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KEY=FLOW - WEBB LACI

GROUNDWATER OPTIMIZATION HANDBOOK

FLOW, CONTAMINANT TRANSPORT, AND CONJUNCTIVE MANAGEMENT

CRC Press Existing and impending water shortages argue for improving water quantity and quality management. Groundwater Optimization Handbook: Flow, Contaminant Transport, and Conjunctive Management helps you formulate and solve groundwater optimization problems to ensure sustainable supplies of adequate quality and quantity. It shows you how to more effectively use simulation-optimization (S-O) modeling, an economically valuable groundwater management tool that couples simulation models with mathematical optimization techniques. Written for readers of varying familiarity with groundwater hydrology and mathematical optimization, the handbook approaches complex problems realistically. Its techniques have been applied in many legal settings, with produced strategies providing up to 57% improvement over those developed without S-O modeling. These techniques supply constructible designs, planning and management strategies, and metrics for performance-based contracts. Learn how to: Recognize opportunities for applying S-O models Lead client, agency, and consultant personnel through the strategy design and adaptation process Formulate common situations as clear deterministic/stochastic and single/multiobjective mathematical optimization problems Distinguish between problem nonlinearities resulting from physical system characteristics versus management goals Create an S-O model appropriate for your specific needs or select an existing transferrable model Develop acceptable feasible solutions and compute optimal solutions Quantify tradeoffs between multiple objectives Evaluate and adapt a selected optimal strategy, or use it as a metric for comparison Drawing on the author’s numerous real-world designs and more than 30 years of research, consulting, and teaching experience, this practical handbook supplies design procedures, detailed flowcharts, solved problems, lessons learned, and diverse applications. It guides you through the maze of multiple objectives, constraints, and uncertainty to calculate the best strategies for managing flow, contamination, and conjunctive use of groundwater and surface water. Ancillary materials are available from the Downloads tab on the book page at www.crcpress.com.

MODELING GROUNDWATER FLOW AND CONTAMINANT TRANSPORT

Springer Science & Business Media In many parts of the world, groundwater resources are under increasing threat from growing demands, wasteful use, and contamination. To face the challenge, good planning and management practices are needed. A key to the management of groundwater is the ability to model the movement of fluids and contaminants in the subsurface. The purpose of this book is to construct conceptual and mathematical models that can provide the information required for making decisions associated with the management of groundwater resources, and the remediation of contaminated aquifers. The basic approach of this book is to accurately describe the underlying physics of groundwater flow and solute transport in heterogeneous porous media, starting at the microscopic level, and to rigorously derive their mathematical representation at the macroscopic levels. The well-posed, macroscopic mathematical models are formulated for saturated, single phase flow, as well as for unsaturated and multiphase flow, and for the transport of single and multiple chemical species. Numerical models are presented and computer codes are reviewed, as tools for solving the models. The problem of seawater intrusion into coastal aquifers is examined and modeled. The issues of uncertainty in model input data and output are addressed. The book concludes with a chapter on the management of groundwater resources. Although one of the main objectives of this book is to construct mathematical models, the amount of mathematics required is kept minimal.

FLOW AND CONTAMINANT TRANSPORT IN FRACTURED ROCK

Academic Press In the past two or three decades, fractured rock domains have received increasing attention not only in reservoir engineering and hydrology, but also in connection with geological isolation of radioactive waste. Locations in both the saturated and unsaturated zones have been under consideration because such repositories are sources of heat and potential sources of groundwater contamination. Thus, in addition to the transport of mass of fluid phases in single and multiphase flow, the issues of heat transport and mass transport of components have to be addressed.

CONTAMINANT TRANSPORT IN GROUNDWATER

PROCEEDINGS OF AN INTERNATIONAL SYMPOSIUM, STUTTGART, 4-6 APRIL 1989

CRC Press Proceeding of a symposium on Contaminant transport in groundwater held in Stuttgart, April 1989. Topics covered include: Field methods & data processing; Field studies & tracer experiments; Contaminant chemistry & column experiments; Modelling of chemistry coupled to transport; Dispersion theory & transport in fractured media; Numerical aspects of modelling, parameter identification & optimization; Multiphase flow & transport in saturated soil.

GROUNDWATER HYDRAULICS AND POLLUTANT TRANSPORT

Waveland Press This rigorous and comprehensive text provides fundamental information geared to students in either engineering or natural sciences courses dealing with groundwater. The first four chapters consider subsurface fluid flow, while the remaining twelve chapters cover subsurface contamination and pollutant transport. Charbeneau views the application of groundwater hydraulics and pollutant transport as a quantitative field. Although quantitative methods are exact, the fields of study are usually homogeneous; laboratory and field methods provide estimates for ideal (not real) fields. What impact does the use of ideal fields have on model predictions? The unknown answer places the study of subsurface flow of water and chemical mass transport in a prime position for continued researchand this readily accessible text opens the door to that research. Outstanding features include: Comprehensive, rigorous, and highly accessible coverageIncludes information on groundwater flow, well hydraulics, field methods for parameter estimation, hydrologic relationships between surface water and groundwater hydrology, mass transport of contaminants by advection, diffusion and dispersion, and special problems posed by nonaqueous phase liquids (oils). Strong focus on applicationsEmpowers readers with knowledge and methodologies that they can use in real, day-to-day practices. Includes 66 worked examples and 178 problems integrated throughout. Examination of standard software being used in the industry todayExposes readers to the USGS MODFLOW model (the most widely used numerical simulation model for groundwater flow) and the USGS MOC3D. These models, together with a user interface (MFI), can be downloaded from the Internet.

