
- Cow Creek near Colstrip
- Hanging Woman Creek at State Line near Otter
- Waddle Creek near Otter
- Trail Creek near Otter
- Corral Creek near Otter
- Horse Creek near Birney
- Locate Creek near Ismay
- Fox Creek near Lambert
- Lone Tree Creek near Sidney
- Beaver Creek at Wibaux

*Includes daily measurements of specific conductance

3. Report Products: Basic records from water quality sites will be submitted to BLM annually or as mutually agreed upon. Records will be published by the USGS in an annual report, "Water Resources Data for Montana." The data will be used by the USGS in preparing interpretive reports described in other parts of the work plan.
4. Relationship to Other USGS Studies: Data collected from the listed water quality stations will supplement information from other water quality stations located throughout the area. Approximately 25 other monitoring sites are funded by the USGS Coal Hydrology program on the USGS/State cooperative program. Data from the network is used to define baseline water quality conditions in areas where mining may impact the hydrologic system. The information is also used to develop an understanding of factors controlling water quality in the

region. Prediction of water quality changes requires a broad base of information that not only defines current conditions but also provides an understanding of cause-effect relationships.

5. Distribution of Funds:

Salaries	\$ 44,000
Lab Services	24,000
Contractual Services	10,000
Travel	22,000
Supplies	2,000
Data Processing	7,000
Total	<u>\$109,000</u>

B. Ground-Water Monitoring

Thomas E. Reed, WRD Project Chief (FTS 585-5263)

1. Location: Fort Union and Powder River Basin coal regions of eastern Montana.
2. Objectives: To provide ground-water data base from which an assessment can be made of the resource, future responses to stresses can be predicted, and pollution and supply problems can be detected and defined. This activity provides for long-term collection of ground-water data from selected observation wells. Specifically, wells monitored in CMP study sites are incorporated in this program to extend periods of data collection. In addition, selected holes drilled by industry or other agencies are cased and tested.
3. Procedures
 - a. Make water-level measurements and continue operation of water-level recorders.
 - b. Compile and analyze data.
 - c. Collect ground water samples from selected wells.
 - d. Analyze water samples.
4. Report Products: Data collected under this program will be incorporated in CMP Site Study reports and in regional evaluations. The data will be stored in automated data files for rapid retrieval.
5. Relationship to Other USGS Studies: Data collected under this activity will be used to help define premining conditions of reclamation study sites, help calibrate ground water models to predict the effects of mining, and help transfer data to surrounding areas from intensively studied reclamation sites.

6. Distribution of Funds:

Salaries for Data Collection	\$ 9,200
Laboratory Services	600
Travel	5,000
Data Processing	3,200
Total	<u>\$18,000</u>

II. Hydrologic Site Studies

Neal E. McClymonds and Michael R. Cannon, WRD Project Chiefs
(FTS 585-5263)

- A. Locations: Areas of study will include the Redwater River coal field in the Fort Union coal region and the Moorhead coal field in the Powder River Basin coal region. Reports describing studies conducted in Horse Creek, Little Bear Creek, and Glendive areas will be completed and submitted for review.
- B. Objectives: To collect and evaluate hydrologic data at potential coal-lease area sites for activity planning in the Powder River and Fort Union coal regions. The studies are designed to compile available hydrologic information, design and implement site-specific data collection programs, coordinate data collection activities with other agencies and private companies, and evaluate the potential hydrologic impacts of mining and reclamation.

Procedures: Available hydrologic data will be compiled and evaluated. Data collection networks will be designed and implemented to acquire information.

Report Products: A report summarizing the hydrologic data and presenting the interpretations of hydrologic conditions in each site will be prepared. In most cases, a USGS Water Resources Investigation report would be the intended publication media, but BLM-CMP reports may be used as the publication release.

Distribution of Funds:

Salaries	
Data Collection	\$ 44,000
Data Analysis	46,000
Travel	12,000
Laboratory	6,000
Test Drilling	5,000
Total	<u>113,000</u>

III. Salinity Modeling of Redwater River

Roger F. Ferreira, WRD Project Chief (FTS 585-5263)

- A. Location: Redwater River
- B. Objectives: To construct and calibrate a digital model of Redwater River which will simulate the salinity of the river through and downstream from proposed mines. The model would be useful in simulating salinity in the river under various conditions of flow and development. This model would provide a tool for evaluating cumulative, off-site effects of various mine operations.
- C. Procedures: A salinity model has been developed for use on the Tongue River. Data collection will be designed and implemented to obtain the necessary input information to apply the model to the Redwater River. Ground water quality conditions, tributary quantity and quality, evapotranspiration, irrigation diversion, and return flow will be used to calibrate the model and simulate flow and quality in the river. When the model has been calibrated, various development scenarios will be simulated.
- D. Report Products: A final report, summarizing the investigation findings, will be prepared for release in the USGS Water Resources Investigations series, will outline the modeling techniques used, and will present the simulation runs performed.
- E. Relationship to Other USGS Studies: This program will bring together the results of several previous and ongoing studies, including runoff monitoring, surface-water quality monitoring, ground-water surface-water interrelation studies, and runoff modeling activities.
- F. Distribution of Funds:

<u>Salaries</u>	
Data Collection	\$ 2,500
Data Analysis	12,000
Travel	500
Computer	3,000
	<u>3,000</u>
Total	\$18,000

IV. Streamflow Characteristics

Robert J. Omang, WRD Project Chief (FTS 585-5263)

- A. Location: Fort Union and Powder River Basin coal regions.

- B. Objectives: To calculate and summarize various streamflow characteristics including monthly and annual mean discharges, flood frequency, low-flow frequency, high-flow frequency, and flow duration for stream gaging stations in the Yellowstone River.
- C. Procedures: Records from stream gaging stations in the Yellowstone River basin will be compiled and summarized in various statistical ways to describe streamflow characteristics of use to land managers, hydrologists, and other. Information will be developed to describe monthly and annual mean discharges, magnitude and probability of annual low flow, magnitude and probability of instantaneous peak flows, magnitude and probability of annual high flow, duration of daily mean flow, and summaries of extremes in flow and other basin characteristics. Techniques and computer programs used to develop the statistical summaries are standard methods used by the U.S. Geological Survey.
- D. Report Products: A report titled "Streamflow Characteristics of the Yellowstone River Basin, Montana, thorough 1981" will be prepared and published in the U.S. Geological Survey Water-Resources Investigations series.
- E. Relationship to Other USGS Studies: Data used in the statistical analysis has been collected through several ongoing federal and state programs including the EMRIA program. The analysis will be used in preparation of EMRIA site study reports and will be useful in estimating streamflow characteristics throughout the Fort Union and Powder River Basin Coal Regions.
- F. Distribution of Funds:

Salaries	\$11,000
Computer Costs	4,000
Total	\$15,000

V. Hydrologic Modeling

Lawrence E. Cary, WRD Project Chief (FTS-585-5263)

- A. Location: Prairie Dog Creek and selected small watersheds in Powder River Basin Coal Region.
- B. Objectives: To develop and test a streamflow model capable of simulating runoff from small watersheds. Specific objective for FY 83 program is to develop regionalized variables to use in applicatin of the model to ungaged basins and to test the ability of the modeling technique to accurately simulate runoff in watersheds having limited site-specific data.

- C. Procedures: The runoff model developed, tested, and calibrated for the Prairie Dog Creek watershed will be used to test the regionalized parameters at selected sites in Montana and perhaps Wyoming. Tentative sites include Deer Creek and Squirrel Creek watersheds near Decker, Montana. Sites in Wyoming may be identified by USGS offices in that state. Using available maps of the watersheds, the basins will be partitioned and input parameters will be estimated using the regionalized methods developed from the Prairie Dog Creek study. The model-generated runoff characteristics will be compared to historic data to determine the accuracy or validity of prediction. Step-by-step procedures for application of the model to ungaged watersheds will be developed and a discussion of error analysis will be included.
- D. Report Products: A U.S. Geological Survey Water-Resources Investigations report will be prepared and submitted for review by September 30, 1983. The report will describe the development of regionalized parameters, provide instructions on application of the model, and discuss the accuracy of predictions.
- E. Relationship to Other USGS Studies: This project is the Montana contribution to a regionwide study of the Leavesley model. The model study is designed to demonstrate the applicability of the Leavesley model to various climatological, geographical, topographical and hydrological settings. In Montana, the Northern Plains environment which includes frozen soil runoff as a unique aspect has been studied.

