SUMMARY OF WATER-RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN OREGON: FISCAL YEAR 1989

Compiled by David A. Curtiss

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SUMMARY OF WATER-RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN OREGON: FISCAL YEAR 1989

INTRODUCTION

Water-resources related activities of the U.S. Geological Survey in Oregon consist of collecting water-resources data and conducting interpretive hydrologic investigations. The water-resources data and the results of investigations are published or released by the U.S. Geological Survey or by cooperating agencies. This report describes the water-resources investigations in Oregon for the 1989 fiscal year (October 1, 1988 to September 30, 1989).

In 1984, the Oregon and Washington Districts combined to form the Pacific Northwest District. Garald G. Parker, Jr. is the District Chief of the Pacific Northwest District. The Pacific Northwest District office is located in Tacoma, Washington. The Oregon State office is located in Portland, Oregon, and Marvin O. Fretwell is the State Chief. The Oregon Office has four field offices located in Portland, Salem, Eugene, and Medford. Request for information should be addressed to

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MISSION OF THE U.S. GEOLOGICAL SURVEY

The U.S. Geological Survey was established by an act of Congress on March 3, 1879, in order to answer the need for a permanent government agency at the Federal level to conduct, on a continuing, systematic, and scientific basis, investigations of the "geological structure, mineral resources, and products of the national domain." Although a number of laws and executive orders have expanded and modified the scope of the Survey's responsibilities during its 110-year history, the Survey has remained principally a scientific and technical investigation agency, as contrasted with a developmental or regulatory one. Today the Survey is mandated to assess onshore and offshore energy and mineral resources; to provide information for society to mitigate the impact of floods, earthquakes, landslides, volcanoes, and droughts; to monitor the Nation's ground- and surface-water supplies; to study the impact of man on the Nation's water resources; and to provide mapped information on the Nation's landscape and land use. The Survey is the principal source of scientific and technical expertise in the earth sciences within the Department of the Interior and the Federal Government. The Survey's activities span a wide range of earth-science research and services in the fields of geology, hydrology, and cartography, and represent the continuing pursuit of the long-standing scientific missions of the Survey.[1]

MISSION OF THE WATER-RESOURCES DIVISION

The mission of the Water-Resources Division, which supports the mission of the Geological Survey and the U.S. Department of the Interior, is to develop and disseminate scientific knowledge and understanding of the Nation's water resources. The activities carried out by the Water-Resources Division fall into three broad categories: (1) resource assessment; (2) research; and (3) coordinating the activities and cataloging the products of numerous other entities involved in water research, data acquisition, or information transfer.

Resource Assessment. Resource assessment consists of:

- Collecting data on the quantity, quality, and use of surface water (rivers, streams, lakes, reservoirs, estuaries, and glaciers); the quantity, and use of ground water (including water in the unsaturated zone); and the quality of precipitation.
- Storing and disseminating these data.
- Interpreting these data and publishing the results of these interpretations. This interpretation involves the inference of hydrologic causes, effects, and probabilities; and the extension, over space and time, of information contained directly in the data.
- Developing and applying new methods of hydrologic data collection, analysis, and interpretation.

[1]Source: Adapted (and updated December 1984) from U.S. Geological Survey Yearbook for Fiscal Year 1983.

- Conducting areally focused interpretive investigations and appraisals at national, regional, State, or local scales. These include characterizations of ground and surface waters, and of precipitation chemistry; evaluation of natural hydrologic hazards; and studies of other water-related topics. Frequently these investigations involve the development, testing, and application of mathematical models capable of quantitatively evaluating the hydrologic consequences of management actions, development plans, or natural phenomena. These investigations are carried out through specific Federal programs or in cooperation with State and local governments or other Federal agencies. Results are published in technical journals or in State, local, U.S. Geological Survey or other Federal agency publications.

- Reporting to the Nation, on a regular basis, on the overall status of water resources, and on hydrologic events and water-resource issues.

Research. The Division conducts research in a wide variety of scientific disciplines--geochemistry, ecology, geomorphology and sediment transport, water chemistry, ground-water hydrology, and surface-water hydrology--particularly as these disciplines relate to the quantity, flow, and quality of surface water and ground water and to other aspects of the hydrologic cycle. The research is intended to:

- Improve the overall understanding of the pathways, rates of movement, chemical processes, and biological processes in the hydrologic cycle.

- Improve the overall understanding of the hydraulic, chemical, and biological factors, both natural and man caused, which affect the resource.

- Provide new strategies of data collection, analysis, and interpretation, in the light of new knowledge and evolving scientific capabilities.

- Improve methods of predicting the response of hydrologic systems to stresses, whether hydraulic or chemical, and whether of natural or human origin.

Coordinating the Activities and Cataloging the Products of Other Entities Involved in Water Research, Data Acquisition, or Information Transfer. This function has four major components:

- The coordination of water-data acquisition activities of Federal agencies (as mandated by Office of Management and Budget Circular A-67).

- The acquisition of water-use data and development of State and national water-use data bases in cooperation with State governments.

- The operation of water-information exchanges and centers, which provide all interested parties with indexing and access to many sources of water data and information.

- The administration of extramural water-resources research, technology, development, academic training, and information-transfer programs mandated by the Water Resources Research Act of 1984 (Public Law 98-424). The Act mandates research oriented to the environmental values associated with the resource. The research promoted by the Act involves many disciplines and activities other than those required in the assessment, research, and coordinating functions of the Water-Resources Division.[2]

COOPERATING AGENCIES

In Oregon, some of the water-resources data-collection activities and interpretive hydrologic investigations of the Water-Resources Division are conducted in cooperation with Federal, State, and local agencies. Agencies cooperating with the U.S. Geological Survey during fiscal year 1989 are:

Oregon Water Resources Department
Oregon Department of Fish & Wildlife
Oregon Department of Transportation, Highway Division
Oregon Department of Human Resources
    Oregon Health Division, Drinking Water Program
Oregon Department of Natural Resources
    Analysis & Planning Management Services Division
City of Eugene
City of Florence
City of Klamath Falls
City of McMinnville
City of Portland
Douglas County
Jackson County
Clark County Intergovernmental Resource Center, Washington
Coos Bay North Bend Water Board
Confederated Tribes of Warm Springs Indian Reservation
Confederated Tribes of Umatilla Indian Reservation
Klamath Tribe
U.S. Department of the Army
    Corps of Engineers
U.S. Department of the Interior
    Bureau of Land Management
    Bureau of Reclamation
    National Park Service
U.S. Department of Energy
    Bonneville Power Administration
U.S. Department of Commerce
    National Weather Service
U.S. Department of Agriculture
    Forest Service

[2]Source: Mission statement by the Chief Hydrologist, September 18, 1984.

COLLECTION OF WATER-RESOURCES DATA

Hydrologic-data stations are maintained at selected locations throughout Oregon and constitute the major water-resources data network in the State for obtaining records on stream discharge and stage, reservoir and lake storage, ground-water levels, well and spring discharge, and the quality of surface and ground water (table 1). Every year some new stations are added and other stations are terminated; thus, the U.S. Geological Survey has both a current and a historical file of hydrologic data. Most water-resources data are stored in the U.S. Geological Survey's WATSTORE (National Water Data Storage and Retrieval System) data base and are available on request to water planners and others involved in making decisions affecting Oregon's water resources. These data can be retrieved in machine-readable form or in the form of computer-printed tables, statistical summaries, and digital plots. Local assistance in the acquisition of services or products from WATSTORE can be obtained by contacting the State Chief, Oregon Office in Portland, Oregon.

Table 1.--Water-resources data-collection stations in operation in Oregon during fiscal year 1989, by station classification

Station classification	Number of stations
Streamflow:	
Continuous (daily) record	260
Peak flow, crest-stage record	5
Real-time stage and discharge	12
Lakes and reservoirs:	
Stage and content	41
Water quality:	
Periodic chemical quality	10
Daily quality monitoring	31
Meteorological:	
Daily precipitation quantity and quality	3

Surface-water Data

Surface-water discharge (streamflow), stage (water level) and water-quality data are collected for general hydrologic purposes, such as assessment of water resources, areal analysis, determination of long-term trends, research and special studies, or for management and operational purposes. Data-collection platforms (DCP's), used for the transmission of satellite-telemetered river-stage information, have been installed at 12 sites throughout the State. Satellite-telemetry acquisition of the information is essential to many agencies for operating reservoirs, predicting river stage and flood conditions, and optimizing the use of water resources. Data are received directly from the U.S. Geological Survey ground-receiver site located in Tacoma, Washington and processed at the Portland, Oregon office, where they are made available to other agencies.