APPLIED FLOW AND SOLUTE TRANSPORT MODELING IN AQUIFERS

FUNDAMENTAL PRINCIPLES AND ANALYTICAL AND NUMERICAL METHODS

CRC Press Over recent years, important contributions on the topic of solving various aquifer problems have been presented in numerous papers and reports. The scattered and wide-ranging nature of this information has made finding solutions and best practices difficult. Comprehensive and self-contained, Applied Flow and Solute Transport Modeling in Aquifers compiles the scattered literature on the topic into a single-source reference of the most up-to-date information in the field. Based on Dr. Batu's 20 years of practical experience tackling aquifer problems in a myriad of settings, the book addresses essentially all currently applied aquifer flow and contaminant transport solutions, combines theory with practical applications, covers both analytical and numerical solutions, and includes solutions to real world contaminant transport modeling scenarios. Batu approaches the subject from the practicing consultant's point of view and elucidates the difficulties real world professionals have faced in solving aquifer flow and contamination problems. The author simplifies the necessary theoretical background as much as possible and provides all derivational details of the theoretical background as worked examples. He uses this method to explore how the derivations were generated for those who need to know while allowing others to easily skip them and still benefit and learn from the practical applications of the mathematical approaches. Containing 51 tables and 323 figures, the book covers both the breadth and the depth of currently applied aquifer flow and contaminant transport modeling solutions.

APPLIED CONTAMINANT TRANSPORT MODELING

Wiley-Interscience The challenges facing groundwater scientists and engineers today demand expertise in a wide variety of disciplines–geology, hydraulics, geochemistry, geophysics, and biology. As the number of the subdisciplines has increased and as each has become more complex and quantitative, the problem of integrating their concepts and contributions into a coherent overall interpretation has become progressively more difficult. To an increasing degree transport simulation has emerged as an answer to this problem, and the transport model has become a vehicle for integrating the vast

amount of field data from a variety of sources and for understanding the relationship of various physical, chemical, and biological processes. Applied Contaminant Transport Modeling is the first resource designed to provide coverage of the discipline’s basic principles, including the theories behind solute transport in groundwater, common numerical techniques for solving transport equations, and step-by-step guidance on the development and use of field-scale modeling. The Second Edition incorporates recent advances in contaminant transport theory and simulation techniques, adding the following to the original text: -An expanded discussion of the role of aquifer heterogeneity in controlling solute transport -A new section on the dual-domain mass transfer approach as an alternative to the classical advection-dispersion model -Additional chemical processes and reactions in the discussion of reactive transport -A discussion of the TVD (total-variation-diminishing) approach to transport solution -An entirely new Part III containing two chapters on simulation of flow and transport under variable water density and under variable saturation, respectively, and a third chapter on the use of the simulation-optimization approach in remediation system design Applied Contaminant Transport Modeling, Second Edition remains the premier reference for practicing hydrogeologists, environmental scientists, engineers, and graduate students in the field. In 1998, in recognition of their work on the first edition, the authors were honored with the John Hem Excellence in Science and Engineering Award of the National Ground Water Association

MODELING GROUNDWATER FLOW AND POLLUTION

Springer Science & Business Media Groundwater constitutes an important component of many water resource systems, supplying water for domestic use, for industry, and for agriculture. Management of a groundwater system, an aquifer, or a system of aquifers, means making such decisions as to the total quantity of water to be withdrawn annually, the location of wells for pumping and for artificial recharge and their rates, and control conditions at aquifer boundaries. Not less important are decisions related to groundwater qUality. In fact, the quantity and quality problems cannot be separated. In many parts of the world, with the increased withdrawal of ground water, often beyond permissible limits, the quality of groundwater has been continuously deteriorating, causing much concern to both suppliers and users. In recent years, in addition to general groundwater quality aspects, public attention has been focused on groundwater contamination by hazardous industrial wastes, by leachate from landfills, by oil spills, and by agricultural activities such as the use of fertilizers, pesticides, and herbicides, and by radioactive waste in repositories located in deep geological formations, to mention some of the most acute contamination sources. In all these cases, management means making decisions to achieve goals without violating specified constraints. In order to enable the planner, or the decision maker, to compare alternative modes of action and to ensure that the constraints are not violated, a tool is needed that will provide information about the response of the system (the aquifer) to various alternatives.