F. Distribution of Funds:

Salaries	\$63,000
Travel	2,500
Computer	4,000
Laboratory	500
Equipment	1,000
Total	\$71,000

VI. Small Basin Sediment Yields

John Lambing, WRD Project Chief (FTS 585-5263)

- A. Location: Small watersheds throughout Fort Union and Powder River Basin coal regions in Montana.
- B. Objectives: To estimate sediment yields from small watersheds over a wide range of geologic, vegetative, topographic, and land use conditions in order to provide regional values of sediment yields.

- C. Procedures: The USGS, BLM, Industry, and others have collected information on sediment yields throughout the study area. The Montana district of USGS has collected samples of sediment at numerous streamflow sites. In addition, special studies by the Public Lands Hydrology section of the USGS has included estimation of sediment yields at several sites. BLM has collected information on sediment accumulations in stock ponds and reservoirs at approximately 50 sites. Mining companies have monitored sediment yields at several sites near potential coal mines. A compilation of this existing data will provide a data base that will be useful in estimating sediment yields for the study area. All available data will be compiled and evaluated. An estimate of sediment yield will be made. The sediment yields will be used to develop regional yield maps or other tools that could provide estimates of yields from ungaged areas, as correlated with soils and topography.
- D. Report Products: A final report containing a description of the study, compilation of sediment yield estimates, discussion of study conclusions, and presentation of yield map or regionalized techniques to estimate yields will be prepared for release in the U.S.G.S. Water-Resources Investigations series. A draft copy will be available for review in October, 1983.
- E. Distribution of Funds:

Salaries	\$ 9,000
Computer Costs	3,000
Report Preparation	5,000
Total	<u>\$17,000</u>

VII. Impacts of Mining on Water Quality

Wayne A. Van Voast, Project Chief, MBMG (406-259-9834)
 Robert E. Davis, Project Cordinator, WRD (FTS 585-5263)

- A. Location: Fort Union coal region in Montana and Powder River Basin coal region in Montana and Wyoming.
- B. Objectives: 1) To create a regional data file of overburden analyses from existing data from numerous federal and state agencies and industry, 2) to characterize the overburden chemistry for various areas to allow computation of salt loads from mine spoils, and 3) to apply the overburden chemistry information in areas of interest to BLM to estimate post-mining ground water quality.
- C. Procedures: Overburden chemistry, specifically paste-extract analyses, will be compiled from existing records on file with state and federal agencies and from private industry where possible. This information will be added to the existing

saturated-paste extract computer file maintained by the Montana Bureau of Mines and Geology (MBMG). With the expanded data base, MBBMG can develop regional characteristics information that would allow extension of the overburden chemistry information to areas with little or no data. Using techniques developed in earlier programs, the regional chemistry data can be used to estimate soluble salt loads from mine spoils. The salt loading can then be applied to existing ground water quality data at selected sites of interest to predict post-mining ground water quality.

D. Report Products: Results of the work will provide planners with estimations of the degree of hydrologic consequences of proposed actions. The results would be made available for inclusion in EIS reports, EA reports, mine plan reviews, or other products. A compilation of the data will be maintained in computer files and available for use upon request.

E. Distribution of Funds:

Contract to MBBMG	\$81,000
Contract award and monitoring, USGS	13,000
	<u>\$94,000</u>

New Mexico

NEW MEXICO

SUMMARY OF FUNDS
WATER RESOURCES DIVISION

San Juan Coal Region

CMP Funding

<u>Project</u>	<u>Total</u>
Watershed Characterization	\$32,000
Hydrologic Surveillance	27,000
Hydrologic Modeling-Kimbeto	<u>95,000</u>
Total	\$154,000

Total for the State of New Mexico: \$154,000

USGS WATER RESOURCES DIVISION
WORK PLAN OUTLINE
NEW MEXICO - FEDERAL COAL MANAGEMENT PROGRAM
WORK PLAN PROPOSAL FOR FY 1983

Charles W. Luscher, BLM State Director (FTS 476-6217)
Herb Garn, BLM Technical Investigations Coordinator (FTS 476-6227)
James F. Daniel, WRD District Chief (FTS 474-2246)

I. Watershed Characterization

Bob Hejl, WRD Project Chief (FTS 474-6506)

- A. Location: Coal-lease areas in San Juan, Sandoval, and McKinley Counties located in northwestern New Mexico.
- B. Introduction: The BLM needs methods to estimate quantity and quality of runoff from small ungaged drainage areas to evaluate water resources in planning studies.
- C. Objectives: To provide BLM with a method to estimate quantity of runoff from small ungaged drainage areas in northwestern New Mexico.
- D. Approach: The data to develop relationships to estimate streamflow and water-quality characteristics from watershed parameters in the coal-lease areas is continually being compiled and analyzed. The data being collected for gaged small watersheds, most of which have short periods of streamflow and water-quality records, include channel-geometry measurements, streambed material particle-size distribution, channel slope, infiltration rate of watershed and vegetative cover. Other data being compiled for each of the watersheds include drainage area, mean annual precipitation, watershed slope, and basin shape. Regression techniques are used to develop methods for predicting streamflow and water-quality characteristics from channel geometry and watershed characteristics.
- E. Report Products and Due Dates: A report defining parameters for estimating selected streamflow characteristics will be completed in December 1982, which will be based on additional data and will include more parameters than the 1981 report. Report on the surface water/water quality characteristics of strippable coal areas in northwestern New Mexico will be completed by October, 1983.
- F. Relationship to Other Studies: This study was closely coordinated with a regional watershed characterization study of strippable coal areas in the central and western United States. This study differs from the regional study in that it is specific to the coal-lease areas in northwestern New Mexico. The objectives of the regional study are: (1) to

test the transferability of existing streamflow-basin characteristic relationships to coal-lease areas; (2) to develop new relationships for streamflow characteristics to measurable dimensions of channel geometry and basin characteristics for ephemeral streams; and (3) to develop similar relationships for estimating sediment transport characteristics and other water-quality transport characteristics for perennial and ephemeral streams.

- G. Progress: Report published --
Hejl, H. R., Jr., Preliminary appraisal of ephemeral streamflow characteristics as related to drainage area, active channel width and soils in northwestern New Mexico:
U.S. Geological Survey Open-File Report 81-64, 23 p.

H. Distribution of Funds:

Salaries	\$30,000
Computer	2,000
Total	<u>\$32,000</u>

II. Hydrologic Surveillance of Coal-Lease Areas

Bob Hejl, WRD Project Chief (FTS 474-6506)

- A. Location: Coal-lease areas of San Juan and McKinley Counties located in northwestern New Mexico.
- B. Introduction: Prior to 1975, virtually no water resources information was available in the coal-lease areas in northwestern New Mexico. The technical investigation (formerly EMRIA) program began in New Mexico in FY 1975 to assure adequate baseline water resources data would be available for choosing reclamation goals and establishing lease stipulations for surface mining for coal.
- C. Objectives: To (1) document hydrologic characteristics of streamflow and ground water in coal-lease areas and their variabilities in quantity and quality and (2) predict the effects of coal extraction and associated development on the water resources in northwestern New Mexico. This information will aid BLM in their operations pertaining to coal-lease stipulations and land management practices of multiple purpose uses of the public domain.
- D. Approach: Basic data collection sites were established to collect adequate water resources data under natural or present conditions to establish a baseline as to quantity and quality from which to predict the effects of surface extraction of coal and related activities. Some of the areas at or near the gaged sites will be mined in the future which will enable us to compare the measured effects of surface mining for coal on the water resources to the predicted effects.

