Water Resources Research Grant Program
Project Descriptions
Fiscal Year 1985

By Branch of Research Grants and Contracts

U.S. GEOLOGICAL SURVEY Open-File Report 85—687
1985

UNITED STATES DEPARTMENT OF THE INTERIOR

DONALD PAUL HODEL, Secretary

GEOLOGICAL SURVEY

Dallas L. Peck, Director

For additional information
write to:

Chief Branch of Research
Grants and Contracts
U.S. Geological Survey
426 National Center
12201 Sunrise Valley Drive
Reston, Virginia 22092

Copies of this report can be
purchased from:

Open-File Services Section
Western Distribution Branch
U.S. Geological Survey
Box 25425, Federal Center
Denver, Colorado 89225

PREFACE

In January 1985, the U.S. Geological Survey (USGS) was assigned responsibility for administering the functions of the Water Resources Research Act of 1984 (Public Law 98-242). The first appropriation under this Act was the Department of the Interior Appropriation Bill in fiscal year 1985. Under section 105 of the Act, $2.3 million was provided in the appropriation bill to be issued for research grants, on a matching basis, to qualified groups as defined in the legislation. An announcement was issued by the USGS on January 15, 1985, requesting applications for grants to be funded under the Act with a deadline for submittal of April 15, 1985.

In all, 368 applications were received, requesting funds totaling approximately $33 million. Each proposal was evaluated by government and nongovernment experts in the same technical field as the applicant. Twenty-four proposals were selected for funding based on the evaluations, the funds available, and the areas of research that were considered to be the most important.

INTRODUCTION

This report contains information on each of the 24 projects funded in FY 1985 under section 105 of Public Law 98-242 and includes the grant number, the title of the project, the principal investigator(s), the performing organization, the period of performance, and a brief description of the work to be carried out.

CONTENTS

PROJECT INFORMATION

GRANT NUMBER:	14-08-0001-G-1130
PROJECT TITLE:	Analysis of Soil-Water Movement on a Sandy Hillslope
PERFORMING ORGANIZATION:	New Mexico Institute of Mining and Technology, Socorro, NM 87801
PRINCIPAL INVESTIGATOR(S):	Daniel B. Stephens
START DATE:	September 1, 1985
COMPLETION DATE:	August 31, 1988

PROJECT DESCRIPTION:

The principal objective of the research is to improve the understanding of the role of the unsaturated zone within the hydrologic cycle, in particular, as it may relate to ground-water recharge. Mechanisms that may control lateral flow in the unsaturated zone on hillslopes--mechanisms such as topographic slope, stratification and heterogeneity, unsaturated hydraulic properties, and precipitation and evaporation characteristics--will be evaluated. The predictive capability of analytical and numerical models which may be applicable to unsaturated flow on a hillslope that is not underlain at shallow depth by an impermeable layer will be studied.

The approach will be to establish a network along a hillslope transect to monitor soil-water potential gradients with tensiometers and moisture content by neutron logging. Tracers, buried at different depths at several different topographic locations along the transect, will be used to map the direction of soil-water movement following precipitation events. Laboratory analyses of field samples will be used to characterize the hydraulic properties that are required input in analytical and numerical models of soil-water movement on hillslopes. The field results will be compared to model predictions of the direction and rate of soil-water movement. Depending upon the agreement of results, the numerical models may be modified to include moisture dependent anisotrophy.

PROJECT INFORMATION

GRANT NUMBER:	14-08-0001-G-1133
PROJECT TITLE:	Aquifer Recharge - Electrical Resistivity Relationships
PERFORMING ORGANIZATION:	University of Nebraska--Lincoln Department of Civil Engineering Lincoln, NE 68588
PRINCIPAL INVESTIGATOR(S):	William E. Kelly
START DATE:	September 1, 1985
COMPLETION DATE:	August 30, 1988

PROJECT DESCRIPTION:

This research is directed at extending the quantitative capabilities of surface geoelectrics to include estimating the properties of the unsaturated or vadose zone controlling ground-water recharge. A three-phase study will consist of: (1) development of the theoretical background for this application, (2) a laboratory study, and (3) a field validation of the proposed methodology at several sites in Nebraska where field recharge studies will be carried out. The initial work will deal primarily with the first two phases.

The objectives of this research are the following:

(1) Establish the appropriate electrical parameters to be determined for different recharge situations using theoretical models.

(2) Develop geoelectrical models for the different cases to determine if the appropriate electrical parameters can be obtained by sounding.