Periodic water-quality data (common ions, nutrients, and (or) trace metals) are obtained at 10 of the surface-water stations listed in table 1. Eight of these stations are part of a U.S. Geological Survey nationwide network known as NASQAN (National Stream Quality Accounting Network) and two are part of the nationwide Benchmark network, that provides data used in the evaluation of long-term trends in stream quality.

Daily water-quality monitoring is being conducted at one site for water temperature, specific conductance, pH, and dissolved oxygen. Seven sites are being monitored for water temperature and turbidity, and an additional 28 sites are being monitored for water temperature and (or) specific conductance. Automatic instruments measure the characteristic of interest continuously during the day, enabling the information , such as the daily maximum, minimum, and mean values to be summarized for the day.

Information from water-quality stations is used to monitor the quality of surface-water in Oregon. The frequency of sample collection can range from daily for some of the physical data to annual for pesticide or radiochemical data. In addition to the water-quality data collected at the aforementioned stations, a variety of information is collected at miscellaneous sites as part of interpretive hydrologic studies. This information also is available from the U.S. Geological Survey files.

Meteorological Data

Three stations located in Oregon are part of the nationwide NADP/NTN (National Atmospheric Deposition Program/National Trends Network) program to monitor long-term precipitation-quality changes. Composite samples are collected weekly by observers who record precipitation amounts, measure pH and specific conductance of the composite sample, and submit the sample to the laboratory for chemical analyses.

INTERPRETIVE HYDROLOGIC INVESTIGATIONS

Twenty-one interpretive hydrologic investigations are being conducted in Oregon during fiscal year 1989 in cooperation with 24 Federal, State, and local agencies. Hydrologic investigations are being conducted that will provide information to answer hydrologic questions specific to the State's needs, as well as questions addressing statewide, multistate, and nationwide hydrologic problems. A summary of each investigation, including problem, objectives, approach, progress, and plans follows.

PROJECT TITLE: Oregon Water Use Program

PROJECT NUMBER: OR-007

STUDY LOCATION: Statewide

COOPERATING AGENCY: Oregon Water Resources Department

PROJECT CHIEF: Tyson M. Broad

PROJECT DURATION: Ongoing, beginning in 1979

PROBLEM: With the increasing rate of utilization and competition for water, accurate up-to-date water-use information is vital for determining future water availability in critical areas and in making sound resource-management decisions. Documentation of water supplies, water uses, and volumes of water consumed or available are needed to provide an ongoing comprehensive picture of the statewide water resources.

OBJECTIVES: Collect, store, and disseminate historic and current water-use information that is available from a variety of users.

APPROACH: Develop and maintain an extensive data base for water-use information which will be accessible to all users at local, State, and Federal levels.

PROGRESS: Site specific water-use information was collected in connection with the Portland Basin ground-water project (OR-143) and entered into an INFO data base. The Oregon chapter for the 1987 National Water Summary "Water Supply and Demand" has been completed and approved.

PLANS FOR FY 1989: The 1985 Oregon Water-Use report will be completed and approved for publication. Assist Oregon Water Resources Department in creating a water-use data base to store data gathered as a result of State legislation requiring all public entities with water rights to report water use.

PROJECT TITLE: Roseburg Storm Runoff Study

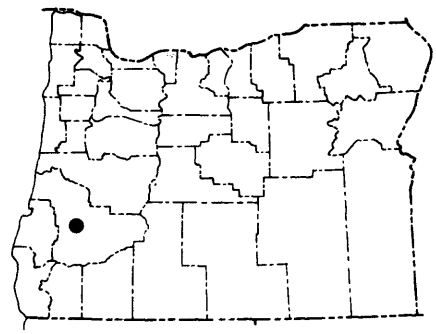
PROJECT NUMBER: OR-113

STUDY LOCATION: Douglas County, southwestern Oregon

COOPERATING AGENCY: Douglas County

PROJECT CHIEF: Lawrence E. Hubbard

PROJECT DURATION: Project complete except report



PROBLEM: Douglas County has a need to assess magnitudes, volumes, and frequency of storm-water runoff within Roseburg and potential urban-growth areas. The assessment can be accomplished by collecting rainfall and runoff data at several selected sites in the vicinity of Roseburg and relating results to data collected at Salem and Portland. Equations relating to peak flow and flood-volume frequencies have been prepared for the Portland and Salem areas. Comparison of results for Roseburg, Salem, and Portland will indicate transferability of data, and provide assurance of reliability of results.

OBJECTIVES: Identify local rainfall-runoff characteristics sufficiently to determine applicability of equations either directly from Portland and Salem area studies or from a nationwide study with adjustments made based on Roseburg data.

APPROACH: A network of five rainfall, four runoff, and two crest-stage stations was developed in the Roseburg and Douglas County urban-growth area. The rainfall-runoff data will be used to develop a model for each gaged basin. These models were used with historical rainfall data to produce synthetic, historical runoff. Peaks and volumes from this synthetic record was then analyzed to define flood frequency. Discharge derived from frequency analyses was tested for accuracy using Portland-Salem and national urban-runoff equations. Of primary interest was the testing of transferability of information from one geographical location to another.

PROGRESS: A report describing the rainfall-runoff characteristics in the Roseburg area has been prepared and is being revised after review.

PLANS FOR FY 1989: Complete revisions and submit report for Director's approval for publication.

PROJECT TITLE: Malheur Lake Historic Flood Elevation

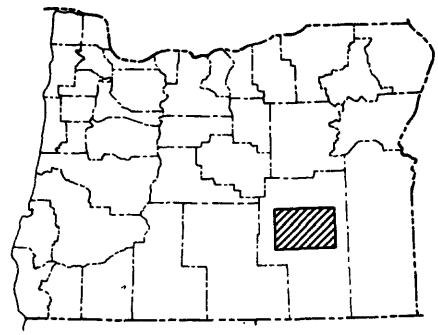
PROJECT NUMBER: OR-125

STUDY LOCATION: Harney County, southeastern Oregon

COOPERATING AGENCY: U.S. Department of the Army, Corps of Engineers

PROJECT CHIEF: Larry L. Hubbard

PROJECT DURATION: Project complete except report



PROBLEM: In 1984, Malheur and Harney Lakes experienced the most extreme flooding since water levels have been observed at Malheur Lake (1932). The inundated area was 150,000 acres, of which 20,000 were agricultural land. A flood inundation map was needed as a technical starting point for analyzing management alternatives for diverting water to another basin and providing upstream storage.

OBJECTIVES: Prepare a flood inundation map of Malheur and Harney Lakes.

APPROACH: The high-water boundary was located on U.S. Geological Survey maps. The Oregon Water Resources Department ran level surveys from established benchmarks to high-water reference marks. Aerial photography was used to supplement and verify mapping. The report includes an inundation map with accompanying graphs, tables, and a short narrative text.

PROGRESS: The map-type report has been prepared and is being revised after review.

PLANS FOR FY 1989: Complete the revisions and submit the report for Director's approval for publication.

PROJECT TITLE: Iron Geochemistry of the Dunes Aquifer near Coos Bay, Oregon

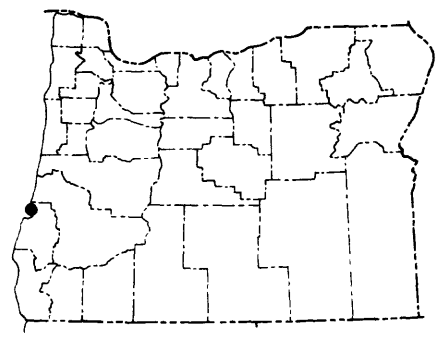
PROJECT NUMBER: OR-138

STUDY LOCATION: Coos County, southwestern Oregon Coast

COOPERATING AGENCY: Coos Bay-North Bend Water Board

PROJECT CHIEF: Gilbert C. Bortleson, Tacoma, Washington

PROJECT DURATION: October 1985 to October 1989



PROBLEM: The sand dunes area of the Oregon Dunes National Recreation Area is characterized by a series of sand ridges separated by deflation plains. In the 1950's, the ground-water resources of the dunes area were developed. Currently, 20 production wells that produce an average of 6.5 million gallons of water per day are being operated by the Coos Bay-North Bend Water Board. In 1956, shallow exploratory wells in the deflation plains yielded water with a median iron concentration of 0.10 milligrams per liter; in 1977, the shallow wells in the deflation plain yielded median iron concentration of 9.8 milligrams per liter. A need exists to confirm whether increased vegetation in the deflation plains is causing increased iron concentration in the shallow aquifer and, if so, what remedial actions can be taken to reduce the iron concentrations.