The hydrologic data collection network consisted of four continuous record streamflow/water quality stations, seven partial-record water quality of streamflow stations, and 22 observation wells completed either in the Pictured Cliffs sandstone underlying the coal seams, in the coal seams of the Fruitland Formation, or in the overburden. There will be no data collected during FY 1983.

- E. Report Products and Due Dates: All data collected in the Federal Coal Management Program are published by the USGS in the annual basic data report, "Water Resources Data for New Mexico." Water resources information that has been collected in the Federal Coal Management Program and other programs in the strippable coal areas is being analyzed to aid BLM in management decisions of coal-lease areas of the public domain in the interim, prior to the release of comprehensive formal reports such as water-supply papers. Preliminary information on transfer techniques and interpretations of flow systems will be the subject of these studies. The subjects of these studies will be determined through close collaboration with BLM personnel.
1. Characteristics and chemical quality of shallow water-bearing units in the strippable coal areas in north-western New Mexico, November 1982.
 2. Surface-water/water-quality characteristics in strippable coal areas in northwestern New Mexico, October, 1983.
- F. Relationship to Other Studies: The hydrologic surveillance effort was coordinated with 15 streamflow gaging sites, 25 surface-water quality sites, 15 observation-well sites (water level and water quality), supported with USGS Federal coal hydrology funding, and three streamflow and water-quality sites funded by the National Park Service. Most of the sites were established October 1977. Interpretation of hydrology and techniques to transfer data to ungaged drainage basin in coal-lease areas of northwestern New Mexico for BLM-CMP reports will make use of all data available from all projects in the project area.
- G. Progress: Reports published--
- U.S. Department of the Interior, 1976, Resource and potential reclamation evaluation, Bisti West study site -- Bisti coal field: Bureau of Land Management EMRIA Report 5-1976, p. 69-80, F1-F16.
- _____, 1981, Resource and potential reclamation evaluation, Kimbeto study area: Bureau of Land Management EMRIA Report 17-1977, p. J1-J7, L13-L18, Q1-Q19.
- _____, 1981, Resource and potential reclamation evaluation, Ojo Encino study area: Bureau of Land Management Technical Investigations Report 19-78, p. C17-C20, J1-J9, Q1-Q-12.

H. Distribution of Funds:

Salaries (complete report in preparation)	\$25,000
Computer cost	\$ 2,000
Total	\$27,000

III. Hydrologic Modeling-Kimbeto Reclamation Study Site

Bob Hejl, WRD Project Chief (FTS 474-6506)

- A. Location: The modeling control basin with drainage area of 8.2 mi² is located within BLM's Kimbeto Reclamation Study Area in northwestern New Mexico.
- B. Introduction: Initially (1975) the Federal Coal Management Program was directed to obtaining baseline water-resources information. In 1977, Congress passed the Surface Mining Control and Reclamation Act (Public Law 95-87). This act specifically addressed hydrologic impacts of surface mining, i.e., the mine plan would have to show how the hydrologic balance of the mine area would be restored to premine conditions before a plan could be approved. The Federal land manager must be certain reclamation criteria goals can be met. A drainage basin was instrumented in 1978 to collect data for the development of a predictive precipitation-runoff model.
- C. Objectives: The objectives are to develop, calibrate, and verify precipitation-runoff models for predicting surface runoff characteristics and sediment yield under various land-use conditions in the coal-lease areas in northwestern New Mexico. The emphasis will be on relating parameters used by the model to measurable physical features of a selected watershed basin to facilitate transferability of the model from an instrumented basin to uninstrumented basins.
- D. Approach: A watershed (Ah-shi-sle-pah Wash) with a drainage area of 8.2 square miles in the strippable coal-lease area in the San Juan Basin was instrumented to collect data for the development, testing, calibration, and verification of precipitation-runoff models. The instrumentation included a streamflow gaging station, an automatic pump sampler, single-stage samplers, meteorological station, and five recording rain gages located for equal area distribution over the basin (T. 22 N., R. 10 W.) and two rain gages outside the basin to define regional rainfall intensities and frequencies. Water-quality data from reclaimed spoil piles at three sites at the San Juan mine (T. 30 N., R. 15 W.) and three sites at the Navajo mine (T. 29 N., R. 15 W.) was collected during FY 1983.

Data analyses for model development will be continued to define basin soil properties, soil-water storage characteristics, soil detachability, vegetation characteristics, and topography. Data will be tested in the basic model developed by the Regional Precipitation-Runoff Modeling Project.

E. Report Products: A report will be prepared in 1983 to document the calibration and optimization of basin characteristics at the Ah-shi-sle-pah Wash modeling basin.

F. Relationship to Other Studies: This program is closely coordinated with the Regional Precipitation-Runoff Modeling Group in Lakewood, Colorado. The modeling group in Lakewood has developed a basic model to be used in coal-lease areas.

G. Distribution of Funds:

Salaries	\$82,000
Travel	2,500
Modeling (computer cost)	10,500
Total	\$95,000

North Dakota

NORTH DAKOTA

SUMMARY OF FUNDS
WATER RESOURCES DIVISION

<u>Site-Specific Hydrologic Investigations</u>	<u>CMP FUNDS</u>
Western Williams County Coal Area Hydrology	\$45,000
New England-Mott Coal Area Hydrology	45,000
South Dickinson Coal Area Hydrology	<u>45,000</u>
Total	\$135,000

Total for the State of North Dakota: \$135,000

NORTH DAKOTA

Michael J. Penfold, BLM Montana State Director (FTS 585-6462)
Mike Whittington, BLM Technical Investigations Coordinator
(FTS 585-6474)
Grady L. Moore, WRD District Chief (FTS 783-4601)

I. Site Specific Hydrologic Investigations

A. Western Williams County Coal Area Hydrology

Clarence A. Armstrong, Project Chief (FTS 783-4607)

1. Objectives: The study area consists of about 700 square miles in western Williams County. However, the focus of the study will be concentrated in two areas of about 175 square miles each as outlined by BLM (Bureau of Land Management). The southern area is comprised of two major drainage basins--Painted Woods Creek basin and Sand Creek basin, both tributary to the Missouri River. The northern area is made up of several small basins drained by Pats Coulee, Scorio Creek, and Black tail Creek on the east and Cottonwood and Willow Creeks on the west. The area is largely cultivated, with small grains being the principal crops, though there is grazing land. The majority of farmsteads in the area (virtually all rely on ground water for their water supply) draw water from wells 200 feet or less in depth. Depending on the hydraulic properties and the areal continuity of the lignite and adjacent aquifer, many of these water supplies could be diminished or obliterated by mining.

Primary use of the streams in the area at this time is for livestock. Any coal-development-induced diminution of streamflow, increase in dissolved chemical constituents, or increase in sediment load could have an effect on the usability of the water.

Currently, there are no coal mines active in the study area. Therefore, mining impacts will not be observable directly during the proposed life of this study. All hydrologic observations will be of the premining or natural condition. Coal-development-related stresses on the system will have to be extrapolated. The primary objective, accordingly, will be to define the hydrologic regime in the greatest possible detail consistent with the project duration and funding. This will include assessment of the ground water flow system and chemical characteristics, and determination of surface-water flow magnitudes, chemical quality, sediment concentration, and sediment load.

By defining the hydrologic regime of the study area, a second objective will be satisfied--the establishment of a historical base with which to monitor changes in the system as mining proceeds. A third objective will be to ascertain the use of water so as to determine probable disruptions of water supplies by mining.

2. Approach: Existing geologic and hydrologic data and reports involving the study area will be assembled to serve as an information framework on which to build. Additional data required to meet the objectives of the study will be outlined and collected as completely as possible at this initial stage. Initial planning will establish priorities for the various project activities, but amendments and refinement may be made as the study advances.