(3) Conduct a laboratory study to determine the electrical properties of typical unsaturated sediments for the range of moisture contents and soil water resistivities likely to be encountered in the field.

(4) Develop a methodology for estimating recharge properties with geoelectric methods.

PROJECT INFORMATION

GRANT NUMBER:	14-08-0001-G-1136
PROJECT TITLE:	Biodegradation of Trichloroethylene and Biomanipulation of Aquifers
PERFORMING ORGANIZATION:	Princeton University Department of Civil Engineering Princeton, NJ 08544
PRINCIPAL INVESTIGATOR(S):	P. R. Jaffe C. D. Milly
START DATE:	September 1, 1985
COMPLETION DATE:	August 31, 1988

PROJECT DESCRIPTION:

This research will study the multifaceted problem of biodegradation of trichloroethylene (TCE) and biomanipulation of aquifers through an interdisciplinary attack employing the methods of microbiology, groundwater chemical hydrology, and engineering. The work will identify and quantify the environmental factors controlling biodegradation and investigate the dynamics of biomanipulation. Specifically, the work has the following objectives:

(1) Determine the appropriate or optimal soil environment for TCE biodegradation, with special attention given to TCE toxicity levels, redox conditions, and carbon sources.

(2) Measure TCE biodegradation rates and relate them to the uptake rate of a metabolite, the formation rate of a product, and the microbial biomass.

(3) Measure TCE degradation and test models of biofilm dynamics, in steady flows through porous media.

(4) Evaluate the potential of aquifer biomanipulation as a strategy for enhancement of TCE biodegradation.

The toxicological response of microbes to increasing TCE concentrations will be determined in batch experiments with soil under several redox environments: oxygen respiration, fermentation, nitrate reduction, sulfate reduction, and methanogenesis. These samples will be monitored for signs of TCE degradation. Through static experiments, the relation among the TCE degradation rate, the substrate uptake rate, and the microbial biomass will be established. The applicability of these findings to the process of degradation in continuous flow columns, which simulate the conditions of aquifers by including the spatial factor, will be studied.

PROJECT INFORMATION

GRANT NUMBER:	14-08-0001-G-1135
PROJECT TITLE:	Development of Purge and Trap with Whole Column Cryotrapping for the Analysis of Ground Water Contaminated with Organic Compounds
PERFORMING ORGANIZATION:	Oregon Graduate Center 19600 N.W. VonNewman Drive Beaverton, WA 97006-1999
PRINCIPAL INVESTIGATOR(S):	James F. Pankow
START DATE:	September 30, 1985
COMPLETION DATE:	September 29, 1988

PROJECT DESCRIPTION:

This research will be oriented toward full development of the Purge and Trap with Whole Column Cryotrapping (PT/WCC) method for use in the determination of organic compounds in ground water. The following elements will be included in the project: (1) investigation of the efficiency of the PT/WCC cryotrapping step as a function of trapping temperature and column film thickness; (2) comparison of the results obtained in (1) with the results of an investigation of "partial" column cryotrapping (PCC) as applied with commercially available narrow band cryotraps; (3) investigation of utility of different column coating types in PT/WCC; (4) optimization of the use of capillary gas chromatography in PT/WCC to extend the PT method to less volatile compounds; (5) application of the flame ionization detector, Hall detector, and electron capture detector for use in PT/WCC as cost-effective alternatives to the MS detector in ground-water analyses; and (6) evaluation of the fully developed PT/WCC methods with real ground-water samples obtained from sites currently under study.

PROJECT INFORMATION

GRANT NUMBER:	14-08-0001-G-1142
PROJECT TITLE:	Ground-Water Tracing with Stable Isotopes of Chlorine: Uses and Limitations
PERFORMING ORGANIZATION:	University of Arizona Department of Geoscience Tucson, AZ 85721
PRINCIPAL INVESTIGATOR(S):	Austin Long Ronald Kauffman Stanley Davis
START DATE:	September 1, 1985
COMPLETION DATE:	February 28, 1987

PROJECT DESCRIPTION:

The objective of this proposed research is to perform a series of integrated laboratory/field experiments to test the tracing potential of the chlorine stable isotope ratio 37/35 parameter. A perfect isotopic ground-water tracer is conservative; it moves at exactly the same rate as the average water molecule without sources or sinks along the way, and does not change its isotopic composition during its travel. Chloride, although not perfect, is known to fulfill reasonably well all but the constancy of the isotopic composition. This project is designed to fill this gap in our knowledge and to establish the conditions necessary for using 37/35 as an environmental tracer.