APPLIED GROUNDWATER MODELING

SIMULATION OF FLOW AND ADVECTIVE TRANSPORT

Academic Press This second edition is extensively revised throughout with expanded discussion of modeling fundamentals and coverage of advances in model calibration and uncertainty analysis that are revolutionizing the science of groundwater modeling. The text is intended for undergraduate and graduate level courses in applied groundwater modeling and as a comprehensive reference for environmental consultants and scientists/engineers in industry and governmental agencies. Explains how to formulate a conceptual model of a groundwater system and translate it into a numerical model Demonstrates how modeling concepts, including boundary conditions, are implemented in two groundwater flow codes-- MODFLOW (for finite differences) and FEFLOW (for finite elements) Discusses particle tracking methods and codes for flowpath analysis and advective transport of contaminants Summarizes parameter estimation and uncertainty analysis approaches using the code PEST to illustrate how concepts are implemented Discusses modeling ethics and preparation of the modeling report Includes Boxes that amplify and supplement topics covered in the text Each chapter presents lists of common modeling errors and problem sets that illustrate concepts

GROUND WATER CONTAMINATION

TRANSPORT AND REMEDIATION

Prentice Hall This text addresses the scientific and engineering aspects of subsurface contaminant transport, analysis, and modeling as well as remediation in ground water. It offers a modern engineering approach to ground water contamination problems of the nineties and beyond.

GUIDE TO PLUMES

DELINEATION, TRANSPORT & VARIETY OF SOFTWARE: WHAT CONTAMINATES GROUNDWATER

Contaminants can enter the groundwater by seeping in from the surface or by flowing in from another part of the aquifer. Once in the aquifer they move with the groundwater flow. As contamination moves it disperses. This means that the concentration decreases as it moves farther away from the source of the pollution. For that reason there are different concentrations of contaminants at different points in the aquifer. Contaminant plumes are most often considered, as these have some associated urgency. All of the plumes I have worked with in the past forty years have been either chemical or thermal and in some way impacted the environment. There are two main considerations for such plumes: 1) delineation and 2) transport. The associated questions are: 1) how much of what is present and 2) where is moving to. Combined with possible migration and spreading is the question of how it might be changing, including chemical and nuclear reactions. Whether the plume in consideration is in air, surface water, or ground water determines what calculations are appropriate, but the basic issues are the same in any case. In this text we will be considering all of these aspects with several actual plumes plus a variety of software, some of which is publicly available.

GROUNDWATER ENGINEERING

A TECHNICAL APPROACH TO HYDROGEOLOGY, CONTAMINANT TRANSPORT AND GROUNDWATER REMEDIATION

Springer This textbook employs a technical and quantitative approach to explain subsurface hydrology and hydrogeology, and to offer a comprehensive overview of groundwater-related topics such as flow in porous media, aquifer characterization, contaminant description and transport, risk assessment, and groundwater remediation. It describes the characterization of subsurface flow of pristine and polluted water and provides readers with easily applicable tools for the design of water supply systems, drinking-water source protection, and remediation interventions. Specific applications range from groundwater exploitation as a drinking water supply to the remediation of contaminated aquifers, from the definition and safeguarding of drinking-water sources to the assessment of human health risks in connection with groundwater contamination events. The book represents an ideal learning resource for upper-undergraduate and graduate students of civil engineering, environmental engineering, and geology, as well as practitioners in the fields of water resource management and environmental protection who are interested in groundwater engineering and technical hydrogeology.

CONTAMINATION OF GROUNDWATERS

CRC Press International experts have contributed key chapters to this major work on groundwater contamination. Section 1: Methodology and Modeling deals with both organic and inorganic contaminants, including those from agricultural operations. Section 2: Case Studies presents contamination scenarios with both inorganic and organic chemicals including agriculturally-related constituents, such as the nitrates. This important new publication is a welcome addition to the literature and will enhance recent information on methodology, modeling and real-world situations. It is of interest to scientists and planners in local and national government; environmental chemists, geochemists, geologists, and health and safety officers; river authorities; hydrologists; and the mining and land reclamation industries.

GROUNDWATER MODELS FOR RESOURCES ANALYSIS AND MANAGEMENT

CRC Press Written by renowned experts in the field, this book assesses the status of groundwater models and defines models and modeling needs in the 21st century. It reviews the state of the art in model development and application in regional groundwater management, unsaturated flow/multiphase flow and transport, island modeling, biological and virus transport, and fracture flow. Both deterministic and stochastic aspects of unsaturated flow and transport are covered. The book also introduces a unique assessment of models as analysis and management tools for groundwater resources. Topics covered include model vs. data uncertainty, accuracy of the dispersion/convection equation, protocols for model testing and validation, post-audit studies, and applying models to karst aquifers.

3D-GROUNDWATER MODELING WITH PMWIN

A SIMULATION SYSTEM FOR MODELING GROUNDWATER FLOW AND TRANSPORT PROCESSES

Springer Science & Business Media This book offer a complete simulation system for modeling groundwater flow and transport processes. The companion full-version software (PMWIN) comes with a professional graphical user-interface, supported models and programs and several other useful modeling tools. Tools include a Presentation Tool, a Result Extractor, a Field Interpolator, a Field Generator, a Water Budget Calculator and a Graphic Viewer. Book targeted at novice and experienced groundwater modelers.