To gain information on the water usage in the area, local residents will be interviewed. Well depths, water levels, pumpage rates, and general water-quality information at each site may give an indication of current and potential water supply problems. Flow measurements will be made periodically at selected points on the streams to determine streamflow characteristics. Wells in the area will be sampled for water quality analysis. Spatially, temporally, and stratigraphically distributed ground water samples will be analyzed for standard constituents. The streams will be sampled for water quality analysis, and if feasible, sediment. These data will provide a sampling of premining conditions. The water quality data, for both surface and ground waters, will establish the utility of the water for various uses and should give some indication of the geochemical influences operational within the undisturbed flow system. The water quality data could also aid in understanding surface water/ground water relationships within the study area.

3. Relationship to Other Closely Associated Non-BLM Funded Activities: There are no other known activities in the area that could be related to this investigation.

4. Distribution of Funds:

Salaries	\$ 27,000
Travel	10,000
Laboratory costs	4,000
Contractual services	1,500
Equipment and supplies	2,000
Data processing	500
Total	\$ 45,000

5. Reports: Report preparation will start upon approval of the project and will be developed and expanded

throughout the duration of the project. The topic outline will be prepared on approval, and annotation added as the project progresses. The report will be scheduled for review by July 1983. The final report is tentatively planned for the Water-Resources Investigation series. Basic records will be available to BLM and other interested parties as they are collected.

B. New England-Mott Coal Area Hydrology

Mack G. Croft, Project Chief (FTS 783-4607)

1. Objectives: The study area consists of about 600 square miles in northern Adams and western Hettinger counties. The northwest part of the area is drained by tributaries of the North Fork Cannonball River. The southeast part of the area is drained by tributaries of Cedar Creek and North Fork Cannonball River. These streams drain into the Missouri River. The study area does not include land administered by the Forest Service except as necessary.

Specific hydrologic ramifications of coal development in the study area may be hypothesized. Probably the most obvious effect will be the disruption of aquifers existing in the lignite beds and overburden material. The majority of farmsteads in the area (virtually all rely on ground water for their water supply) draw water from wells 400 feet or less in depth. Depending on the hydraulic properties and the areal continuity of the lignite and adjacent aquifer, any of these water supplies could be diminished or obliterated by mining.

Primary use of the streams at this time is stock watering. Any coal-development-induced diminution of streamflow, increase in dissolved chemical constituents, or increase in sediment load could have an effect on the usability of water in Cedar Creek and the North Fork Cannonball River.

Currently, there are no coal mines active in the study area. Therefore, mining impacts will not be observable directly during the proposed life of this study. All hydrologic observations will be of the premining or natural condition. Coal-development-related stresses on the system will have to be extrapolated. The primary objective, accordingly, will be to define the hydrologic regime in the greatest possible detail consistent with the project duration and funding. This will include assessment of the ground water flow system and chemical characteristics, and determination of surface-water flow magnitudes, chemical quality, sediment concentration, and sediment load.

By defining the hydrologic regime of the study area, a second objective will be satisfied--the establishment of a historical base with which to monitor changes in the system as mining proceeds. A third objective will be to ascertain the use of water so as to determine probable disruptions of water supplies by mining.

2. Approach: Existing geologic and hydrologic data and reports involving the study area will be assembled to serve as an information framework on which to build. Additional data required to meet the objectives of the study will be outlined and collected as completely as possible at this initial stage. Initial planning will establish priorities for the various project activities, but amendments and refinement may be made as the study advances.

To gain information on the water usage in the area, local residents will be interviewed. Well depths, water levels, pumpage rates, and general water-quality information at each site may give an indication of current and potential water supply problems. Flow measurements will be made periodically at selected points on the streams to determine streamflow characteristics. Wells in the area will be sampled for water quality analysis. Spatially, temporally, and stratigraphically distributed ground water samples will be analyzed for standard constituents. The streams will be sampled for water quality analysis, and if feasible, sediment. These data will provide a sampling of premining conditions. The water quality data, for both surface and ground waters, will establish the utility of the water for various uses and should give some indication of the geochemical influences operational within the undisturbed flow system. The water quality data could also aid in understanding surface water/ground water relationships within the study area.

3. Relationship to Other Closely Associated Non-BLM Funded Activities: Data on streamflow, quality of water, and ground water levels are being collected in the study vicinity. These data are being collected through programs with the North Dakota State Water Commission, corps of Engineers, and USGS funds. There will be a mutually beneficial exchange of data between the programs.

4. Distribution of Funds:

Salaries	\$ 26,500
Travel	11,500
Laboratory costs	3,000
Contractual services	2,000
Equipment and supplies	1,500
Data processing	500
Total	<u>\$ 45,000</u>

5. Reports: Report preparation will start upon approval of the project and will be developed and expanded throughout the duration of the project. The topic outline will be prepared on approval, and annotation added as the project progresses. The report will be scheduled for review by October 1, 1983. The final report is tentatively planned for the Water-Resources Investigation series. Basic records will be available to BLM and other interested parties as they are collected.

C. South Dickinson Coal Area Hydrology

Clarence A. Armstrong, Project Chief (FTS 783-4607)

1. Objectives: The study area consists of about 500 square miles south of Interstate 94 and southwest of Dickinson in western Stark, eastern Billings, northwest Hettinger, and northeast Slope Counties. The area is primarily composed of 6 drainage basins. The basins are Norwegian Creek, South Branch Heart River, Bull Creek, Philbrick Creek, Antelope Creek, and North Fork Cannonball River. The study area does not include land administered by the Forest Service except as necessary.

The area is largely cultivated, with small grains being the principal crops, though there is grazing land. The majority of farmsteads in the area (virtually all rely on ground water for their water supply) draw water from wells 200 feet or less in depth. Depending on the hydraulic properties and the areal continuity of the lignite and adjacent aquifer, many of these water supplies could be diminished or obliterated by mining.

Primary use of the streams in the area at this time is for livestock. Any coal-development-induced diminution of streamflow, increase in dissolved chemical constituents, or increase in sediment load could have an effect on the usability of the water.

Currently, there are no coal mines active in the study area. Therefore, mining impacts will not be observable directly during the proposed life of this study. All hydrologic observations will be of the premining or natural condition. Coal-development-related stresses on the system will have to be extrapolated. The primary objective, accordingly, will be to define the hydrologic regime in the greatest possible detail consistent with the project duration and funding. This will include assessment of the ground water flow system and chemical characteristics, and determination of surface-water flow magnitudes, chemical quality, sediment concentration, and sediment load.

By defining the hydrologic regime of the study area, a second objective will be satisfied--the establishment of a historical base with which to monitor changes in the system as mining proceeds. A third objective will be to ascertain the use of water so as to determine probable disruptions of water supplies by mining.

2. Approach: Existing geologic and hydrologic data and reports involving the study area will be assembled to serve as an information framework on which to build. Additional data required to meet the objectives of the study will be outlined and collected as completely as possible at this initial stage. Initial planning will establish priorities for the various project activities, but amendments and refinement may be made as the study advances.

To gain information on the water usage in the area, local residents will be interviewed. Well depths, water levels, pumpage rates, and general water-quality information at each site may give an indication of current and potential water supply problems. Flow measurements will be made periodically at selected points on the streams to determine streamflow characteristics. Wells in the area will be sampled for water quality analysis. Spatially, temporally, and stratigraphically distributed ground water samples will be analyzed for standard constituents. The streams will be sampled for water quality analysis, and if feasible, sediment. These data will provide a sampling of premining conditions. The water quality data, for both surface and ground waters, will establish the utility of the water for various uses and should give some indication of the geochemical influences operational within the undisturbed flow system. The water quality data could also aid in understanding surface water/ground water relationships within the study area.

3. Relationship to Other Closely Associated Non-BLM Funded Activities: Data on streamflow, quality of water, and ground water levels are being collected in the study vicinity. These data are being collected through programs with the North Dakota State Water Commission, corps of Engineers, and USGS funds. There will be a mutually beneficial exchange of data between the programs.