Specifically, the research will measure 37/35 at and downgradient from sewage treatment plants in an alluvial aquifer and design clay column laboratory experiments to measure chlorine isotope fractionation induced by its passage through clays and matrix. Results of these investigations will indicate the extent to which the chlorine isotope ratio can be used as a ground-water tracer. As a tracing tool, the chlorine ratio will aid in evaluating the extent of chlorine pollution from such sources as industrial wastes, mining operations, road salting, and salt-water intrusion.

PROJECT INFORMATION

GRANT NUMBER:	14-08-0001-G-1126
PROJECT TITLE:	Investigation of the Transport and Fate of Gasoline Hydrocarbon Pollutants in Ground Water
PERFORMING ORGANIZATION:	Orange County Water District P.O. Box 8300 Fountain Valley, CA 92728
PRINCIPAL INVESTIGATOR(S):	David Argo Harry Ridgeway
START DATE:	September 26, 1985
COMPLETION DATE:	September 29, 1987

PROJECT DESCRIPTION:

This study will provide insight into the physicochemical and biological factors which govern the transport and fate of gasoline hydrocarbon pollutants in the ground-water environment. A major goal of the study will be to evaluate the potential usefulness of selected petroleum-degrading microorganisms in enhancing in situ biodegradation. The primary objectives of the proposed research are sixfold, including (1) identification and quantification of the major and minor hydrocarbon pollutants associated with gasoline contamination of the aquifer system; (2) delineation of the physicochemical and biological factors which govern the migration and transformation of hydrocarbons in ground water; (3) enumeration and identification of hydrocarbon-oxidizing microorganisms and the selection of those bacteria exhibiting the greatest hydrocarbon degradation potential; (4) comparison of microbial hydrocarbon-oxidizing activity among gasoline-contaminated and uncontaminated control sites; (5) investigation of nutritional and other environmental conditions which influence biotransformations of hydrocarbon pollutants; and (6) evaluation of nutrient-infiltration and bacterial-seeding techniques for enhancing in situ hydrocarbon-degradation in gasoline-polluted ground water. The research will involve the application of computerized gas chromatographic methods of analyses with conventional and mass-spectrometry detection, the use of surrogate radiolabeled hydrocarbon probes, and sophisticated microbiological techniques for the detection and selection of hydrocarbon-degrading bacteria.

PROJECT DESCRIPTION

GRANT NUMBER:	14-08-0001-G-1139
PROJECT TITLE:	Microbiological Cleanup of Pentachlorophenol-Contaminated Ground Water
PERFORMING ORGANIZATION:	International Tree Corp. 1055 E. Wayzata Blvd. # 211 Wayzata, MN 55391
PRINCIPAL INVESTIGATOR(S):	James M. Knoblach
START DATE:	September 30, 1985
COMPLETION DATE:	September 29, 1986

PROJECT DESCRIPTION:

In this research, PCP-contaminated ground water from an aquifer beneath a Minnesota wood treatment facility will be pumped from the ground and decontaminated using strains of Flavobacterium that are able to degrade PCP completely. The work will include:

(1) Demonstration of the effectiveness of using pentachlorophenol-degrading bacteria of the genus Flavobacterium to remove the chlorinated phenols from large volumes of contaminated ground water.

(2) Investigation of the performance of two continuous flow systems (serial well-mixed bioreactor and fixed-biofilm percolating filter) which utilize these bacteria.

(3) Determination of optimum operating parameters for these continuous flow systems. There will be a compromise between optimum decontamination and optimum throughput for these systems which will be evaluated.

(4) Determination of the place where biological decontamination fits in the overall process of water decontamination. The effectiveness of the system will be determined by its cost and physical size, as well as its ability to decontaminate water. Investigation of whether a compromised biological treatment combined with conventional activated charcoal treatment could provide the most cost-effective treatment system.

PROJECT INFORMATION

GRANT NUMBER:	14-08-0001-G-1140
PROJECT TITLE:	Nitrate Retention as it Affects Ground-Water Pollution in Mid-Atlantic Soils
PERFORMING ORGANIZATION:	University of Delaware Plant Science Department Newark, DE 19717-1303
PRINCIPAL INVESTIGATOR(S):	Donald L. Sparks
START DATE:	September 15, 1985
COMPLETION DATE:	September 14, 1987

PROJECT DESCRIPTION:

This research will seek to determine the nitrate retention potential for important soil types of the Mid-Atlantic Region, to test the hypothesis that other anions competing with NO_3^- affect the degree of retention, and to determine the kinetics of nitrate adsorption and desorption in the above soils.