OBJECTIVES: Understand the processes controlling the occurrence and distribution of dissolved iron to accumulate in the Coos Bay dunes aquifer. Phase I object is to discern if vegetation in the deflation plains is causing large concentrations of iron in the shallow aquifer. Phase II objectives are to test the hypothesis that (1) removal of vegetation by clearing and burning a plot of lodgepole pine forest will reduce the production of carbon dioxide and organic acids to reduce mobilization of ferrous iron; (2) the high percentage of shell fragments in the underlying marine sands causes a decrease in dissolved iron concentration.

APPROACH: Collect data on water chemistry, mineralogy, and ground-water flow to determine probable geochemical causes of high iron concentrations in the shallow aquifer.

PROGRESS: Phase I of the study has been completed and shows that the major source of large iron concentrations in the shallow aquifer is caused by vegetation, and that water in the deeper dunes-sand aquifer has smaller concentrations of iron than the shallow aquifer because of marine shells interbedded with the sand. A report describing the phase I results has received Director's approval for publication. A second report describing the iron geochemistry and iron concentrations of the dunes sand aquifer is being revised after review. Also a 1-acre plot of lodgepole-pine forest growing on the sand dunes was cleared and burned in April 1988. Studies will be conducted during 1989-90 to see if this action will reduce iron concentrations in the shallow aquifer.

PLANS FOR FY 1989: Monitor the 1-acre plot cleared of lodgepole pine to determine if removing forest canopy will reduce iron concentrations in the shallow aquifer. Prepare a report documenting results. All reports will receive Director's approval for publication.

PROJECT TITLE: Water-resource Evaluation for the Umatilla Indian Reservation

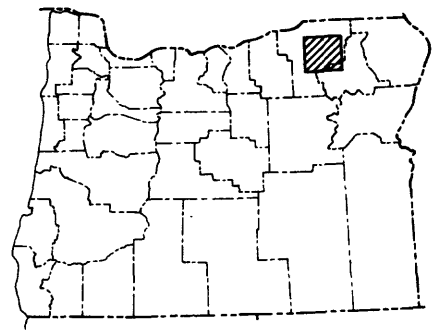
PROJECT NUMBER: OR-140

STUDY LOCATION: Northeastern Oregon

COOPERATING AGENCY: None, U.S. Geological Survey funds only

PROJECT CHIEF: Joseph B. Gonthier

PROJECT DURATION: Complete, except for report



PROBLEM: Ground-water supplies on the Umatilla Indian Reservation are being affected by declining water levels in the Columbia River Basalt aquifer system. Water levels for several wells completed in the regional aquifer system in and near the reservation have shown as much as 80 feet of decline from 1962 to 1984. Local seasonal declines are occurring in the basalt in the Mission area of the Umatilla River valley. These declines may be due in part to regional pumpage from wells for irrigation or public supply and local pumpage for irrigation and domestic use. Streamflow during low-flow periods may be inadequate for sustaining and propagating anadromous fish.

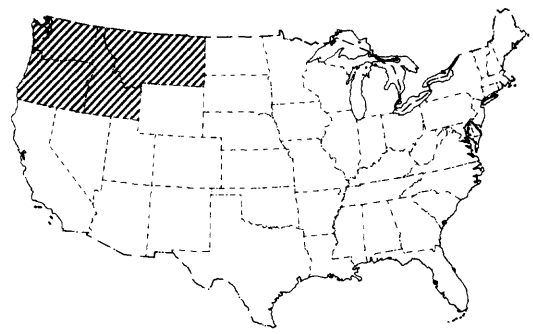
OBJECTIVES: Using data and available ground-water models, provide the best assessment possible of the surface- and ground-water supplies of the Umatilla Indian Reservation. Develop a project workplan that outlines the steps necessary for a full evaluation of water availability and problems and their possible solutions.

APPROACH: The approach will rely heavily on data and results from previous studies. A literature search will be made; the resulting data will be compiled and evaluated to ascertain to what extent the geometry, stresses, hydraulic characteristics, recharge-discharge, and the flow system and its boundaries can be determined. Using the foregoing information, a general description of the ground-water flow system in the reservation, its relation to the regional flow system, and its relation to streamflow will be written. A planned workshop will identify the effort needed for collecting and analyzing additional data in those problem areas where present information is insufficient for quantification of the Tribe's water rights.

PROGRESS: All available literature has been reviewed, and all available hydrologic and geologic data have been compiled. Streamflow statistics have been updated and maps and hydrographs have been prepared showing geology, thickness, and water levels in selected hydrogeologic units on the reservation. A draft of the final report was begun.

PLANS FOR FY 1989: Report will be completed and revised according to review comments and will be submitted for Director's approval for publication.

PROJECT TITLE: Encoding of 1:100,000-Scale Digital Hydrography with Environmental Protection Agency River-Reach Coding Conventions



PROJECT NUMBER: OR-142

STUDY LOCATION: States of Oregon, Washington, Idaho, and Montana

COOPERATING AGENCY: Bonneville Power Administration

PROJECT CHIEF: Douglas D. Nebert

PROJECT DURATION: July 1986 to September 1990

PROBLEM: In 1984, the Bonneville Power Administration (BPA) established the Pacific Northwest Rivers Study in cooperation with the States of Oregon, Washington, Idaho, and Montana and other Federal agencies in order to develop a data base for the management of rivers in the Columbia River basin. This data base is to be used by BPA and the Northwest Power Planning Council in the evaluation of hydropower siting and alternatives on the basis of river characteristics. In May 1985, BPA convened a task force of GIS (Geographic Information System) users from the northwest to evaluate the spatial data and data-management needed for the study. The task force recommended that the data attributes should be referenced to a recently compiled 1:100,000-scale digital base map which would provide an appropriate level of detail and cartographic consistency.

OBJECTIVES: Automate existing hydrographic coverage for the Pacific Northwest prepared by the the National Mapping Division and assign Environmental Protection Agency (EPA) river-reach codes to all river segments.

APPROACH: The U.S. Geological Survey will acquire a full set of 1:100,000 Digital Line Graph (DLG) hydrography for the four-state area. The map data will be loaded and checked for errors against base materials. Edges will be matched with minimal distortion, and point, line, and area features will be segregated to facilitate the coding process. Stream features will then be assigned a direction of flow, stream order, identification as manmade or natural, and linked with the River Reach File. Map products will be generated in map (paper) and digital form.

PROGRESS: Protocol for processing digital hydrography has been developed and presented to various groups with and outside of BPA. Enhanced EPA river-reach features and attributes have been completed for streams in 75 of the 318 hydrologic units in the study area. The full number of hydrologic units will be completed for the four-state area by September 1990.

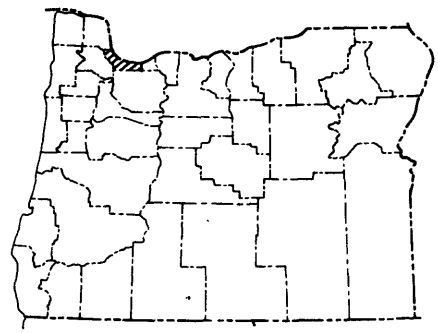
PLANS FOR FY 1989: Complete the matching of enhanced EPA river-reach features and attributes from the 1:250,000 scale stream traces to the 1:100,000 scale stream traces for the remaining 243 hydrologic units.