4. Distribution of Funds:

Salaries	\$ 27,000
Travel	10,000
Laboratory costs	4,000
Contractual services	1,500
Equipment and supplies	2,000
Data processing	500
Total	<u>\$ 45,000</u>

5. Reports: Report preparation will start upon approval of the project and will be developed and expanded throughout the duration of the project. The topic outline will be prepared on approval, and annotation added as the project progresses. The report will be scheduled for review by July, 1983. The final report is tentatively planned for the Water-Resources Investigation series. Basic records will be available to BLM and other interested parties as they are collected.

Additional data required to meet the objectives of the study will be collected during the initial planning phase. It is anticipated that the study will be completed by July, 1983. The final report is tentatively planned for the Water-Resources Investigation series. Basic records will be available to BLM and other interested parties as they are collected.

Travel	1,000
Laboratory costs	1,000
Contractual services	1,000
Equipment and supplies	1,000
Data processing	1,000
Total	5,000

Oklahoma

OKLAHOMA

SUMMARY OF FUNDS
WATER RESOURCES DIVISION

Western Interior Coal Region

Distribution of CMP Funds

<u>Project</u>	<u>Total</u>
Hydrologic Modeling	
Coal Creek near Lehigh	\$ 40,750
Watershed Characteristics	<u>36,250</u>
Total	\$ 77,000

Total for the State of Oklahoma: \$ 77,000

OKLAHOMA

Charles Luscher, BLM State Director (FTS 476-6217)

Herb Garn, BLM Technical Investigations Coordinator (FTS 476-6227)

James H. Irwin, WRD District Chief (FTS 736-4256)

I. Introduction

- A. Purpose and Scope: BLM is responsible for assessing the probable water resources impacts and reclamation capabilities of any area under Federal jurisdiction in which surface coal mining might occur. To meet this responsibility, a variety of hydrologic data is required. In Oklahoma, these data are being provided by: (1) hydrologic monitoring in selected areas, and (2) hydrologic modeling of Coal Creek Basin near Lehigh. In addition, hydrologic data are also being generated by the Survey's monitoring program at 12 sites in the coal field and sediment data collection at these 12 sites under the auspices of the BLM.

II. Hydrologic Investigations

Robert L. Tortorelli, WRD Project Chief (FTS 736-4256)

- A. Location: Areas near Blocker, Rock Island, Red Oak, and Stigler have been identified as having high potential for mining of Federal coal. Hydrologic data collection in the Blocker and Rock Island areas began in 1976 and in the Red Oak and Stigler areas in 1978.
- B. Progress: Collection of hydrologic data, including sediment, at all BLM sites was discontinued in January 1982. Hydrologic data, including streamflow, chemical quality of surface water, and sediment have been or will be published in the annual data report.
- C. Report Products: Hydrologic reports will summarize and evaluate data available as of October 1980 for the following areas:
1. Blocker area - report published as WRI 81-1187.
 2. Stigler area - report is complete, reviewed by BLM and now in Reston for approval.
 3. Rock Island and Red Oak areas - completion of report draft is planned by October 1982.
- D. Distribution of Funds: All work on this activity is to be completed in the 1982 fiscal year.

III. Hydrologic Modeling

Steven P. Blumer, WRD Project Chief (FTS 736-4256)

- A. Location: The hydrologic modeling study is located in the Coal Creek basin near Lehigh, Oklahoma.
- B. Work Planned for FY 83:
1. Complete reduction and evaluation of the available hydrologic data.
 2. Complete calibration and verification of hydrologic model.
 3. Test transferability of model to other hydrologically similar basins.
 4. Test application of model to hypothetical situation.
- C. Distribution of Funds:
- | | |
|------------------------|-----------------|
| Salaries | \$36,250 |
| Computer costs | 3,000 |
| Supplies and materials | 1,500 |
| Total | <u>\$40,750</u> |
- D. Report Plans: A final report describing the development and use of the model will be prepared.

IV. Watershed Characteristics

Robert L. Tortorelli, WRD Project Chief (FTS 736-4256)

- A. Location: Data collected under the hydrologic investigation program element plus supplementary stream-discharge and water quality data from sites in five basins will be used to aid in transferring hydrologic models.
1. Blue Creek near Blocker - Two supplementary sites
 2. Ti Creek near Blanco - One supplementary site
 3. Red Oak Creek near Red Oak - One supplementary site
 4. Morris Creek at Howe - Two supplementary sites
 5. Holi-Tuska Creek near Panama - No additional sites.
- B. Work Planned for FY 83:
1. Complete reduction and evaluation of available hydrologic data for basins of Blue Creek near Blocker, Red Oak Creek near Red Oak, and Holi-Tuska Creek near Panama.
 2. Complete calibration and verification of USGS rainfall-runoff model and SCS TR 20 model.
 3. Test model results in comparison with model of Coal Creek near Lehigh.

C. Distribution of Funds:

Salaries	\$32,250
Computer costs	2,500
Supplies and materials	1,500
Total	<u>\$36,250</u>

D. Report Plans: Begin draft of final report evaluating results of models and their application to other basins in the Federal coal area.

Utah

UTAH

SUMMARY OF FUNDS
WATER RESOURCES DIVISION

Unita-Southwestern Utah Coal Region

Distribution of CMP Funds

<u>Project</u>	<u>Total</u>
Cooperative State Programs (UT-1, 3, and 4)	\$ 78,960
Gaging station at the Mouth of the White River, Uinta Basin (UT-1 and 4)	15,300
Hydrology of Kaiparowits Alton, and Kolob Coal Fields (UT-146)	144,000
Ground Water Conditions in the Trail Mountain Coal Resource Area (UT-152)	72,000
Summary and Regionalization of Streamflow Characteristics, Colorado River Basin, Utah	114,000
Sediment and Trace-metal Transport to Scofield Reservoir by Streams in the Pleasant Valley Coal Resource Area, Central Utah	117,000
Hydrology of Eleven Tar Sands Areas, Colorado River Basin, Utah	216,000
Total	<u>\$757,260</u>

Total for State of Utah: \$ 757,260

UTAH

Roland Robison, BLM State Director (FTS 588-5311)
Boyd Christensen, BLM Technical Investigations Coordinator
(FTS 588-4033)
Ted Arnow, WRD District Chief (FTS 588-5663)

I. Cooperative State Programs (UT-1, 3, and 4)

Russell W. Cruff, Project Chief (FTS 588-5663)

- A. Objective: To determine the sediment, salinity, and discharge of selected streams in the San Rafael River, Muddy River, and Sevier River and Pariette Wash drainages in Emery, Wayne, Sevier, and Uintah Counties.
- B. Approach: Operate and maintain sediment, water quality, and gaging stations during FY 83.
- C. Distribution of Funds

(Totals for UT-1, 3, and 4 = \$78,960)

UT-1 Collection of streamflow records.

Floy Wash	\$ 4,280
Indian Creek	4,280
Pariette Draw below Pleasant Valley Wash, near Myton	4,280
Pariette Draw at mouth, near Ouray	4,280
Cottonwood Creek near Orangeville	4,280
Bull Creek	4,280
Total	<u>\$25,680</u>

UT-3 and 4 Collection of chemical quality, and sediment records.

Floy Wash	\$ 3,880
Indian Creek	3,880
Pariette Draw below Pleasant Valley Wash, near Myton	3,880
Pariette Draw, 5 miles above mouth	3,880
Cottonwood Creek near Orangeville	3,880
Bull Creek	3,880
Total	<u>\$23,280</u>

Construction Costs

Floy Wash	\$ 7,500
Indian Creek	7,500
Cottonwood Creek	7,500
Bull Creek	7,500
Total	<u>\$30,000</u>

- D. Report Products: Information will be included in annual basic data report. BLM may request data directly if needed.