This study will include measurements of the soils' charge properties, including cation and anion exchange capacities, point of zero charges, and the magnitude of NO_3^- retention on a wide range of soil types in the Mid-Atlantic Region. Each horizon of the soil profiles will be investigated to determine how soil physicochemical properties affect NO_3^- retention. In addition, the rate of NO_3^- adsorption and desorption in the soils will be investigated using a flow technique to model solute transport reactions of NO_3^- in the soils.

PROJECT INFORMATION

GRANT NUMBER:	14-08-0001-G-1132
PROJECT TITLE:	Behavior of Toxic Metals in Lakes and Streams: Use of Naturally Occurring Radioactive Metals as Tracers of Biochemical Processes
PERFORMING ORGANIZATION:	Massachusetts Institute of Technology Cambridge, MA 02149
PRINCIPAL INVESTIGATOR(S):	Harold F. Hemond
START DATE:	September 1, 1985
COMPLETION DATE:	August 31, 1987

PROJECT DESCRIPTION:

This research will use a mass balance and solid phase speciation analysis approach, focusing on those critical processes in order to yield a detailed yet holistic description of the biogeochemistry of metals in surface-water supplies. The objectives of the project are threefold: (1) to quantify and evaluate the effect of organic complexing agents on the total concentration of metals in streams, (2) to identify the particulate materials that scavenge metals from solution and to test the hypothesis that such particles control removal of dissolved metals from the water column, and (3) to gain a detailed knowledge of the cycle of remobilization and scavenging that takes place near the sediment-water interface under the influence of changing redox conditions.

The approach will be to use naturally occurring radioactive metals as tracers of the behavior of their stable counterparts. Thus, radioisotopes can be measured at extremely low levels and do not require the same stringently controlled "clean lab" techniques that are often needed for trace metal analyses.

PROJECT INFORMATION

GRANT NUMBER:	14-08-0001-G-1137
PROJECT TITLE:	Binding of Xenobiotics to Humic Material in the Aquatic Environment
PERFORMING ORGANIZATION:	Pennsylvania State University 207 Willard Bldg. University Park, PA 16802
PRINCIPAL INVESTIGATOR(S):	J. Bollag
START DATE:	September 15, 1985
COMPLETION DATE:	September 14, 1988

PROJECT DESCRIPTION:

This study will cover the mechanism of complex-formation between xenobiotics and humic material by determining the effect of microbial enzymes, in particular oxidoreductases and abiotic catalysts such as metals and clays.

The investigation will include the following objectives:

(1) To study the binding of ^{14}C-labeled xenobiotics (halogenated phenols, alkylated and halogenated anilines) to humic and fulvic acids in the presence of oxidoreductive enzymes (laccases, tyrosinases, and peroxidases), metal ions, or clay.

(2) To immobilize oxidoreductases to various support material to enhance the binding of xenobiotics to humic substances. Addition of enzymes in this form in aquatic systems should prevent their decomposition.

(3) To compare the transformation of selected xenobiotics (for instance, substituted phenols and anilines) by free and immobilized oxidoreductases.

(4) To incorporate immobilized oxidoreductases into an aquatic system and to evaluate their effect on selected xenobiotics.

(5) To investigate the possible release of bound xenobiotics from humic and fulvic acids through microbial activity.

PROJECT INFORMATION

GRANT NUMBER:	14-08-0001-G-1154
PROJECT TITLE:	Effects of Microtopography and Vegetation Cover Density on Infiltration and Runoff
PERFORMING ORGANIZATION:	University of Washington Geological Sciences/Forest Resources Seattle, WA 98195
PRINCIPAL INVESTIGATOR(S):	Thomas Dunne
START DATE:	September 30, 1985
COMPLETION DATE:	September 29, 1988

PROJECT DESCRIPTION:

The proposed research will provide a means for clarifying and unifying the interpretation of many field measurements of infiltration, and for improving the computation of runoff by explicitly incorporating the feedback effects of runoff characteristics on infiltration. The research addresses the increase in infiltration rate which occurs at one location as a function of rainfall intensity and systematically along a hillslope under a single rainfall intensity and soil type. The effects occur because of the progressive inundation of more permeable microtopography as local rate and depth of runoff increase. The effects, in turn, reflect the interaction of various factors, including land use.