PROJECT TITLE: Ground-water Hydrology of the Portland Basin

PROJECT NUMBER: OR-143

STUDY LOCATION: Multnomah County, northwest Oregon

COOPERATING AGENCY: City of Portland and Oregon Water Resources Department



PROJECT CHIEF: William D. McFarland

PROJECT DURATION: October 1986 to September 1990

PROBLEM: The City of Portland and adjacent surburban areas is the largest metropolitan area in the State of Oregon. In recent years, the need for a better understanding of the hydrogeology of the region has arisen due to increasing concern over ground-water contamination from cesspools and septic tanks, development of the the Portland Well Field as a backup water supply for the city, and water-level decline problems in outlying areas. The most recent regional study of ground-water resources in the area was in 1965--since that time development of the Portland Well Field and other drilling in the area have provided a wealth of lithologic and hydraulic information. With some additional data collection it will be possible to vastly improve our understanding of the hydrogeology of the area.

OBJECTIVES: The objective of this two-phase study is to quantify the ground-water hydrology in the Portland regional ground-water basin to the extent needed for management purposes, including predicting the impacts of existing and proposed wells on the basin. The results of the study will aid in development of a regional water-resources plan and in development of a single-well permit process. (Single-well evaluation will be based on a compilation of maps of hydraulic properties and model results.)

APPROACH: The first-phase effort will be to characterize and quantify the water resources of the area to the extent readily available data allow; we will then identify the time, cost, and effort needed to collect and interpret additional information, if needed. A model sensitivity analysis will be done as part of Phase I to evaluate data adequacy. If Phase I shows that the data are adequate to define the aquifer-system geometry, aquifer hydraulic characteristics, ground-water flow directions, quantities of ground-water recharge and discharge, and distribution and rates of ground-water pumpage, then Phase II of the project will be undertaken to develop a predictive ground-water model for the region.

A Geographic Information System (GIS) has been developed for management of project data and also for use with the ground-water flow model. This work has been done in conjunction with the Clark County ground-water study (OR-145) and the GIS/model interface project (OR-151).

PROGRESS: This project is being conducted parallel with the Clark County ground-water study (OR-145). Exchange of information between projects has allowed a regional study that encompasses the full extent of this "ground-water basin" in Oregon and Washington. Data collection has included field location of selected existing wells, drilling of piezometers near streams to observe ground-water/surface-water interactions, detailed geologic mapping, collection of water-use information, repeated water-level measurements, collection of drill samples from local drillers, and logging wells with borehole geophysical tools. Hydraulic characteristics are being estimated from existing specific capacity and aquifer tests. Recharge for the basin has been estimated using available soils, precipitation, temperature, and elevation data as input to the Deep Percolation Model by Bauer and Vaccaro (1986).

PLANS FOR FY 1989: With the exception of continued water-level measurements, data collection will be completed in FY 1989. All parameters needed to construct the ground-water flow model will be estimated and the model will be constructed. The model will first be used to conduct sensitivity runs to evaluate the input data. After analysis of the sensitivity model runs, model calibration is likely to begin late in FY 1989.

PROJECT TITLE: Walla Walla River basin GIS/Ground-water Model Demonstration

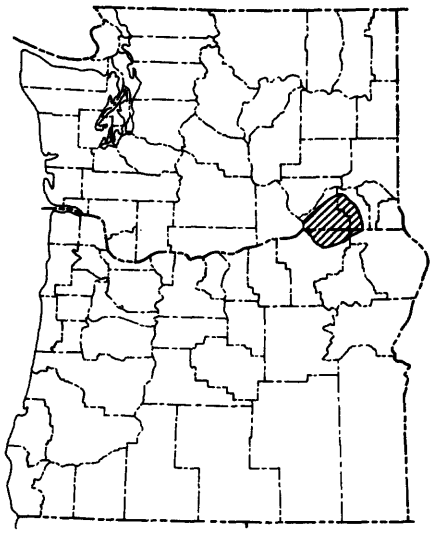
PROJECT NUMBER: OR-144

STUDY LOCATION: Umatilla County, northeastern Oregon, and Walla Walla County, southeastern Washington

COOPERATING AGENCY: None--U.S. Geological Survey funds only

PROJECT CHIEF: Michael E. Darling

PROJECT DURATION: Project complete except report



PROBLEM: Typically hydrologic models, especially ground-water models, require an enormous amount of effort to assemble, examine, sort, and plot all the relevant geologic, geographic, land use, and hydrologic data. An equally large effort is usually required to relate these data temporally and spatially. Ground-water models are grid based; once a grid has been developed and data have been discretely assigned to the grid, it becomes impossible to change the size or grid orientation. The time and cost of these unwieldy tasks are often highly disproportionate to the more productive functions of calibrating and verifying the model itself. Consequently, a modeling approach is often discarded as "too lengthy" or "too costly" because of what may be viewed as excessive data-handling requirements.

OBJECTIVES: Utilize new ARC/INFO techniques to regrid an existing ground-water model and produce a new set of data arrays. The existing hydrologic model is for the Walla Walla River basin. This planned model offers the opportunity to develop and utilize the GIS in a practical, highly visible situation.

APPROACH: The analytical tools of the GIS will be used to construct and test the data arrays used by the component models (recharge, ground water, and surface water). ARC/INFO graphic displays will be used to test the regridding process.

PROGRESS: A GIS interface to the Walla Walla River basin model which can transfer data arrays from a low-resolution to a high-resolution model has been completed. A report documenting the regridding process utilizing GIS has been prepared and is in the review process.

PLANS FOR FY 1989: Receive Director's approval for publication of the documentation report. Develop GIS interfaces to ground-water model calibration and water-use data base. Begin preparation of report that documents each GIS interface.

PROJECT TITLE: Ground-water Hydrology of Clark County, Washington

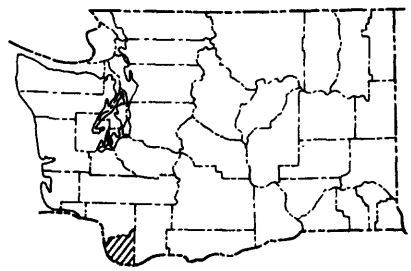
PROJECT NUMBER: OR-145

STUDY LOCATION: Clark County, southwestern Washington

COOPERATING AGENCY: Intergovernmental Resource Center, Clark County, Washington

PROJECT CHIEF: David S. Morgan

PROJECT DURATION: January 1987 to September 1990



PROBLEM: Water for municipal, domestic, industrial, and irrigation uses in Clark County is almost entirely derived from ground-water resources. Because of this dependency on ground water and concern that the quality and quantity of this resource be preserved, the Intergovernmental Resource Center of Clark County successfully petitioned the State of Washington to designate Clark County as a "ground-water management area." This designation has enabled Clark County to obtain funding from the Washington State Department of Ecology to study the ground-water resources in the county for the purpose of developing a management plan.

OBJECTIVES: The U.S. Geological Survey will quantify the ground-water hydrology of Clark County to the extent needed for ground-water management purposes, including predicting the impacts of existing and proposed wells within the study area through use of a ground-water flow model. The results of the study will aid local managers and planners in development of a water-resources management plan.

APPROACH: The U.S. Geological Survey will delineate the subsurface hydrogeology of the area, inventory the location and rate of ground-water withdrawals, estimate hydraulic characteristics, assess the distribution and rate of recharge, make water-level measurements, and define the boundaries to the system. These data will be utilized to formulate a conceptual model of the flow system and ultimately translate that model into an appropriate mathematical model. All project data are being stored, manipulated, and analyzed using a Geographic Information System (GIS). A sub-project (OR-151) has the objectives of developing a software interface to facilitate data transfer between the GIS and ground-water model as well as pre- and post-processing of model data.

PROGRESS: This project is being conducted in parallel with the Portland Basin ground-water study (OR-143). Exchange of information between projects has allowed a regional study that encompasses the full extent of this "ground-water basin" in Oregon and Washington. Data collection has included field location of selected existing wells, drilling of streambed piezometers, detailed geologic mapping, collection of water-use information, repeated water-level measurements, collection of drill samples from local drillers, and logging wells with borehole geophysical tools. Hydraulic characteristics are being estimated from existing specific capacity and aquifer tests. Recharge for the basin has been estimated using available soils, precipitation, temperature, and elevation data as input to the Deep Percolation Model by Bauer and Vaccaro (1987).