II. Gaging Station at the Mouth of the White River, Uinta Basin (UT-1 and 4)

Russell W. Cruff, WRD Project Chief (FTS 588-5663)

- A. Location: Southeastern Uinta Basin; drainage area is about 2,400 sq mi.
- B. Objectives: To collect streamflow and sediment data in FY 1983 and to continue depending on annual funding.
- C. Approach:
1. Operate streamflow gaging station at one site:

09306900 White River at mouth, near Ouray, Utah, in SE1/4 SE1/4NW1/4 sec. 2, T. 9 S., R. 20 E., Uintah County, latitude 40°03'54", longitude 109°38'06".
 2. Collect daily sediment samples at gaging site shown under item 1 and calculate daily suspended-sediment loads.

D. Distribution of Funds

Salaries	\$ 4,070
Travel and transportation	1,620
Supplies and equipment	160
Laboratory support	3,340
Data processing and report	830
Overhead (District and National Headquarters)	5,280
Total	<u>\$15,300</u>

- E. Report Products: Information will be included in annual basic data reports. BLM may request data directly if needed.

III. Hydrology of the Kaiparowits Plateau, Alton, and Kolob Coal Fields (UT-146)

Gerald Plantz, WRD Project Chief (FTS 588-5654)

- A. Location: The Kaiparowits Plateau, Alton, and Kolob coal fields in southern Utah.
- B. Objectives: To define the hydrologic system and, where possible, to identify or predict the effects of coal mining on the water resources.

C. Approach: Work will concentrate on defining the quantity and quality of surface water and extent and characteristics of aquifers above, within, and directly below the coal-bearing rocks. Major work items include a well and spring inventory; an inventory of water use and discharges from mines; water sampling from selected wells and springs for chemical analyses; miscellaneous discharge measurements and water sampling to define seasonal variations in surface-water quality and to define losing and gaining reaches of streams, aquifer tests on existing wells, and preparation of reports.

D. Distribution of Funds:

Reports Preparation and Review	\$ 50,300
Data Processing and Analysis	40,000
Supplies	1,000
Computer Services	3,000
Overhead (District and National Headquarters)	49,700
Total	<u>\$144,000</u>

E. Report Products: A basic data report and a Hydrologic Investigations Atlas will be prepared by September 1983.

IV. Ground-Water Conditions in the Trail Mountain Coal-Resource Area, Central Utah (UT-152)

Gregory C. Lines, WRD Project Chief (FTS 588-5654)

A. Location: Trail Mountain in the Wasatch Plateau coal field, central Utah.

B. Objectives: (1) Determine aquifer characteristics, recharge-discharge relationships, hydraulic connection between aquifers and with streams, and chemical quality of water in water-bearing zones within, above, and immediately below the coal-bearing rocks in the Blackhawk Formation, (2) predict, quantitatively where possible, the effects of underground mining on the ground-water system, including discharge to streams.

C. Approach: Major work items include testing wells with expandable packers to determine head and water-quality differences with depth in the ground-water system; determinations of aquifer characteristics utilizing conventional aquifer tests; an extensive spring inventory to define points and volumes of ground-water discharge, chemical quality of ground water, and typical discharge recessions; baseflow measurements on streams

to define losing and gaining reaches; and laboratory determinations of porosity and hydraulic conductivity of cores to define intrinsic characteristics of both aquifers and confining beds. A digital-computer model of the ground-water system will be constructed and calibrated. The unverified model will be used to make semiquantitative predictions of effects of mine dewatering on the ground-water system, including discharge along streams.

D. Distribution of Funds:

Salaries	41,700
Per diem	1,000
Vehicles	1,500
Chemical analyses	1,000
Computer	2,000
Overhead (District and National Headquarters)	24,800
Total	\$ 72,000

E. Report Products: The interpretive report will be prepared by September 30, 1983 and will be released to the open file pending publication as a Water-Supply Paper.

V. Summary and Regionalization of Streamflow Characteristics, Colorado River Basin, Utah

Rulon C. Christensen, WRD Project Chief (FTS 588-5654)

A. Location: Colorado River Basin, Utah

B. Objectives: (1) Compute and summarize streamflow characteristics for gaging stations in the Colorado River Basin, Utah. Using standard techniques, compute frequency curves for peak flow, 1-, 3-, 7-, and 15-day flood flow, and 1-, 7-, 14-, 30-, 60-, and 90-day low flow, and (2) provide methods for transferring streamflow characteristics from gaged to ungaged sites.

C. Approach: Using Geological Survey computer programs, data in the WATSTORE files will be processed and statistics tabulated for all stations in the Colorado River Basin, Utah. The statistics will include listings of high-and low-flow summaries, flow duration, and flow variability of monthly and annual values for active and discontinued stations with 1 or more years of daily record; and annual peaks for all stations, including crest-stage partial records. Frequency curves will be computed for stations with 10 or more years of record, and the high- and low-flow values will be tabulated depending on record length for recurrence intervals of 2, 5, 10, 25, 50 and 100 years. The information will be published in an interim report with a short manuscript for each station, followed by the statistics. A brief text will define terms and give examples of how to use the data.

The second phase will be the regionalization of selected flow characteristics. Equations will be developed by relating flow to basin characteristics using multiple regression techniques. Accuracy of these relations for transferring flow characteristics from gaged to ungaged sites will be compared to equivalent years of record at gaging stations. Derived relations will be matched and adjusted to available results from adjacent states. A final report will outline procedures for using the relations to determine flow characteristics at ungaged sites.

D. Distribution of Funds:

Salaries	\$ 69,100
Computer	3,500
Typing and drafting	2,100
Overhead (District and National Headquarters)	39,300
Total	<u>\$114,000</u>

E. Report Products: The streamflow and basin characteristics will be summarized in an interim report to be completed by September 1983. The final interpretative report will be prepared by September 1984. Both are planned as open file reports in the Water-Resources Investigations Series.

VI. Sediment and Trace-metal Transport to Scofield Reservoir by Streams in the Pleasant Valley Coal-Resource Area, Central Utah

Doyle W. Stephens, WRD Project Chief (FTS 588-5654)

- A. Location: Pleasant Valley and Scofield Reservoir area of Central Utah.
- B. Objectives: Determine sediment and common trace-metal loads in selected streams in the Pleasant Valley coal resource area. Determine trace-metal loads entering Scofield Reservoir and their effects on reservoir geochemistry. Determine if coal mining, coal washing, and associated timber clear-cutting in Eccles Canyon have increased loads compared to a nearby undisturbed watershed.
- C. Approach: Monitor and compute sediment loads at existing gaging stations on Pleasant Valley and Fish Creeks at points of inflow to Scofield Reservoir. Construct and maintain a gaging station on Woods Canyon Creek as a control watershed to be compared with data from Eccles Canyon where extensive timber cutting and coal related activities are underway. Analyze for the types and weights of metal oxides attached to sediment samples in order to compute trace metal loads. Collect a set of reservoir sediment core samples and analyze for trace metal content. Predict effects of present and future sediment and trace metal transport into Scofield Reservoir on reservoir geochemistry.

D. Distribution of Funds:

Salaries	\$ 28,000
Vehicle and transportation	5,000
Installation and maintenance of Woods Canyon gaging station	3,500
Per diem	1,600
Chemical analyses	18,000
Sediment analyses	4,500
Core sample analyses	16,000
Site fees for trailer	200
Overhead (District and National)	40,200
Total	<u>\$117,000</u>

E. Report Products: An interpretive report will be prepared by October 1985.

VII. Hydrology of Eleven Tar Sands Areas, Colorado River Basin, Utah

Kenneth L. Lindskov, WRD Project Chief (FS 588-5654)

- A. Location: The following 11 tar sands areas in the Colorado River Basin of Utah: Asphalt Ridge-Whiterocks, Raven Ridge, Pariette, Hill Creek, P.R. Springs, Sunnyside, Argyle Canyon, San Rafael Swell, Tar Sands Triangle, Circle Cliffs, and White Canyon.
- B. Objectives: Define the existing hydrologic system in the 11 tar sands areas listed in location paragraph, and define the ground water system in the P.R. Springs area in detail. Where possible, predict hydrologic impacts of tar sands production.
- C. Approach: Define the hydrologic system by utilizing available hydrologic information, mainly from oil shale studies and all other previous studies in and near the 11 areas. During the summer of 1983, update existing well and spring inventories and collect additional samples, where needed, to further refine definition of the chemical quality of surface and ground water. Prepare an interim report for submission to BLM by April 1, 1983, that describes the hydrology, primarily using existing data and interpretations available from previous studies. During the summer of 1984, conduct a well-drilling and testing program in the P.R. Springs area in order to define the ground water system, namely the extent and hydraulic connection between aquifers, aquifer characteristics, and head and water quality differences with depth. Prepare a final basic data report and interpretive report which meet the stated objectives by September 1985.