THE HANDBOOK OF GROUNDWATER ENGINEERING, THIRD EDITION

CRC Press This new edition adds several new chapters and is thoroughly updated to include data on new topics such as hydraulic fracturing, CO2 sequestration, sustainable groundwater management, and

more. Providing a complete treatment of the theory and practice of groundwater engineering, this new handbook also presents a current and detailed review of how to model the flow of water and the transport of contaminants both in the unsaturated and saturated zones, covers the protection of groundwater, and the remediation of contaminated groundwater.

CONTAMINATION MOVEMENT

DELINEATION & TRANSPORT OF PLUMES: CONTAMINANT PLUME DEVELOPMENT

Contaminants can enter the groundwater by seeping in from the surface or by flowing in from another part of the aquifer. Once in the aquifer they move with the groundwater flow. As contamination moves it disperses. This means that the concentration decreases as it moves farther away from the source of the pollution. For that reason there are different concentrations of contaminants at different points in the aquifer. Contaminant plumes are most often considered, as these have some associated urgency. All of the plumes I have worked with in the past forty years have been either chemical or thermal and in some way impacted the environment. There are two main considerations for such plumes: 1) delineation and 2) transport. The associated questions are: 1) how much of what is present and 2) where is moving to. Combined with possible migration and spreading is the question of how it might be changing, including chemical and nuclear reactions. Whether the plume in consideration is in air, surface water, or ground water determines what calculations are appropriate, but the basic issues are the same in any case. In this text we will be considering all of these aspects with several actual plumes plus a variety of software, some of which is publicly available.

CONTAMINANT HYDROGEOLOGY

THIRD EDITION

Waveland Press Tremendous progress has been made in the field of remediation technologies since the second edition of Contaminant Hydrogeology was published two decades ago, and its content is more important than ever. Recognizing the extensive advancement and research taking place around the world, the authors have embraced and worked from a larger global perspective. Boving and Kreamer incorporate environmental innovation in studying and treating groundwater/soil contamination and the transport of those contaminants while building on Fetter’s original foundational work. Thoroughly updated, expanded, and reorganized, the new edition presents a wealth of new material, including new discussions of emerging and potential contaminant sources and their characteristics like deep well injection, fracking fluids, and in situ leach mining. New sections cover BET and Polanyi adsorption potential theory, vapor transport theory, the introduction of the Capillary and Bond Numbers, the partitioning interwell tracer testing technique for investigating NAPL sites, aerial photographic interpretation, geophysics, immunological surveys, high resolution vertical sampling, flexible liner systems, groundwater tracers, and much more. Contaminant Hydrogeology is intended as a textbook in upper level courses in mass transport and contaminant hydrogeology, and remains a valuable resource for professionals in both the public and private sectors.

ANALYTICAL MODELING OF SOLUTE TRANSPORT IN GROUNDWATER

USING MODELS TO UNDERSTAND THE EFFECT OF NATURAL PROCESSES ON CONTAMINANT FATE AND TRANSPORT

John Wiley & Sons Teaches, using simple analytical models how physical, chemical, and biological processes in the subsurface affect contaminant transport Uses simple analytical models to demonstrate the impact of subsurface processes on the fate and transport of groundwater contaminants Includes downloadable modeling tool that provides easily understood graphical output for over thirty models Modeling tool and book are integrated to facilitate reader understanding Collects analytical solutions from many sources into a single volume and, for the interested reader, shows how these solutions are derived from the governing model equations

GROUNDWATER CONTAMINANT TRANSPORT

IMPACT OF HETEROGENOUS CHARACTERIZATION: A NEW VIEW ON DISPERSION

CRC Press Impacts of developed tools of heterogenous characterization on the hydrodynamics of flow and the transport mechanisms are illustrated in this text through a series of extensive numerical simulations consisting of single and multiple-realizations (Monte Carlo method).

PRINCIPLES OF CONTAMINANT HYDROGEOLOGY, SECOND EDITION

CRC Press This second edition features new and expanded coverage of contaminant hydrogeologic investigations. It presents a practical approach to completing investigations for environmental compliance, emphasizing the use of geologic principles in assessment to move sites toward cleanup. Stressing the basics of collecting data that can withstand regulatory scrutiny and achieve remediation, Principles of Contaminant Hydrogeology, Second Edition demonstrates how to solve a client's site contamination problem while maximizing cost effectiveness. It focuses on small- and medium-sized firms, for which speed, accuracy, and cost are all crucial factors in the site assessment and closure process. Based on "real world" problems, the book takes you step-by-step through the investigation and includes client-consultant-regulator interaction, budgets, ethics, and data extrapolation for solving problems. It introduces concepts such as field logistics, drilling techniques, sampling protocols, contaminant movement, and remediation. Regulatory personnel, hydrogeological consultants, drilling contractors, remediation contractors, university instructors, and students will benefit from the wealth of information provided in this new edition.