This research will investigate these effects through mathematical modeling of flow and infiltration on idealized and natural hillslope surfaces; the modeling will be based on detailed field measurements of runoff characteristics and infiltration, collected during experiments for a study of soil erosion. The experiments provide more detailed, simultaneous information on infiltration, the hydraulic characteristics of sheetflow, microtopography, and vegetation than is currently available elsewhere. The necessary mathematical models of one-dimensional and two-dimensional flow have already been developed by the writers.

PROJECT INFORMATION

GRANT NUMBER:	14-08-0001-G-1147
PROJECT TITLE:	Hydrology and Sedimentology Model for Dynamic Rill System
PERFORMING ORGANIZATION:	University of Kentucky Research Foundation 105 Kincaid Hall Lexington, KY 40506-0057
PRINCIPAL INVESTIGATOR(S):	Billy J. Barfield
START DATE:	September 15, 1985
COMPLETION DATE:	September 14, 1988

PROJECT DESCRIPTION:

The objectives of this work are to develop the following:

(1) A stochastic predictor of developing rill drainage networks as affected by soil, topographic, and land-use conditions.

(2) A model of runoff to developing rills and flow within rills.

(3) A model of sediment yield to developing rills.

(4) A model of rill growth and development.

A model of the developing rill drainage system will be developed based on the stochastic properties of a given soil tillage operation and conservation practice system, utilizing a combination of networking theory and forward-moving random walk. A deterministic runoff-erosion model will be applied to the described drainage system and a prediction made of topographic changes resulting from the erosion process. The new plot characteristics will then be used to generate a new network. This interaction is necessary since the deterministic model does not directly predict the random variations in rill channel morphology that one observes in nature.

PROJECT INFORMATION

GRANT NUMBER:	14-08-0001-G-1138
PROJECT TITLE:	Influence of Spatial Variability and Scale Effects on the Parameterization of Hydrologic Responses
PERFORMING ORGANIZATION:	Princeton University Department of Civil Engineering Princeton, NJ 08544
PRINCIPAL INVESTIGATOR(S):	Eric F. Wood
START DATE:	September 1, 1985
COMPLETION DATE:	August 31, 1987

PROJECT DESCRIPTION:

The objectives of this research are to investigate the effect of spatial variability on the parameterization of hydrologic rainfall-runoff models over a range of scales, to develop the concept of a representative elementary area (REA) for rainfall-runoff models of spatially averaged hydrologic processes, and to investigate the transition of hydrologic response as the averaging area passes from smaller to larger scales.

For derivation of the statistics of the spatially averaged response, the study will use analytical/numerical procedures for intrascale averaging (that is, areas less than an REA) and use a hybrid analytical/numerical computer simulation approach to investigate interscale averaging (that is, areas greater than an REA). The determination of the REA size is a task of the research and initially will utilize work from statistical mechanics and statistical turbulence theory. It is envisioned that the linkage between adjacent scales will be through the REA-averaged smaller scale rainfall-runoff representation (and its averaged output) and the larger scale (lumped) rainfall-runoff representation. Linkages between parameterizations at these different scales will be investigated using "feature sensitivity analysis," which has been used in quantum chemistry.

PROJECT INFORMATION

GRANT NUMBER:	14-08-0001-G-1146
PROJECT TITLE:	Investigation of the Structural Features and Interactions of Aquatic Fulvic Acids in Surface and Ground Water
PERFORMING ORGANIZATION:	North Texas State University Box 13078 Denton, TX 76203-3078
PRINCIPAL INVESTIGATOR(S):	F. Y. Saleh
START DATE:	September 1, 1985
COMPLETION DATE:	August 31, 1988

PROJECT DESCRIPTION:

The objective of this research is to extend current knowledge on the structural features and interactions of water fulvic acid (WFA) extracted from selected streams and lakes. The proposal focuses on two approaches that can lead to better understanding of the structure and reactivity of WFA. The first approach relates to the stepwise fragmentation of WFA components, using mild fractionation by reversed-phase high-pressure liquid chromatography (RP-HPLC). This will be followed by spectroscopic characterization, including ^{13}C-nuclear magnetic resonance (NMR), mass spectroscopy (MS), and electron spin resonance (ESR). The second approach involves the utilization of ESR to study the nature and identity of free radicals in WFA.