D. Distribution of Funds:

Salaries	\$108,500
Vehicle and transportation	12,000
Supplies	2,000
Computer changes	2,000
Water quality analysis	10,000
Training	2,000
Report Preparation	5,000
Overhead (District and National Headquarters)	\$ 74,500
Total	\$216,000

E. Report Products: An interpretive report will be submitted by April 1, 1983. The final interpretive report will be prepared by September 30, 1985.

Virginia

VIRGINIA

SUMMARY OF FUNDS (FY 83)
WATER RESOURCES DIVISION

Northern Appalachian Coal Region

<u>Project</u>	<u>Funds</u>
Hydrologic Reconnaissance of the Coal Bearing Regions of Jefferson National Forest - Clinch Ranger District	\$54,000

Total for State of Virginia: \$54,000

VIRGINIA

I. Hydrologic Reconnaissance of the Coal Bearing Regions of Jefferson National Forest - Clinch Ranger District

- A. Introduction: Total coal production in Virginia between 1978 and 1980 increased by almost 30 percent to an all-time record of 41,008,884 tons. Assuming this trend continues, the demand for areas to lease for coal mining will increase in like proportion. This demand will probably bring increased pressure on the leasing of federal lands. In June, 1979, under presidential order, the Secretary of the Interior announced a program to make federally-owned lands more readily available for competitive leasing. In the program, the Bureau of Land Management is charged with the responsibility of leasing federal coal resources to meet anticipated regional coal demands, and for insuring that the environmental consequences of the proposed coal production activities are identified and adequately addressed.¹

A hydrologic data base in the Federal coal lands of southwest Virginia is virtually nonexistent. Without this data base an assessment of the potential hydrologic impacts resulting from coal removal cannot be addressed adequately.

- B. Location: Most federal coal in Virginia is located in the Jefferson National Forest, Clinch Ranger District in the extreme southwest part of the State. The areal extent of the Forest proper (study area) is about 132 square miles and includes portions of Scott, Lee, Dickenson, and Wise counties. Numerous parcels of private land are within the confines of the Forest.
- C. Objectives:

1. Complete a hydrologic reconnaissance of those areas in and adjacent to the Clinch Ranger District where there exists a potential for coal mining.
2. Compile a hydrologic data base of available ground and surface water characteristics including quality.
3. Initiate a program to collect data on streamflow and ground water conditions throughout the study area. These data will be used to generate streamflow statistics and to develop a conceptual model of the hydrologic system.

¹ Grason, David, 1981, A presentation and evaluation of the hydrologic information available for the major coal lands in seven eastern states, sources of available information, and a plan for future work.

D. Procedures:

1. Hydrologic reconnaissance

- a. Coupled with BLM and Forest Service input and available geologic maps, delineate areas of potential coal mining.
- b. Complete hydrologic reconnaissance of these areas for general overview of existing hydrologic conditions.

2. Compilation of existing hydrologic data--Visit Federal, State, and private agencies associated with data collection in and adjacent to the Forest. Collect available records of water discharge, water levels, and water quality that may apply to the study area. Retrieve existing data from computer files (USGS-WATSTORE, EPA-STORET).

3. Data collection program

- a. Inventory springs and wells in areas subject to mining. Measure discharge and/or water levels on representative number on a quarterly basis to determine seasonal and annual variability. Collect water samples and analyze for major constituents, temperature, specific conductance, and pH.
- b. Install raingages (2) at selected sites to continuously record precipitation.
- c. If adequate locations are found, install 2-4 gaging stations (on 3-inch pipe) to continuously record stage on selected drainages. Reactivate existing continuous recording gaging station 035249 (Stony Creek near Ka).
- d. Install crest-stage gages on minimum of 10 small (<10 mi²) drainages.
- e. Measure, on a monthly basis, discharge, stage, specific conductance, temperature, and pH at 20 basins with drainage areas ranging from 0.5-15 mi². Included in these are crest-stage and continuous record sites.

E. Report Procedures: An interpretive report describing the hydrology of the study area, a conceptual model of the ground and surface water systems, and the potential impacts of mining on the hydrology will be prepared at the conclusion of the study in 1984.

F. Distribution of Funds:

Salaries	\$ 40,000
Travel	6,000
Equipment and Supplies	5,000
QW Analyses	3,000
	<hr/>
	\$ 54,000

West Virginia

WEST VIRGINIA

SUMMARY OF FUNDS
WATER RESOURCES DIVISION

<u>Project</u>	<u>Funds</u>
Hydrologic Modeling of Small Streams in the Coal Areas of Appalachia	\$104,000
Total for the State of West Virginia:	\$104,000

WEST VIRGINIA

Curt Jones, BLM ESO Director (FTS 235-2833)

Jerry Coalgate, BLM Technical Investigations Coordinator (FTS 235-2868)

David H. Appel, WRD District Chief (FTS 924-1300)

I. Hydrologic Modeling of Small Streams in the Coal Areas of Appalachia

Celso Puente, WRD Project Chief (FTS 924-1300)

- A. Introduction: Maximum development of coal as a source of energy will require the mining of Federal reserves in Appalachia. The development will be accompanied by environmental changes that will impact water resources. As part of the Federal Coal Leasing Program, the Bureau of Land Management is required to incorporate into leasing decisions (1) an assessment of hydrologic impacts that could result from mining, and (2) stipulations on mining and reclamation procedures that will minimize resulting impacts. In anticipation of this mining, a regional assessment of hydrologic conditions (flow regime, water quality, and basin water-balance relationships) and changes caused by coal mining is needed to aid Federal managers in planning and implementing optimum development of Federal reserve in Appalachia.
- B. Location: Study sites are small basins (generally less than 10 mi²) with similar topographic, geologic, and hydrologic settings, and varying land-use characteristics in West Virginia, Kentucky, and other coal areas of Appalachia. Principal basins under study include Gilmer Run, Horse Camp, Collison, Drawdy, and Brier Creeks (in Randolph, Pocahontas, Nicholas, Boone, and Wyoming Counties in West Virginia)
- C. Objectives: The primary objective is to develop predictive methodology useful to BLM for describing the hydrologic system and for assessing the impacts of mining in ungaged areas under Federal mineral ownership in the coal-producing areas of Appalachia. The primary objective requires the accomplishment of the following subordinate objectives:
 1. To develop, calibrate, and verify deterministic rainfall-runoff models for simulating streamflow under various climatic and land-use conditions.
 2. To develop water quality regression models for estimating water quality changes resulting from coal mining and for simulating chemical constituent concentrations and solute loads.

- D. Procedures: Continue model development based on calibration of measurable climatic, hydrologic, and physical features to achieve acceptable synthetic streamflow. It will be useful for estimating soil-moisture storage relationships, infiltration, surface runoff, and ground-water/surface-water relationships.

Model calibration and verification will be based on available data that ranges from 4 to 10 years in duration from five small basins monitored as part of other hydrologic studies in West Virginia. Available data from two small basins in Kentucky will be added to the study in order to expand the modeling effort to other coal areas in Appalachia.