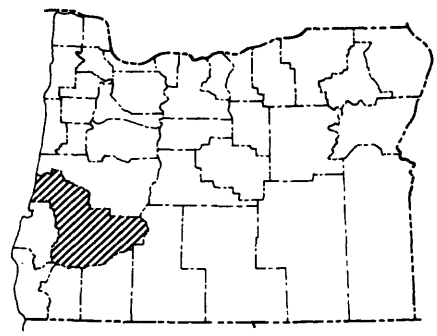
PLANS FOR FY 1989: Continue data collection for water levels and water use, complete the recharge model for the entire study area, begin construction of a ground-water flow model, and begin writing a report describing the hydrology and modeling effort.

PROJECT TITLE: Water Use and Water Supply in the Umpqua River Basin, Oregon

PROJECT NUMBER: OR-146

STUDY LOCATION: Douglas County, southwestern Oregon

COOPERATING AGENCY: Oregon Department of Human Resources



PROJECT CHIEF: Tyson M. Broad

PROJECT DURATION: October 1987 to September 1989

PROBLEM: The Umpqua River of western Oregon is subject to prolonged low-flow conditions during the summer months which necessitate restrictions on water use in the river system. These conditions make the river highly susceptible to sudden contamination. Water use, discharge, water-quality, and time-of-travel data are maintained by the U.S. Geological Survey and other government agencies, but little effort has been made to consolidate these data into a format useful for simulating water-quality conditions in the Umpqua River basin.

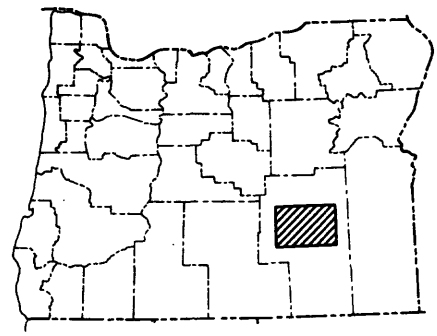
OBJECTIVES: The National Water-Use Program of the U.S. Geological Survey is designing a topologic, site-specific water-use data base which integrates water use into the hydrologic cycle. This new data base is compatible with a geographic information system (GIS). The object of this study is to develop a spatial (GIS-based) water-use data base management system which incorporates withdrawal locations, water use, stream discharge, gradient, and time-of-travel to develop an interactive water contaminant routing model for the soluble substances.

APPROACH: The proposed topologic water-use data base will be used as a basis for the development of a hydrographic GIS-linked data base management system. This system will store information not only on water users, but on stream characteristics such as discharge, velocity, and gradient. A routing model will then be developed which predicts the amount of time that a contaminant takes to travel from spill-site to water user, for a given value of discharge. Using the water-use data base in an application such as this should bring to light any shortcomings in the design of the data base.

PROGRESS: This project is one of two test cases for the Integrated Water Resources Information System (IWRIS), a site-specific water-use database designed to interface with the ARC/INFO GIS. The IWRIS data base design group meets once during the year to review and coordinate efforts of the two test-case projects. A presentation was made to the American Water Resources Association Symposium in August 1988 on contaminant routing using the described model.

PLANS FOR FY 1989: Continue to develop the hydrographic GIS-linked data base for the Umpqua River basin, which will be used to define velocity and travel-time in unmeasured parts of the basin.

PROJECT TITLE: Department of the Interior Irrigation Drainage Field-screening Study of Malheur National Wildlife Refuge



PROJECT NUMBER: OR-147

STUDY LOCATION: Harney County, southeastern Oregon

COOPERATING AGENCY: U.S. Fish and Wildlife Service

PROJECT CHIEF: Frank A. Rinella

PROJECT DURATION: October 1987 to September 1989

PROBLEM: The Malheur National Wildlife Refuge (MNWL) is located within a closed basin in Harney County, Oregon. The Refuge is one of the largest inland marshes in the United States and is one of the major migratory bird use areas in the Pacific Flyway. Agriculture is the principal land use within the study area; large numbers of birds congregate in the basin each spring as extensive areas are flooded naturally or artificially for irrigation purposes. The study area also supports a large variety of resident wildlife and game and nongame fish species. Farming and water-regulation practices may affect the ecology of the area by introducing trace metals and pesticides into the waterway; these contaminants could in turn become a part of the food chain and seriously impact fish and wildlife and perhaps ultimately human health.

OBJECTIVES: Determine from existing information and new data collection the potential for irrigation drainage waters to cause harmful effects to human health, fish and wildlife, and other beneficial water uses. If constituent concentrations suggest potential impacts to fish and wildlife, human health, or impairment of other downstream water uses, additional work will be needed to determine the areal extent and cause of the water-quality degradation.

APPROACH: Surface-water quality sampling sites have been selected to include the kinds of waters and habitats representative of the study areas and are located where irrigation drainage may have an impact. Sites upstream of irrigated areas also will be sampled for comparative purposes. Population observations will be recorded, concentrating on unusual or uncharacteristic traits of wildlife, especially migratory birds, such as abnormal births, reduced reproduction and nesting, and feather loss. As the lead agency, the U.S. Geological Survey will be responsible for providing personnel and equipment for water-quality sampling, assisting in the collection of biological samples by the U.S. Fish and Wildlife Service, providing analytical and quality-assurance service pertaining to water-quality determinations, and providing expertise for the data interpretation and report-writing phases of the study.

PROGRESS: One field reconnaissance, over 10 water-quality and biological data-collection field trips, and one technical-review site visit were completed in the 1988 water year at the Malheur National Refuge. Quarterly reports, prepared jointly by the U.S. Geological Survey and the U.S. Fish and Wildlife Service, have been submitted to the project coordinator.

PLANS FOR FY 1989: Data compilation, interpretation, and report writing will be completed.

PROJECT TITLE: High-volume Liquid-liquid Extraction of Trace Organic Contaminants from Water

PROJECT NUMBER: OR-148

STUDY LOCATION: Not applicable

COOPERATING AGENCY: None--U.S. Geological Survey funds only

PROJECT CHIEFS: Gregory D. Foster, Central Water-quality Laboratory, Arvada, Colorado
Frank A. Rinella, Portland, Oregon

PROJECT DURATION: December 1987 to September 1989

PROBLEM: The need to sample large volumes of water is becoming an ever-increasing priority in measuring trace concentrations of organic contaminants in water-quality surveillance programs. Organic chemicals that are toxic to man and aquatic life at sub-parts per billion concentrations are of primary interest. Because some toxicants commonly have extremely low solubility in water, preconcentration techniques are an absolute requirement prior to quantitative analysis. Measurements must be made at part-per-trillion concentrations to properly define the occurrence of toxicants in the aquatic environment. A need exists for the development of a high-volume, cross-current, liquid-liquid extractor that will lower analytical detection limits for trace organic contaminants in water, relative to existing U.S. Geological Survey standard methods.

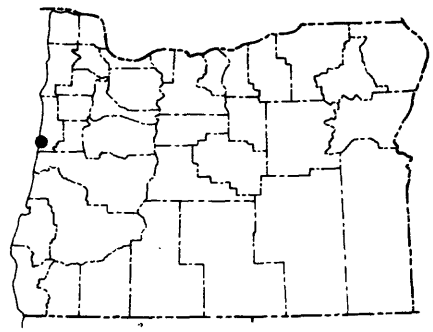
OBJECTIVES: The objective of this project is to evaluate a method of improving analytical detection limits for small-concentration organic compounds: a method of high-volume continuous-flow cross-current extraction. The method utilizes a liquid-liquid (water and solvent) extraction technique. The cross-current liquid extraction technique allows a large volume of water sample to be continuously extracted using a relatively small amount of organic solvent, which concentrates the organic compound in the solvent.

APPROACH: A cross-current liquid extractor (CLLE) will be constructed using a modification of the design of Goulden and Anthony of the Canadian Water Research Institute. The first step will then be to optimize the system in the laboratory to extract 10, 40, and 120 L of water and compare these results with the U.S. Geological Survey 1-L batch standard method. Results from the optimization procedure will be used as the control. Surrogate standards will be metered into influent tapwater for 10, 40, 120 L extractions. If the CLLE proves to be a worthwhile device for high-volume water extractions in the laboratory, performance will then be tested under field conditions.

PROGRESS: Laboratory and field testing of the extraction unit have been completed. Results of the laboratory and field work are being reviewed and recommendations as to the utility of the extraction unit will appear in the next study progress report.