PROJECT INFORMATION

GRANT NUMBER:	14-08-0001-G-1143
PROJECT TITLE:	Optimal Sampling of the Rainfall and Runoff Processes and Its Relationship to Rainfall Structure and Basin Characteristics
PERFORMING ORGANIZATION:	Massachusetts Institute of Technology Department of Civil Engineering Cambridge, MA 02149
PRINCIPAL INVESTIGATOR(S):	Rafael L. Bras
START DATE:	September 30, 1985
COMPLETION DATE:	September 29, 1988

PROJECT DESCRIPTION:

The main objectives of this work are: (1) to determine the optimal sampling rules which are related to basin and rainfall (climate) characteristics, and (2) to evaluate the obtained sampling schemes. Discharge from the basin is obtained by coupling a parameterization of the rainfall process and a characterization of basin response. The coupling is via a convolution equation whose transfer function represents the basin's response in terms of fluvial geomorphology. The representations use physical parameters, whose influence on the monitoring network design is then studied and quantified. The monitoring network design problem is defined as a mathematical optimization problem, whose decision variables include the number of rain gages and the time sampling intervals of rainfall and discharge. The optimization formulation accounts for our inability to know the processes continuously in time and space. The optimal solution represents a tradeoff between sampling accuracy and measurement costs, with accuracy being quantified by the difference between the observed and real processes. The effectiveness of the derived sampling schemes will be tested using data from several basins.

rKOJECT INFORMATION

GRANT NUMBER:	14-08-0001-G-1145
PROJECT TITLE:	Multiobjective Reservoir Operations Using Forecasts of Water Supply and Water Use
PERFORMING ORGANIZATION:	Interstate Commission on the Potomac River Basin 6110 Executive Blvd. Rockville, MD 20852-3903
PRINCIPAL INVESTIGATOR(S):	James A. Smith Daniel P. Sheer
START DATE:	September 30, 1985
COMPLETION DATE:	September 29, 1987

PROJECT DESCRIPTION:

This research concerns the development of operating rules for a system of reservoirs. First, reservoir operating rules are developed that incorporate water-use forecasts. Second, an operational water-use forecasting model is developed.

The approach that is taken for development of operating rules is to obtain the optimal policy within a restricted class of operating rules, which will be referred to as parametric operating rules. Heuristically, a parametric operating rule is one that specifies releases from a reservoir system at time "t" as a function of forecasts based on data collected up until time "t" and a finite number of real-valued parameters.

An operational water-use forecasting system will be developed based on a random coefficient regression model of water use. The principal explanatory variables are meteorological variables and lagged water use.

PROJECT INFORMATION

GRANT NUMBER:	14-08-0001-G-1144
PROJECT TITLE:	A Robustness Constraint for Nonlinear Programming Models of Water Resource Systems
PERFORMING ORGANIZATION:	University of Illinois Department of Civil Engineering 208 North Romine Urbana, IL 61801
PRINCIPAL INVESTIGATOR(S):	E. Downey Brill
START DATE:	September 15, 1985
COMPLETION DATE:	September 14, 1987

PROJECT DESCRIPTION:

The primary objective of the research is to develop and to investigate the usefulness of a method for incorporating a robustness measure that is based on the notion of system sensitivity into nonlinear optimization models of water resources systems. Robustness is defined for this research as the ability of a model solution to maintain a level of performance that meets the system design criteria even if the actual values of model parameters are not exactly the same as the values assumed for design. An existing least-cost nonlinear optimization model of a secondary wastewater treatment plant design problem will be used to develop, evaluate, and illustrate the method. The mathematical approach, however, can be applied to many other water resources models. One preliminary set of analyses for the example problem suggests that the robustness measure may have the potential to produce solutions that are different from typical least-cost solutions and more consistent with common design practices that reflect concerns like robustness.

PROJECT INFORMATION

GRANT NUMBER:	14-08-0001-G-1141
PROJECT TITLE:	Development of Methodology and Criteria for Irrigation Management Under Limited Water Conditions
PERFORMING ORGANIZATION:	University of Nebraska--Lincoln Department of Agricultural Economics Lincoln, NE 68583-0922
PRINCIPAL INVESTIGATOR(S):	Raymond J. Supalla
START DATE:	September 9, 1985
COMPLETION DATE:	September 8, 1988

PROJECT DESCRIPTION:

This research will develop irrigation management criteria for irrigation scheduling, crop selection, and irrigation system design under limited water conditions. Specifically, the objectives are the following:

(1) To develop irrigation scheduling methods for seasonal and multiseasonal water-limiting conditions.

(2) To develop methods of selecting optimal cropping systems under water-limiting conditions.