Model calibrations using data from streams draining basins under various phases of mining will permit an evaluation of basin system responses to basin changes imposed by changing land use. An evaluation of results from similar studies in Alabama, Tennessee, and Pennsylvania will be made to assess changes in model parameters required to reproduce the physical processes of the changing hydrologic system. The application of the model to many widely distributed basins will provide an opportunity to demonstrate model parameter regionalization and transferability to other basins in Central Appalachia. The basins selected for modeling will represent the following land-use categories:

1. Active surface-mined areas, active underground-mined areas, and combination of surface- and underground-mined areas.
2. Old, abandoned, and unreclaimed mixed areas.
3. Reclaimed areas.
4. Undisturbed control areas.

An evaluation of water-quality data (major inorganic constituents) in the coal areas of West Virginia will continue for developing regional water quality regression models that could be added to the watershed model as a subroutine module. The regression relationships will be useful for assessing and/or predicting water quality changes in streams affected by coal mining.

- E. Report Products: Study data are stored in USGS computer data files and are available to other agencies and organizations. An interpretive report will be prepared at the conclusion of the study in 1984.

F. Relationship to Other USGS Studies: This project benefits from and supplements other programs in the West Virginia District. A current project (WD-152) consists of monitoring climatic and hydrologic data in mined and unmined basins in the Big Sandy-Tug Fork basins of Virginia, West Virginia, and Kentucky. These sites will provide test cases for demonstrating model applications and transferability to ungedged areas. Other similar studies in Indiana, Pennsylvania, Kentucky, Tennessee, and Alabama will benefit from mutual exchange of information between the programs.

Distribution of Funds:

F.	Salaries	\$89,400
	Travel	5,000
	Data Processing	7,600
	Equipment and Supplies	2,000
	Total	<u>\$104,000</u>

Wyoming

WYOMING
DISTRIBUTION OF FY 83 CMP FUNDS

Water Resources Division

Project	CMP Total
I. Hydrologic Characterization: Surface Water, Water Quality and Sediment	\$ 100,000
II. Potentionetric Maps of Shallow Aquifers	50,000
III. Recharge and Discharge through Alluvium of Ephemeral Stream Channels in Wyoming	70,000
IV. Fluvial System in Energy- Mineral Areas	<u>70,000</u>
Total	\$290,000

Total for State of Wyoming: \$290,000

WYOMING

Maxwell T. Lieurance, BLM State Director (FTS 328-2326)
Cliff Franklin, BLM Technical Investigations Coordinator (FTS 328-2079)
James F. Wilson, Jr., WRD Acting District Chief (FTS 328-2153)

I. Hydrologic Characterization--Streamflow, Water Quality, and Sediment

Ernest S. Denison, WRD Project Chief (FTS 328-2718)

- A. Locations: Powder River and Green River Basins.
- B. Objectives: Determine runoff, chemical quality, and sediment-transport characteristics of streams in or near areas of extensive coal deposits.
- C. Procedures: Reactivate and operate selected hydrologic-data stations that were operated 1976-1981. Specific stations for reactivation are listed below.
- D. Report Products: All data collected have been or will be published in the USGS annual series of data reports. This information has been and will continue to be used in interpretive studies related to coal hydrology.
- E. Distribution of Funds by Area and Station:

1. Green River/Hams Fork Basin

Station Number and Name	SW	QW	Sed.	Total
*	\$	\$	\$	\$

2. Powder River Basin

Station Number and Name	SW	QW	Sed.	Total
*	\$	\$	\$	\$

*Sites to be selected by BLM State Office.

II. Potentiometric Maps of Shallow Aquifers in the Powder River Basin, Wyoming

Pamela B. Daddow, WRD Project Chief (FTS 328-2723)

- A. Location: Northeastern Wyoming.
- B. Objectives: Potentiometric maps, which are fundamental to understanding the ground-water system, are not available for any shallow horizon in most of the basin and are only rudimentary elsewhere. Potentiometric maps will 1) improve the present knowledge of the hydrologic system in the basin; 2) document impacts of surface mines; 3) provide more information about the relative importance of vertical-versus-horizontal and regional-versus-local movement of ground water.

C. Approach: Wells for which the producing horizon can be related to a mappable horizon for construction of potentiometric maps will be inventoried. Emphasis will be on the horizon of the Wyodak Coal, Felix Coal, and Lance-Foxhills. Data will be analyzed pertinent to effects of long-term pumping on overlying or underlying aquifers. Mass water-level measurements will be made during two field seasons, concentrating in areas where there is large stress on the system. A water-level change map for the Wyodak Coal on the east side of Campbell County will be drawn.

D. Report Products: The Lance-Foxhills potentiometric map, essentially completed in FY 82, will be published in FY 83. The final report, which will be prepared in FY 83, will consist of potentiometric maps for the shallow aquifers. It will be published in the Water-Resources Investigation Series.

E. <u>Distribution of Funds</u> :	FY 83
Salaries	\$ 48,000
Travel	2,000
Total	\$ 50,000

III. Recharge and Discharge through Alluvium of Ephemeral Stream Channels in Wyoming

Leslie W. Lenfest, Jr., WRD Project Chief (FTS 328-2723)

A. Location: Wyoming, statewide.

B. Objectives: The Surface Mining Act requires protection of "the essential hydrologic function of alluvial valley floors" by either preservation or reclamation. However, the hydrology of alluvium is poorly understood. The objective of this study is to determine the relationship of water in the alluvium to streamflow and the hydrologic relationship of the alluvial and bedrock aquifers.

C. Procedures: Three concepts of hydrologic functions of the alluvium have been postulated: 1) significant recharge to shallow aquifers occurs from infiltration of ephemeral stream runoff through the alluvium; 2) alluvial aquifers associated with ephemeral streams act as buffers between the channel and the bedrock aquifers; and 3) the loss of surface-water runoff to the alluvium is reflected in the runoff hydrograph shape.

Streamflow, soil moisture, hydraulic properties of channels, and water level data will be collected and analyzed to test the postulated concepts. A stream-aquifer response model and a finite-difference flow-routing model will be used to aid in the analysis.

D. Report Products: The final report will be prepared in FY 84, and will include data, tests conducted, and the final results.

E. Distribution of Funds: FY 83

Salaries	\$ 58,000
Travel	5,000
Equipment	2 000
Drilling	\$ 5,000
Total	<u>70,000</u>

IV. The Fluvial System in Energy-Mineral Areas of Wyoming

Hugh W. Lowham, WRD Project Chief (FTS 328-2722)

A. Location: Northeastern and southwestern Wyoming

B. Objectives: In the arid and semiarid plains of Wyoming, running water is the most dominant force of all agents that sculpture the land surface. Land uses that affect the runoff might also induce changes in local fluvial systems, causing accelerated erosion and sedimentation and undesirable modification of drainage networks.

The objectives are to describe the processes of the fluvial system for the energy-rich plains areas of Wyoming, and to present procedures and case histories that can be used in land-use planing to minimize erosion and provide stable drainage networks.

C. Approach: Through an extensive literature search, existing knowledge applicable to channel formation and drainage development will be summarized. Case histories of channel response to various past developments in Wyoming will be described to highlight the need for planning and design of stream-related projects. Quantitative relations that describe channel and drainage formation will be developed to aid in the planning of land uses that may affect runoff and channels. Channel and drainage-network data will be measured with a computerized digitizer from maps and aerial photographs. Empahsis will be given to ephemeral and intermittent streams of plains areas. Characteristics to be considered include channel size and gradient, meander patterns, drainage density, and basin slope. Present and past land-use activiteis will be observed and evaluated to determine the most effective procedures. Alternate procedures also will be developed and evaluated.

D. Report Products: A final report will be prepared that summarizes the data, predictive relations, case studies, and alternative procedures that can be used for planning and designing where the fluvial system is subject to alteration. The report will be prepared in FY 85.

E. <u>Distribution of Funds:</u>	FY 83
Salaries	\$ 58,000
Travel	4,000
Digitizing contract	5,000
Computer services	3,000
Total	<u>\$ 70,000</u>