PLANS FOR FY 1989: The final report and several journal articles will be completed.

PROJECT TITLE: Streambed Scour Predictions for the Waldport Bridge Pier Locations at the Alsea River Estuary Crossing, Waldport, Oregon



PROJECT NUMBER: OR-149

STUDY LOCATION: Lincoln County, western Oregon

COOPERATING AGENCY: Oregon Department of Transportation

PROJECT CHIEF: Milo D. Crumrine

PROJECT DURATION: January 1988 to September 1990

PROBLEM: Streambed scour around bridge piers and abutments is a serious problem on many rivers and estuaries and commonly results in bridge failure. Numerous scour-prediction equations have been published, but predicted scour depths are quite variable, especially when equations are applied outside the range of conditions for which they were developed. The problem with the estimation or measurement of scour in a river or estuary system is that the scour is commonly a combination of three types of processes: scour caused by local disturbances such as vortices and eddies, scour from flow construction and sediment transport, or degradation or aggradation of a river reach over a long period of time.

OBJECTIVES: The objective of the study is to accurately compute streambed scour depths at proposed bridge pier locations for a new bridge crossing the Alsea River estuary at Waldport, Oregon, scheduled for construction for the Bridge Division of the Oregon Department of Transportation.

APPROACH: U.S. Geological Survey will measure streambed elevation at cross sections upstream, downstream, and at the proposed bridge site during major storm events for a period of 2 years; soundings will be made to aid in the determination of bedform configuration and rate of movement. Six discharge measurements also will be made during the 2-year period during flood and ebb tides to cover a variety of high-flow conditions. Stage, velocity, and streambed elevation upstream and downstream of the existing bridge pier at which maximum scour is occurring will be continuously monitored. Data on stage, velocity, bed material, and streambed elevation will be presented to the cooperator. An open-file report will be written presenting the results of this study of "clean-water scour."

PROGRESS: Instruments have been installed at Pier No. 6 of the Waldport Bay Bridge for stage, velocity (upstream and down), and depth at two locations. Velocity measurements are made monthly to calibrate readings made at the pier. Scour chains have been installed east of the bridge near the south end to follow sand movement. Discharge measurements have been made to determine total discharge during incoming and outgoing tides. Bed material and bedload samples have been taken to determine material size and if any transport has taken place during the tide cycle and at what time during the cycle. Samples have been taken at 10 locations around and in the bay for X-ray mineralogic analysis.

PLANS FOR FY 1989: Construction of the new bridge has begun; therefore, increased cross-section monitoring will be made to determine changes being made in the bay due to construction. Other sites will be monitored for scour around the new bridge piers during construction, probably just upstream of Pier No. 6. Two slope gaging stations will be installed and several cross-sectional measurements will be made in the estuary to provide information needed to run a flow model that will estimate maximum flow conditions. An annual progress report will be presented to the cooperator in September.

PROJECT TITLE: Army Water Resources Data Base Using GIS

PROJECT NUMBER: OR-150

STUDY LOCATION: Worldwide

COOPERATING AGENCY: U.S. Department of the Army

PROJECT CHIEF: Douglas D. Nebert

PROJECT DURATION: October 1987 to September 1989

PROBLEM: During the past 2 fiscal years the Army Engineering Topographic Laboratories Terrain Analysis Center (TAC) has worked with the U.S. Geological Survey on a relational data-base design for the Army Water Resources Data Base. This effort involved a user-needs assessment, preliminary data-base design, data input form coding, and some retrieval testing with data associated with water resources and facilities in the Middle East. In 1987, the Oregon Office conducted a feasibility study for TAC's implementation of an integrated spatial and tabular data base using GIS software and techniques. That study resulted in automation of the Kuwait 1:250,000-scale quadrangle using ARC/INFO software. At that time, an implementation strategy was suggested for the incorporation of GIS into existing TAC programs over the coming fiscal years.

OBJECTIVES: The objective of this project is to assist the TAC in implementation of GIS in support of Army Water Resources Data Base (WRDB) mapping and analysis activities. Primary responsibilities include training, basic data-base design for the integrated WRDB system, and documentation of data entry, update, maintenance, query, and display techniques.

APPROACH: U.S. Geological Survey will install and test GIS (ARC/INFO) software using data and programs relevant to the WRDB efforts. User needs will be evaluated and on-site training will be provided. U.S. Geological Survey will design and document data conversion modules to meet data-base user requirements, design standard entry procedures for overlay and attribute data, and develop an overlay tracking/management system for all aspects of map and attribute actions. Procedures will be documented in a user manual.

PROGRESS: A data-base design has been created and reviewed to store cartographic and tabular data relating to water-resources data in the Middle East. Input, update, and output modules have been programmed and will be tested on a sample data set. GIS software was installed at Ft. Belvoir and a short training session was conducted in the use of GIS techniques. U.S. Geological Survey also prepared digitizing instructions for use by Tennessee Valley Authority (TVA) to enter more than 1,000 map manuscripts into this new data base. An overlay tracking system also is being developed and tested to manage the large volume of data on-line.

PLANS FOR FY 1989: The prototype data base will be tested, with its menus, programs, and overlay tracking system; and documentation will be written to guide the users through the system. U.S. Geological Survey will assist TVA in testing the automation procedures early so that production can begin later in the year. Selected enhancements will be defined and given priorities. U.S. Geological Survey will program these enhancements as time and budget allow. A report describing data-base design with GIS elements will be written and submitted for Director's approval for publication.

PROJECT TITLE: General Purpose Software Interface between Ground-water Models and GIS Systems to Facilitate Pre- and Post-processing of Model-related Data

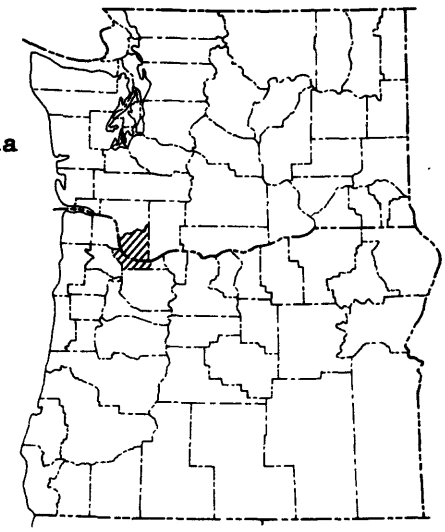
PROJECT NUMBER: OR-151

STUDY LOCATION: Multnomah County, northwestern Oregon, and Clark County, southwestern Washington

COOPERATING AGENCY: Intergovernmental Resource Center, Clark County, Washington

PROJECT CHIEF: Leonard L. Orzol

PROJECT DURATION: October 1987 to September 1989



PROBLEM: The McDonald/Harbaugh three-dimensional finite-difference ground-water flow model describes an inherently spatial process (as a function of time) and yet techniques available through GIS for data entry, management, analysis, and display have not been intensively applied to the ground-water modeling process.

OBJECTIVES: The objective of this study is to develop a generic interface between array-based models (such as those which simulate ground-water flow and percolation) and spatial data management systems, generally known as GIS, and apply the techniques in the Portland Basin ground-water study already underway. This interface will describe the relations between spatial data needed by the modeler, the modeling process, and the functions that GIS in general can provide. A specific interface will then be written to communicate directly between ARC/INFO and the McDonald/Harbaugh model, but the framework also will be laid to develop interfaces between other array-based models and GIS software.

APPROACH: A comprehensive survey and review of existing hydrologic model-to-GIS interface programs (either existing or planned) will be conducted. Agencies and organizations to be canvassed will include known GIS users within the U.S. Geological Survey, state and local agencies, other Federal agencies, and private sector users. The review will provide insight into the spatial pre- and post-processing requirements of model users and should help identify the most useful set of complimentary procedures needed by the modeler in all aspects of the modeling process.

PROGRESS: A literature search was conducted and existing interface models, data files, and program structure, including ARC/INFO FORTRAN utilities, were reviewed for possible use with the interface programs. A report documenting the results was begun.

PLANS FOR FY 1989: Continue to develop software (FORTRAN and AML program) for the GIS/Ground Water model interface. The report will be completed and submitted for Director's approval for publication.