HYDROGEOLOGY AND GROUNDWATER MODELING, SECOND EDITION

CRC Press Coupling the basics of hygrogeology with analytical and numerical modeling methods, Hydrogeology and Groundwater Modeling, Second Edition provides detailed coverage of both theory and practice. Written by a leading hydrogeologist who has consulted for industry and environmental agencies and taught at major universities around the world, this unique book fills a gap in the groundwater hydrogeology literature. With more than 40 real-world examples, the book is a source for clear, easy-to-understand, and step-by-step quantitative groundwater evaluation and contaminant fate and transport analysis, from basic laboratory determination to complex analytical calculations and computer modeling. It provides more than 400 drawings, graphs, and photographs, and a variety of useful tables of all key groundwater parameters, as well as lucid, straightforward answers to common hydrogeological problems. Reflecting nearly ten years of new scholarship since the publication of the bestselling first edition, this second edition is wider in focus with added and updated examples, figures, and problems, yet still provides information in the author's trademark, user-friendly style. No other book offers such carefully selected examples and clear, elegantly explained solutions. The inclusion of step-by-step solutions to real problems builds a knowledge base for understanding and solving groundwater issues.

INEEL SUBREGIONAL CONCEPTUAL MODEL REPORT; VOLUME 1 - SUMMARY OF EXISTING KNOWLEDGE OF NATURAL AND ANTHROPOGENIC INFLUENCES GOVERNING SUBSURFACE CONTAMINANT TRANSPORT IN THE INEEL SUBREGION OF THE EASTERN SNAKE RIVER PLAIN

The National Research Council has defined a conceptual model as ''an evolving hypothesis identifying the important features, processes, and events controlling fluid flow and contaminant transport of consequence at a specific field site in the context of a recognized problem''. Presently, several subregional conceptual models are under development at the Idaho National Engineering and Environmental Laboratory (INEEL). Additionally, facility-specific conceptual models have been described as part of INEEL environmental restoration activities. Compilation of these models is required to develop a comprehensive conceptual model that can be used to strategically plan for future groundwater research activities at the INEEL. Conceptual models of groundwater flow and contaminant transport at the INEEL include the description of the geologic framework, matrix hydraulic properties, and inflows and outflows. They also include definitions of the contaminant source term and contaminant transport mechanisms. The geologic framework of the INEEL subregion is described by the geometry of the system, stratigraphic units within the system, and structural features that affect groundwater flow and contaminant transport. These elements define geohydrologic units that make up the Snake River Plain Aquifer (SRPA). The United States Geological Survey (USGS) conceptual model encompasses approximately 1,920 mi2 of the eastern Snake River Plain. The Waste Area Group (WAG)-10 model includes the USGS area and additional areas to the northeast and southeast. Both conceptual models are bounded to the northwest by the Pioneer Mountains, Lost River Range, and Lemhi Mountains. They are bounded to the southeast by groundwater flow paths determined from aquifer water-level contours. The upgradient extent of the USGS model is a water-level contour that includes the northeastern boundary of the INEEL. The WAG-10 model includes more of the Mud Lake area to utilize previous estimates of underflow into the subregion. Both conceptual models extend approximately 25 miles to the southwest of the INEEL, a distance sufficient to include known concentrations of contaminant tracers. Several hypotheses have been developed concerning the effective thickness of the SRPA at the INEEL. The USGS model has defined the effective thickness from electrical resistivity and borehole data to be as much as 2,500 ft in the eastern part of the subregion and as much as 4,000 ft in the southwestern part. The WAG-10 model has developed two alternatives using aquifer-temperature and electrical resistivity data. The ''thick'' aquifer interpretation utilizes colder temperature data and includes a northtrending zone in which the thickness exceeds 1,300 ft and with a maximum thickness of 1,700 ft. The ''thin'' aquifer interpretation minimizes aquifer thickness, with thickness ranging from 328 to 1,300 ft. Facility-specific models generally have focused efforts on the upper 250 ft of saturation. Conceptual models have utilized a stratigraphic data set to define geohydrologic units within the INEEL subregion. This data set, compiled from geophysical logs and cores from boreholes, correlates the thick, complex stack of basalt flows across the subregion. Conceptual models generally concur that the upper geohydrologic unit consists of a section of highly fractured, multiple, thin basalt flows and sedimentary interbeds. Beneath this unit is an areally extensive, thick, unfractured basalt flow that rises above the water table southwest of the INEEL. The bottom unit consists of a thick section of slightly- to moderately-altered basalt. A key objective of the DOE water-integration project at the INEEL is to coordinate development of a subregional conceptual model of groundwater flow and

contaminant transport that is based on the best available understanding of geologic and hydrologic features. The first step in this process is to compile and summarize the current conceptual models of groundwater flow and contaminant transport at the INEEL that have been developed from extensive geohydrologic studies conducted during the last 50 years.