(3) To evaluate irrigation system design modifications for adjusting to water-limiting conditions.

Dynamic programming will be used as the basic methodology for addressing the irrigation scheduling and cropping systems objectives. This approach will allow one to identify the intrayear and interyear sequences of management practices which will maximize profits given a selected array of water availability and irrigation system conditions.

The irrigations system design objective will be addressed in the context of the first two objectives by assessing the implications of varying conditions. The design variables to be considered include system type (high pressure sprinklers, low pressure sprinklers, and corner systems) and flow rate.

PROJECT INFORMATION

GRANT NUMBER:	14-08-0001-G-1128
PROJECT TITLE:	Management of Surge Irrigation Systems
PERFORMING ORGANIZATION:	Colorado State University Fort Collins, CO 80523
PRINCIPAL INVESTIGATOR(S):	Terence H. Podmore
START DATE:	September 1, 1985
COMPLETION DATE:	August 31, 1987

PROJECT DESCRIPTION:

The goal of this project is to formulate management guidelines for surge irrigation system users in order to assist them in conserving irrigation water. The project will develop field data, management experience, and unified operational procedures. Specific objectives are the following:

(1) To formulate and test management strategies for surge irrigation in various field conditions.

(2) To evaluate resulting data using existing simulation programs.

(3) To revise and unify management procedures and to develop operational guidelines for surge irrigation systems.

Field tests will be set up with cooperating farmers in conditions of different soil type, slope, and flow rate for surge irrigation. The irrigations will be monitored using standard procedures (ASAE, 1984). Data will be analyzed using existing techniques (Izuno and Podmore, 1984) and management guidelines will be formulated using computer simulation. A final report will present the analysis and guidelines developed with examples.

PROJECT INFORMATION

GRANT NUMBER:	14-08-0001-G-1129
PROJECT TITLE:	Optimal Design Methods for Maximizing Water-Use Efficiency Utilizing Surge Flow Irrigation
PERFORMING ORGANIZATION:	University of Texas--Austin Department of Civil Engineering Austin, TX 78712
PRINCIPAL INVESTIGATOR(S):	Ernest T. Smerdon
START DATE:	September 1, 1985
COMPLETION DATE:	August 31, 1987

PROJECT DESCRIPTION:

This research will integrate all previous and current numerical modeling, optimization methods, field, and physical modeling research relating to surge irrigation. Specific objectives are to: (1) further investigate the effect of soil type and cycle ratio on infiltration during surge irrigation using field recirculating infiltrometer tests; (2) investigate the effect of infiltration on surge irrigation application and distribution efficiencies using the 200-foot model border/furrow at the University of Texas at Austin; (3) perform basic research concerning the effect of furrow geometry, roughness, and boundary conditions on the hydrodynamics of shallow cyclic waves (surges); (4) evaluate several numerical models of surge flow hydrodynamics; (5) incorporate the most robust and applicable numerical model of surge flow into an optimization model to determine the optimal surge flow parameters; (6) develop personal computer software based on the optimization model.

PROJECT INFORMATION

GRANT NUMBER:	14-08-0001-G-1150
PROJECT TITLE:	A Novel Two-Stage, Three-Phase Fluidized Bed Bioreactor with Immobilized Living Cells for Wastewater Treatment Applications
PERFORMING ORGANIZATION:	Ohio State University Research Foundation Chemical Engineering Department Columbus, OH 43212-1194
PRINCIPAL INVESTIGATOR(S):	L. S. Fan
START DATE:	September 23, 1985
COMPLETION DATE:	September 22, 1988

PROJECT DESCRIPTION:

The objective of the proposed research is to examine the fundamental hydrodynamic behavior of gas, liquid and bioparticle and intrinsic interaction between biofilm biodegradation and activated carbon adsorption. Effects of these fundamental characteristics on the overall reactor performance, and the principles of optimal design and operation for an innovative two-stage draft tube fluidized bed bioreactor, will be explored. Fundamental hydrodynamics of the phases will be studied using a high speed camera-video system and a dual electrical resistivity probe system. A complete model for phase mixing and flow will be constructed which, together with the intrinsic biodegradation and adsorption kinetics, will be used as the basic framework for modeling the pseudo-steady state and transient behavior of the fluidized bed bioreactor. Separate experiments will be conducted to evaluate model parameters.