PROJECT TITLE: Determining Effects of Land Development on Hydrology using Rainfall-Runoff Modeling

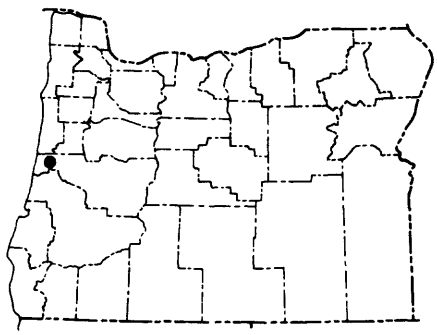
PROJECT NUMBER: OR-152

STUDY LOCATION: Lane County, western Oregon

COOPERATING AGENCY: Bureau of Land Management

PROJECT CHIEF: Antonius Laenen

PROJECT DURATION: March 1988 to September 1988



PROBLEM: At present, the Bureau of Land Management (BLM) has no verified method to identify changes in streamflow caused by land development. They are interested in determining if a computer model is sensitive enough to define streamflow change caused by land-use change. The sensitivity of streamflow simulations for peak flows, mean flows, and low-flows need to be defined for use in comprehensive planning.

OBJECTIVES: The objective of this study is to evaluate the ability to model small changes in streamflow caused by changing land-use activity (model-sensitivity analysis). The study will include calibration of a mathematical computer model, "Precipitation-Runoff Model System" (PRMS), that will simulate streamflow from inputs of precipitation and evaporation for East Fork Lobster Creek.

APPROACH: Hourly and daily streamflow will be retrieved from WATSTORE and entered on the Oregon PRIME computer. Hourly and daily precipitation data will be keyed into the PRIME from handwritten data sheets provided by BLM. Daily evaporation data also will be keyed on the PRIME. The entire flow distribution will be calibrated; calibrations will be performed on about one-half of the data set, while the remainder will be used for verification. After calibration and verification, a sensitivity analysis will be performed to identify land-use change and predictability.

PROGRESS: The PRMS model has been calibrated for East Fork Lobster Creek basin and operated in the daily and storm modes to determine sensitivity to land-use parameters. The basin has been subdivided into hydrologic-response units (HRU's) defined by basin soil type, vegetation, land use, stream channels, and road ditches. ARC-INFO coverages of land use, topography, soils, geology, hydrography, and transportation (roads) have been generated.

PLANS FOR FY 1989: The calibrated PRMS model will be operated in the storm mode to estimate the effects of road building and timber harvesting on the basin. In simulation, the road network will be increased and new HRU's defined where roads affect the routing. Similarly, timbered areas will be changed to cut areas and new HRU's defined to simulate timber harvesting. A presentation will be made to Bureau of Land Management staff to discuss the model results.

PROJECT TITLE: Johnson Creek Water-quality Assessment

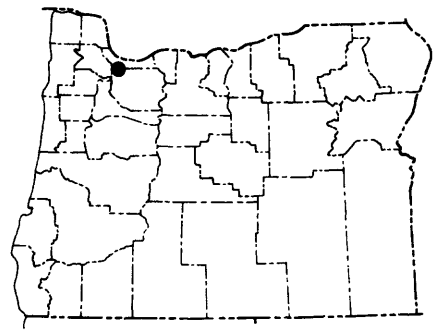
PROJECT NUMBER: OR-153

STUDY LOCATION: Multnomah and Clackamas Counties, northwestern Oregon

COOPERATING AGENCY: City of Portland

PROJECT CHIEF: Thomas K. Edwards

PROJECT DURATION: May 1988 to September 1990



PROBLEM: Johnson Creek flows from a predominantly rural headwater area, down through the highly populated urban areas of Gresham, Portland, and Milwaukie, Oregon. Johnson Creek is a receiving tributary for urban, light industrial, and agricultural runoff throughout its length, and has contact potential for a large segment of Portland's population. For this reason, if poor water quality exists in Johnson Creek, it could be considered a major health concern to the public. The City of Portland is interested in defining water-quality conditions in Johnson Creek and in obtaining data that will evaluate the effects of industry along the creek.

OBJECTIVES: Evaluate temporal and spatial water-quality conditions using existing data and supplementary sampling and provide a "program plan" to the City of Portland for more definitive sampling. If the plan is accepted by the city, the U.S. Geological Survey will evaluate alternative methods of improving water-quality and the effectiveness of in-place improvements.

APPROACH: Bed material will be collected during summer low flow. Visual examination also will be made to help define areas where water-quality problems may occur. In addition, water samples will be collected at three locations along the main stem of Johnson Creek at the same time as bed-material samples. A fully detailed proposal will be written to describe a suggested water-quality sampling program, which will include a sample plan to evaluate the effectiveness of alternative structures for improving the water-quality conditions in the basin. The proposed program will include fixed-location continuous-recording gages that will be established to supplement flow data; in addition, water-quality data will be collected synoptically during three storm events and twice during summer low flow.

PROGRESS: Streambed material was collected and analyzed for organic and trace element constituents, and water samples were collected at a low-flow period to determine the absence or presence of organic compounds. Field work was completed and the laboratory analyses received from the U.S. Geological Survey Denver Water Quality, the Atlanta Research laboratories, and the Oregon Department of Environmental Quality. Trace element, organic compounds, coliform, and various other constituent determinations have been made and evaluated. A preliminary proposal has been prepared.

PLANS FOR FY 1989: A proposal for Step 3 of the Johnson Creek water-quality assessment has been prepared and presented to the cooperator and Region. Work components of Step 3 include installation of a stage recording gage in the lower part of the basin, collection of synoptic water samples that will be analyzed for trace elements and selected organic compounds, and location of sources of contaminants entering Johnson Creek.

PROJECT TITLE: Evaluation of Ground-water Resources of Jackson County, Oregon

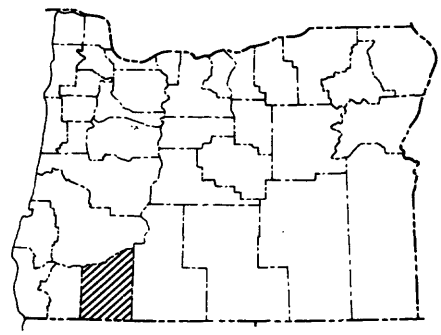
PROJECT NUMBER: OR-156

STUDY LOCATION: Jackson County, southwestern Oregon

COOPERATING AGENCY: Jackson County

PROJECT CHIEF: Joseph B. Gonthier

PROJECT DURATION: January 1989 to September 1990



PROBLEM: There is a perception that the shallow aquifers in the Bear Creek valley are extensively contaminated with nitrate from fertilizers and septic-tank leachate and evidence exists that there is a very high incidence of contamination by naturally occurring arsenic, boron, fluoride, sodium, and chloride in the deeper aquifers. The distribution and source of these contaminants is not well known and the possibility exists that other harmful trace elements may be present. In addition, the well density in some parts of the county is very high and increasing. The low-permeability bedrock combined with the high density of wells probably causes deep, narrow, localized cones of depression during the dry season each year when ground-water pumpage is greatest. However, very few data exist to determine whether long-term water-level declines are taking place or alternatively whether the declines are seasonal in nature. Without these data there is no way to assess the ability of local aquifers to support future growth.

OBJECTIVES: Select wells for an observation-well network to define and document changes in ground-water levels in Jackson County's principal aquifers. Using all available data, develop an understanding of the regional ground-water flow system. On the basis of the data collected and understanding of the regional system, design a long-term study which will quantify the ground-water and surface-water resources to the extent needed for proper management of the system.

APPROACH: Select 40-80 wells in and around pumping centers within the Bear Creek, Applegate, Sam's, and Evans valleys for monitoring water levels in the alluvial and bedrock aquifers. Measure water levels and specific conductance in these wells approximately every 2 months. To the extent possible, determine (1) the thickness of the alluvial aquifer and general distribution of other aquifers and (2) the hydraulic characteristics of the alluvial and other aquifers. Prepare a water-level map of the alluvial aquifer in Bear Creek valley. Use all available data on ground-water quality analysis which may describe the horizontal and vertical distribution of mineralized water within each principal aquifer unit. On the basis of the above work elements, write a proposal for future work to quantify the ground-water flow system to the extent needed for planning purposes.