VARIABLE-DENSITY GROUNDWATER FLOW AND CONTAMINANT TRANSPORT, OPERABLE UNIT 1, NAVAL BASE KITSAP, KEYPORT, WASHINGTON

HYDROLOGY

AN ENVIRONMENTAL APPROACH

Routledge Hydrology covers the fundamentals of hydrology and hydrogeology, taking an environmental slant dictated by the emphasis in recent times for the remediation of contaminated aquifers and surface-water bodies as well as a demand for new designs that impose the least negative impact on the natural environment. Major topics covered include hydrological principles, groundwater flow, groundwater contamination and clean-up, groundwater applications to civil engineering, well hydraulics, and surface water. Additional topics addressed include flood analysis, flood control, and both ground-water and surface-water applications to civil engineering design.

GROUNDWATER CONTAMINANT TRANSPORT

IMPACT OF HETEROGENOUS CHARACTERIZATION: A NEW VIEW ON DISPERSION

Routledge Impacts of developed tools of heterogenous characterization on the hydrodynamics of flow and the transport mechanisms are illustrated in this text through a series of extensive numerical simulations consisting of single and multiple-realizations (Monte Carlo method).

HYDROGEOLOGY

PRINCIPLES AND PRACTICE

John Wiley & Sons HYDROGEOLOGY Hydrogeology: Principles and Practice provides a comprehensive introduction to the study of hydrogeology to enable the reader to appreciate the significance of groundwater in meeting current and future environmental and sustainable water resource challenges. This new edition has been thoroughly updated to reflect advances in the field since 2014 and includes over 350 new references. The book presents a systematic approach to understanding groundwater starting with new insights into the distribution of groundwater in the Earth’s upper continental crust and the role of groundwater as an agent of global material and elemental fluxes. Following chapters explain the fundamental physical and chemical principles of hydrogeology, and later chapters feature groundwater field investigation techniques in the context of catchment processes, as well as chapters on groundwater quality and contaminant hydrogeology, including a section on emerging contamination from microplastic pollution. Unique features of the book are chapters on the application of environmental isotopes and noble gases in the interpretation of aquifer evolution, and a discussion of regional characteristics such as topography, compaction and variable fluid density on geological processes affecting past, present and future groundwater flow regimes. The last chapter discusses future challenges for groundwater governance and management for the long-term sustainability of groundwater resources, including the role of managed aquifer recharge, and examines the linkages between groundwater and climate change, including impacts on cold-region hydrogeology. Given the drive to net-zero carbon emissions by 2050, the interaction of groundwater in the exploitation of energy resources, including renewable resources and shale gas, is reviewed. Throughout the text, boxes and a set of colour plates drawn from the authors’ teaching and research experience are used to explain special topics and to illustrate international case studies ranging from transboundary aquifers and submarine groundwater discharge to the hydrogeochemical factors that have influenced the history of malting and brewing in Europe. The appendices provide conversion tables and useful reference material, and include review questions and exercises, with answers, to help develop the reader’s knowledge and problem-solving skills in hydrogeology. This highly informative and accessible textbook is essential reading for undergraduate and graduate students primarily in earth sciences, environmental sciences and physical geography with an interest in hydrogeology or groundwater topics. The book will also find use among practitioners in hydrogeology, soil science, civil engineering and landscape planning who are involved in environmental and resource protection issues requiring an understanding of groundwater.

APPLIED GROUNDWATER MODELING

SIMULATION OF FLOW AND ADVECTIVE TRANSPORT

Academic Press Creating numerical groundwater models of field problems requires careful attention to describing the problem domain, selecting boundary conditions, assigning model parameters, and calibrating the model. This unique text describes the science and art of applying numerical models of groundwater flow and advective transport of solutes. Key Features * Explains how to formulate a conceptual model of a system and how to translate it into a numerical model * Includes the application of modeling principles with special attention to the finite difference flow codes PLASM and MODFLOW, and the finite-element code AQUIFEM-1 * Covers model calibration, verification, and validation * Discusses pathline analysis for tracking contaminants with reference to newly developed particle tracking codes * Makes extensive use of case studies and problems

WELDON SPRING SITE, REMEDIAL ACTION

ENVIRONMENTAL IMPACT STATEMENT

FLOW AND TRANSPORT IN POROUS FORMATIONS

Springer Science & Business Media In the mid-seventies, a new area of research has emerged in subsurface hydrology, namely sto chastic modeling of flow and transport. This development has been motivated by the recognition of the ubiquitous presence of heterogeneities in natural formations and of their effect upon transport and flow, on the one hand, and by the vast expansion of computational capability provided by elec tronic machines, on the other. Apart from this, one of the areas in which spatial variability of for mation properties plays a cardinal role is of contaminant transport, a subject of growing interest and concern. I have been quite fortunate to be engaged in research in this area from its inception and to wit ness the rapid growth of the community and of the literature on spatial variability and its impact upon subsurface hydrology. In view of this increasing interest, I decided a few years ago that it would be useful to present the subject in a systematic and comprehensive manner in order to help those who wish to engage themselves in research or application of this new field. I viewed as my primary task to analyze the large scale heterogeneity of aquifers and its effect, presuming that the reader already possesses a background in traditional hydrology. This is achieved in Parts 3, 4 and 5 of the text which incorporate the pertinent material.