PROJECT INFORMATION

GRANT NUMBER:	14-08-0001-G-1131
PROJECT TITLE:	Development of the Vacuum Freezing Multiple-Phase Transformation Process for Desalinization and Water Reuse
PERFORMING ORGANIZATION:	Calyxes Research and Development Corporation 730-A Rankin Road, N.E. Albuquerque, NM 87107
PRINCIPAL INVESTIGATOR(s):	Chen-Yen Cheng
START DATE:	September 15, 1985
COMPLETION DATE:	September 14, 1986

PROJECT DESCRIPTION:

This research will test the theory that low pressure water vapor formed in a vacuum freezing step can be directly or indirectly transformed into another water vapor, whose pressure is higher than the triple point pressure of water, in a reliable and economical method. This vapor transformation will be tested in coordination with a preceeding vacuum freezing step and the following ice-melting procedure.

In the VFMPT Process, the desired vapor transformation will be accomplished by a unique way that involves the following multiple-phase transformation operations: (a) a feed is flash vaporized in a vacuum freezing zone to form a first vapor and a first condensed mass containing solvent crystals and mother liquor, the pressure of the first vapor being lower than the triple point pressure of the solvent; (b) the first condensed mass is separated into a mass of purified solvent crystals and a concentrate in a crystal washing unit; (c) the first vapor is brought to a liquid state in a vapor liquefaction zone comprised of several sub-zones by a two-stage transformation involving vapor desublimation and desublimate melting operations; (d) a solvent stream is continuously vaporized in a thin film evaporator within a vapor generation zone to produce a continuous stream of second vapor whose pressure is somewhat higher than the triple point pressure of the solvent; (e) the solvent vapor is brought in contact with the purified solvent crystals to thereby melt the crystals and condense the vapor.

PROJECT INFORMATION

GRANT NUMBER:	14-08-0001-G-1134
PROJECT TITLE:	Financing Water and Sewer Extensions in Urban Growth Areas: Current Practices and Policy Alternatives
PERFORMING ORGANIZATION:	North Carolina State University Box 7912 Raleigh, NC 27695-7912
PRINCIPAL INVESTIGATOR(S):	Raymond J. Burby
START DATE:	September 1, 1985
COMPLETION DATE:	August 31, 1987

PROJECT DESCRIPTION:

Specific objectives of the research are the following:

(1) To describe current utility practices in financing the extension of water and sewer lines in North Carolina and the Southeast.

(2) To evaluate the extent to which extension financing practices comply with principles based on economic theory and sound community planning practice.

(3) To explain variation in utility water and sewer system financing practices in terms of technical, administrative, political/ institutional, and legal factors.

(4) To recommend steps that communities and State Government can take to improve water and sewer extension financing practices.

Key features of the research plan include the formulation of standards for evaluating utility financing practices based on both economic theory and community land use planning principles; a survey of over 300 water and sewer systems in the Southeast to describe the state of practice, as well as uncover innovative financing concepts; development of rigorous statistical models to explain variation in utility financing practices; in-depth case studies of four utilities; computer simulations of alternative financing methods; conduct of an invitational workshop for utility personnel, State and Federal officials, and representatives of the academic community to review the study findings and recommendations for utility financing practices.

PROJECT INFORMATION

GRANT NUMBER:	14-08-0001-G-1127
PROJECT TITLE:	Movement of Pesticides and Nutrients into Tile Drainage Water
PERFORMING ORGANIZATION:	Purdue University West Lafayette, IN 47907
PRINCIPAL INVESTIGATOR(S):	L. E. Sommers E. J. Kladivko
START DATE:	September 22, 1985
COMPLETION DATE:	September 21, 1988

PROJECT DESCRIPTION:

The general objective of this project is to evaluate loss of nutrients and pesticides from an agricultural system by leaching into subsurface tile drains. Specific objectives of the study are the following:

(1) To quantify concentration of pesticides and nutrients in subsurface tile flow.

(2) To estimate rate and uniformity of water flow into tile drains.

(3) To evaluate available models for predicting movement of solutes into tile drainage water.

Tile drainage water samples will be collected from a controlled, uniformly managed field of Clermont silt loam. Water samples will be analyzed for applied pesticides and nutrients. Soil core samples from the soil profile will be analyzed for residual pesticides. Spatial variability of water and chemical movement will be assessed by application of a Br^- tracer followed by intensive soil core sampling and analysis of the data with geostatistical techniques. Field-scale chemical breakthrough curves will help assess the relative importance of macropore flow in this soil. Evaluation of available pesticide fate models will be conducted with data from the field and laboratory studies.