PROGRESS: The Phase I study proposal was prepared and approved.

PLANS FOR FY 1989: About 60 wells will be selected and monitored approximately every 2 months for water levels and specific conductance, beginning in March 1989. Work will begin on describing the distribution and thickness of aquifer units in the study area. All available water-quality data will be gathered to help describe horizontal and vertical distribution of mineralized water with each principal aquifer unit.

PROJECT TITLE: Assessment of nutrient controls of Upper Klamath Lake, Oregon

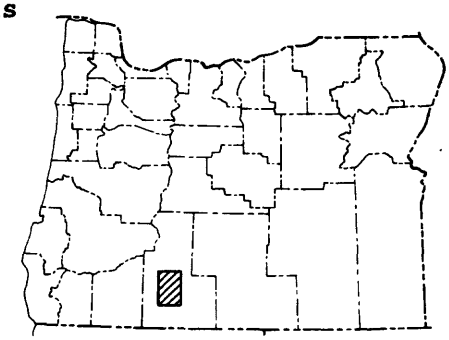
PROJECT NUMBER: OR-157

STUDY LOCATION: Klamath County, southwestern Oregon

COOPERATING AGENCY: City of Klamath Falls and Klamath Tribe

PROJECT CHIEF: Gilbert C. Bortleson

PROJECT DURATION: January 1989 to September 1990



PROBLEM: Upper Klamath Lake is presently a hypereutrophic lake that supports an abundant algal population. Although the eutrophic condition of the lake is natural, accelerated eutrophication may have been caused by agricultural settlement in the basin and changes in hydrologic regime of the lake after construction of the outlet dam in 1917.

OBJECTIVES: The objective of this study is to develop a phased work plan to address the following concerns:

(1) review and refine the the components of the nutrient budget previously developed for the lake; and

(2) review and conduct studies on the possible relation between accelerated eutrophication and (a) agricultural settlement in the basin and (b) changes in the hydrologic regime of the lake.

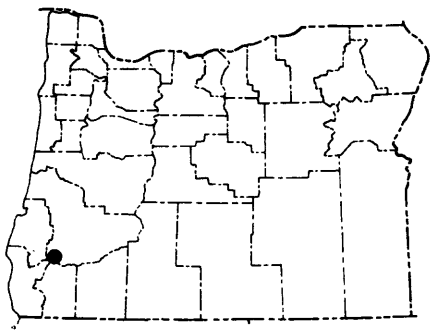
APPROACH: A detailed work plan of study will be developed in Phase I to achieve the objectives outlined. The results of the work plan will be in a published report that will include a detailed approach for further study. The work plan also will reflect the review and comments from research limnologists within the U.S. Geological Survey.

At least one public meeting will be held to obtain input to the work from citizen groups and agencies involved in water and land resources in Upper Klamath Lake. Water-quality problems related to nonpoint-source issues by their very nature require the interaction of various groups.

PROGRESS: The initial proposal to develop a work plan of study has been prepared and approved.

PLANS FOR FY 1989: Conduct a review of all available literature about Klamath Lake and its eutrophic conditions. Consult with limnologists to insure all important aspects of study are addressed. Organize a public meeting in the Klamath Falls area in the summer of 1989. Begin writing report describing Phase II work plans.

PROJECT TITLE: The Effects of Fire-induced Erosion on Stream Channels and Aquatic Habitat, South Fork Cow Creek, Oregon



PROJECT NUMBER: WA-326

STUDY LOCATION: Douglas County, southwestern Oregon

COOPERATING AGENCY: None--U.S. Geological Survey funds only

PROJECT CHIEF: Gary L. Gallino

PROJECT DURATION: Project complete except report

PROBLEM: Fire is an important factor that controls the type and distribution of vegetation in the Pacific Northwest and also contributes to the evolution of the landscape because rates of erosion are known to be accelerated for some period following wildfire. In the summer of 1987, 3,390 km^2 (square kilometers) of forest area was burned in the western United States; these fires, including a large burn in southwest Oregon, are likely to result in accelerated hillslope erosion and associated downstream impacts. In response to these fires, each affected National Forest was required to develop Rehabilitation/Salvage Plans. Although research carried out at this time can do little to help forest planners retroactively confront the planning problems they had in trying to develop responsive rehabilitation plans, it will provide a more sound understanding on which to base future planning decisions.

OBJECTIVES: The processes and timing of sediment movement eroded from hillslopes to and through a stream system following a major forest fire in the Pacific Northwest will be described. The effect of "hot burn" on geomorphic processes that deliver sediment from hillslopes to stream channels in a severely burned watershed and the extent, range, and time of downstream impacts from increased erosion on hillslopes in the headwater of the basin will be measured.

APPROACH: Topographic changes will be sequentially measured along hillslope profiles and channel cross-sections in order to semi-quantitatively estimate hillslope erosion, debris-flow occurrence, and downstream channel response during the first rainy season following wildfire. These measurements will be supplemented by photograph replication, mapping, and replication of stream-structure inventories

PROGRESS: All fieldwork is completed. A report describing the study results has been completed and is in the review process.

PLANS FOR FY 1989: The report will be revised according to review comments and submitted for Director's approval.

PROJECT TITLE: Puget Sound-Willamette Trough regional aquifer system analysis

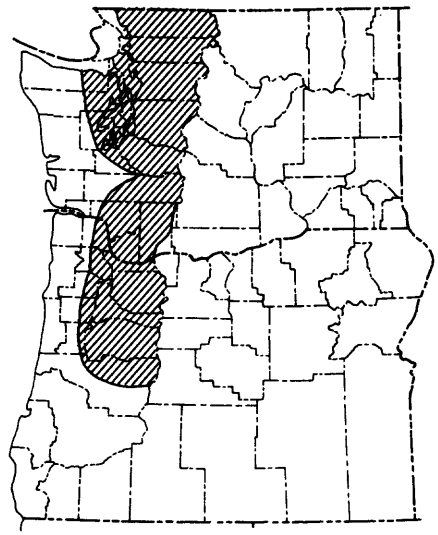
PROJECT NUMBER: WA-336

STUDY LOCATION: Western Oregon and Washington

COOPERATING AGENCY: None--U.S. Geological Survey funds only

PROJECT CHIEF: John J. Vacarro, Tacoma, Washington

PROJECT DURATION: January 1989 to September 1994



PROBLEM: The Puget Sound-Willamette Trough regional aquifer system is one of the 28 regional aquifers chosen for study under the the U.S. Geological Survey Regional Aquifer System Analysis (RASA) program. The States of Washington and Oregon are very interested in this study because over 70 percent of their population resides within the study area boundaries. Within the project area, such information as quantity and direction of ground-water flow, lengths of flow paths, locations of ground-water discharges, stream-aquifer interaction, relations with older rock materials, and continuity between aquifer units is largely unknown. All of these topics require better definition; lack of that information impairs the ability of managers to make knowledgeable decisions.

OBJECTIVES: The primary goal of this program is to obtain a better understanding of the regional ground-water system. To achieve this goal, the following objectives have been defined: (1) describe the geologic framework of the regional aquifer system, (2) describe the geohydrologic characteristics of the regional aquifer system, (3) describe the regional flow system, (4) estimate the water budget for selected areas of the aquifer system, (5) determine the present water quality and variations of native water quality and water-rock interactions along selected ground-water flow paths, and (6) use ground-water-flow models to synthesize the geohydrologic data and concepts on how the regional flow system operates.

APPROACH: The first year of effort will consist of a planning stage or "pre-RASA" study. We will begin the gathering and analyzing existing data and studies. Available information will be mapped and analyzed on a regional scale. Trends and variations of hydrologic and water-quality information will be studied in conjunction with available geologic information. This initial analysis will attempt to see if the available information, including data on discharge, recharge, runoff, and hydraulic characteristics, and results from local studies allow construction of a conceptual model of ground-water flow. This element will identify where information on the regional system is grossly lacking. A plan of study will be formulated by the project chief identifying the timeframe, manpower, costs, and steps to be taken for completion of the study.

PROGRESS: Project proposal was completed and approved.

PLANS FOR FY 1989: Available information will be mapped and analyzed on a regional scale. A plan of study will be formulated by the project chief identifying the timeframe, manpower, costs, and steps to be taken for completion of the study.

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