SEMINAR ON TRANSPORT AND FATE OF CONTAMINANTS IN THE SUBSURFACE

PHASE I HYDROLOGIC DATA FOR THE GROUNDWATER FLOW AND CONTAMINANT TRANSPORT MODEL OF CORRECTIVE ACTION UNIT 97

YUCCA FLAT/CLIMAX MINE, NEVADA TEST SITE, NYE COUNTY, NEVADA, REV. NO.: 0

The U.S. Department of Energy (DOE), National Nuclear Security Administration Nevada Site Office (NNSA/NSO) initiated the Underground Test Area (UGTA) Project to assess and evaluate the effects of the underground nuclear weapons tests on groundwater beneath the Nevada Test Site (NTS) and vicinity. The framework for this evaluation is provided in Appendix VI, Revision No. 1 (December 7, 2000) of the Federal Facility Agreement and Consent Order (FFACO, 1996). Section 3.0 of Appendix VI ''Corrective Action Strategy'' of the FFACO describes the process that will be used to complete corrective actions specifically for the UGTA Project. The objective of the UGTA corrective action strategy is to define contaminant boundaries for each UGTA corrective action unit (CAU) where groundwater may have become contaminated from the underground nuclear weapons tests. The contaminant boundaries are determined based on modeling of groundwater flow and contaminant transport. A summary of the FFACO corrective action process and the UGTA corrective action strategy is provided in Section 1.5. The FFACO (1996) corrective action process for the Yucca Flat/Climax Mine CAU 97 was initiated with the Corrective Action Investigation Plan (CAIP) (DOE/NV, 2000a). The CAIP included a review of existing data on the CAU and proposed a set of data collection activities to collect additional characterization data. These recommendations were based on a value of information analysis (VOIA) (IT, 1999), which evaluated the value of different possible data collection activities, with respect to reduction in uncertainty of the contaminant boundary, through simplified transport modeling. The Yucca Flat/Climax Mine CAIP identifies a three-step model development process to evaluate the impact of underground nuclear testing on groundwater to determine a contaminant boundary (DOE/NV, 2000a). The three steps are as follows: (1) Data compilation and analysis that provides the necessary modeling data that is completed in two parts: the first addressing the groundwater flow model, and the second the transport model. (2) Development of a groundwater flow model. (3) Development of a groundwater transport model. This report presents the results of the first part of the first step, documenting the data compilation, evaluation, and analysis for the groundwater flow model. The second part, documentation of transport model data will be the subject of a separate report. The purpose of this document is to present the compilation and evaluation of the available hydrologic data and information relevant to the development of the Yucca Flat/Climax Mine CAU groundwater flow model, which is a fundamental tool in the prediction of the extent of contaminant migration. Where appropriate, data and information documented elsewhere are summarized with reference to the complete documentation. The specific task objectives for hydrologic data documentation are as follows: (1) Identify and compile available hydrologic data and supporting information required to develop and validate the groundwater flow model for the Yucca Flat/Climax Mine CAU. (2) Assess the quality of the data and associated

documentation, and assign qualifiers to denote levels of quality. (3) Analyze the data to derive expected values or spatial distributions and estimates of the associated uncertainty and variability.

GROUNDWATER

RESOURCE EVALUATION, AUGMENTATION, CONTAMINATION, RESTORATION, MODELING AND MANAGEMENT

Springer Science & Business Media This book provides comprehensive coverage on the assessment and management of groundwater. It contains the work of international experts in the field of groundwater resource evaluation, characterization, augmentation, restoration, modeling and management.

MATHEMATICAL ANALYSIS OF GROUNDWATER FLOW MODELS

CRC Press "This book provides comprehensive analysis of a number of groundwater issues, ranging from flow to pollution problems. Several scenarios are considered throughout, including flow in leaky, unconfined, and confined geological formations, crossover flow behavior from confined to confined, to semi-confined to unconfined and groundwater pollution in dual media. Several mathematical concepts are employed to include into the mathematical models' complexities of the geological formation, including classical differential operators, fractional derivatives and integral operators, fractal mapping, randomness, piecewise differential, and integral operators. It suggests several new and modified models to better predict anomalous behaviours of the flow and movement of pollution within complex geological formations. Numerous mathematical techniques are employed to ensure that all suggested models are well-suited, and different techniques including analytical methods and numerical methods are used to derive exact and numerical solutions of different groundwater models. Features: Includes modified numerical and analytical methods for solving new and modified models for groundwater flow and transport Presents new flow and transform models for groundwater transport in complex geological formations Examines fractal and crossover behaviors and their mathematical formulations Mathematical Analysis of Groundwater Flow Models serves as a valuable resource for graduate and PhD students as well as researchers working within the field of groundwater modeling"--

SOIL AND GROUNDWATER REMEDIATION

FUNDAMENTALS, PRACTICES, AND SUSTAINABILITY

John Wiley & Sons An introduction to the principles and practices of soil and groundwater remediation Soil and Groundwater Remediation offers a comprehensive and up-to-date review of the principles, practices, and concepts of sustainability of soil and groundwater remediation. The book starts with an overview of the importance of groundwater resource/quality, contaminant sources/types, and the scope of soil and groundwater remediation. It then provides the essential components of soil and groundwater remediation with easy-to-understand design equations/calculations and the practical applications. The book contains information on remediation basics such as subsurface chemical behaviors, soil and groundwater hydrology and characterization, regulations, cost analysis, and risk assessment. The author explores various conventional and innovative remediation technologies, including pump-and-treat, soil vapor extraction, bioremediation, incineration, thermally enhanced techniques, soil washing/flushing, and permeable reactive barriers. The book also examines the modeling of groundwater flow and contaminant transport in saturated and unsaturated zones. This important book: Presents the current challenges of remediation practices Includes up-to-date information about the low-cost, risk-based, sustainable remediation practices, as well as institutional control and management Offers a balanced mix of the principles, practices, and sustainable concepts in soil and groundwater remediation Contains learning objectives, discussions of key theories, and example problems Provides illustrative case studies and recent research when remediation techniques are introduced Written for undergraduate seniors and graduate students in natural resource, earth science, environmental science/engineering, and environmental management, Soil and Groundwater Remediation is an authoritative guide to the principles and components of soil and groundwater remediation that is filled with worked and practice problems.

EARTHQUAKES AND WATER

Springer Based on the graduate course in Earthquake Hydrology at Berkeley University, this text introduces the basic materials, provides a comprehensive overview of the field to interested readers and beginning researchers, and acts as a convenient reference point.

GROUNDWATER - VOLUME II

EOLSS Publications Groundwater theme is a component of Encyclopedia of Water Sciences, Engineering and Technology Resources in the global Encyclopedia of Life Support Systems (EOLSS), which is an integrated compendium of twenty one Encyclopedias. Groundwater is water located beneath the ground surface in soil pore spaces and in the fractures of lithologic formations. This theme presents a

perspective of the field of groundwater and an overview of the important aspects of the subject such as, natural origin and distribution, characteristics under diverse climates and surrounding rocky environments, exploration and management, natural quality and human related sources of contamination, sustainable exploitation of resources, protection and current research trends. The content of the theme on Groundwater is organized with state-of-the-art presentations covering several topics: Origin, Distribution, Formation, and Effects; Typical Hydrogeological Scenarios; Transport Processes in Groundwater; Transport Phenomena and Vulnerability of the Unsaturated Zone; Groundwater Development; Groundwater Use and Protection; Groundwater Management: An Overview of Hydro-geology, Economic Values and Principles of Management; Special Issues in Groundwater, which are then expanded into multiple subtopics, each as a chapter. These three volumes are aimed at the following five major target audiences: University and College students Educators, Professional practitioners, Research personnel and Policy analysts, Managers, and Decision makers and NGOs

KARST GROUNDWATER CONTAMINATION AND PUBLIC HEALTH

BEYOND CASE STUDIES

Springer This book sheds new light on contaminant transport in karst aquifers and the public health implications of contaminated karst groundwater. The papers included were presented at a conference held in early 2016 in San Juan, Puerto Rico, and range from lengthy reviews on contaminant transport mechanisms to short articles summarizing research findings. The conference addressed a variety of topics, such as contamination sources, the hydrogeology of contaminant transport, the storage and release of contaminants, and the health impacts as well as the epidemiology of contaminated water supplies drawn from karst aquifers, and gathered perspectives from experts in different disciplines, including hydrogeologists and public health specialists. Although there is a wealth of literature on specific instances of karst groundwater contamination, this book offers an integrated conceptual framework for the public health impacts of karst groundwater, making it a valuable resource for a broad interdisciplinary readership.

GROUND-WATER FLOW AND CONTAMINANT TRANSPORT AT A RADIOACTIVE-MATERIALS PROCESSING SITE, WOOD RIVER JUNCTION, RHODE ISLAND

ADVANCES IN REMEDIATION TECHNIQUES FOR POLLUTED SOILS AND GROUNDWATER

Elsevier Advances in Remediation Techniques for Polluted Soils and Groundwater focuses on the thematic areas for assessment, mitigation, and management of polluted sites. This book covers advances in modelling approaches, including Machine Learning (ML)/ Artificial Intelligence (AI) applications; GIS and remote sensing; sensors; impacts of climate change on geogenic contaminants; and socio-economic impacts in the poor rural and urban areas, which are lacking in a more comprehensive manner in the previous titles. This book encompasses updated information as well as future directions for researchers working in the field of management and remediation of polluted sites. Introduces fate and transport of multi-pollutants under varying subsurface conditions Details underlying mechanisms of biodegradation and biodetoxification of geogenic, industrial and emerging pollutants Presents recent advances and challenges in assessment, water quality modeling, uncertainty, and water supply management Provides authoritative contributions on the diverse aspects of management and remediation from leading experts around the world