Appendix D: Glossary List

acre-foot (ac-ft) - the volume of water required to cover 1 acre of land (43,560 square feet) to a depth of 1 foot. Equal to 325,851 gallons or 1,233 cubic meters.

anisotropy - the condition of having different values of hydraulic conductivity (in particular) in different directions in geologic materials. This is especially apparent in fractured bedrock or layered sediment.

aquifer - a geologic formation(s) that is water bearing. A geological formation or structure that stores and/or transmits water, such as to wells and springs. Use of the term is usually restricted to those water-bearing formations capable of yielding water in sufficient quantity to constitute a usable supply for people's uses.

aquifer (confined) - soil or rock below the land surface that is saturated with water. There are layers of impermeable material both above and below it and it is under pressure so that when the aquifer is penetrated by a well, the water will rise above the top of the aquifer (not necessarily flowing well).

aquifer (unconfined) - an aquifer whose upper water surface (water table) is at atmospheric pressure, and thus is able to rise and fall.

base flow - sustained flow of a stream in the absence of direct runoff. It includes natural and human-induced stream flows. Natural base flow is sustained largely by ground-water discharges.

boundary condition - a mathematical statement specifying the dependent variable at the boundaries of the modeled domain which contain the equations of the mathematical model. Examples are specified head, specified flux, or mixed boundaries.

calibrated model - a model for which all residuals between calibration targets and corresponding model outputs, or statistics computed from residuals, are less than pre-set acceptable values.

calibration - the process of refining the model representation of the hydrogeologic framework, hydraulic properties, and boundary conditions to achieve a desired degree of correspondence between the model simulations and observations of the groundwater flow system, which includes both measured hydraulic head and flux.

calibration target - measured, observed, calculated, or estimated hydraulic heads or groundwater flow rates that a model must reproduce, at lease approximately, to be considered calibrated.

cell - a distinct one-two- or three-dimensional model unit representing a discrete portion of a physical system with uniform properties assigned to it.

code (computer program) - the assembly of numerical techniques, bookkeeping, and control language that represents the model from acceptance of input data and instructions to delivery of output. Examples: MODFLOW, BIOSCREEN, MT3d, etc.

compaction – compaction of a geological unit is often due to groundwater withdrawal or oil/gas extraction. Compaction can cause ground subsidence. Subsidence is the total of compactions from all units.

conceptual model - an interpretation of the characteristics and dynamics of an aquifer system which is based on an examination of all available hydrogeological data for a modeled area. This includes the external configuration of the system, location and rates of recharge and discharge, location and hydraulic characteristics of natural boundaries, and the directions of groundwater flow throughout the aquifer system.

cone of depression - a depression of the potentiometric surface that develops around a well which is being pumped.

Connected linear network (CLN) - a MODFLOW-USG package to simulate any linear structure with a cross-section area smaller than a model cell where the CLN sits in. Linear structure could have different cross-section shapes such as circular (partial or full), square, etc. Therefore, this package can be used to simulate wells, rivers, springs, etc.

constant head boundary – a MODFLOW boundary condition used to simulate a hydraulic feature (such as lake or reservoir) where hydraulic head remains the same over the time period considered. Constant head boundary could receive from or discharge to groundwater.

cubic feet per second (cfs) - a rate of the flow, in streams and rivers, for example. It is equal to a volume of water one foot high and one foot wide flowing a distance of one foot in one second. One "cfs" is equal to 7.48 gallons of water flowing each second.

discharge - the volume of water that passes a given location within a given period of time. Usually expressed in cubic feet per second.

discretization - the process of subdividing the continuous model and/or time domain into discrete segments or cells. Algebraic equations which approximate the governing flow and/or transport equations are written for each segment or cell.

drain boundary - a MODFLOW boundary condition used to simulate a hydraulic feature (such as agriculture drain) which only receives groundwater.

drawdown - a lowering of the ground-water surface caused by pumping.

evaporation - the process of liquid water becoming water vapor, including vaporization from water surfaces, land surfaces, and snow fields, but not from leaf surfaces.

evapotranspiration - the sum of evaporation and transpiration.

finite difference method (FDM) - a discretization technique for solving a partial differential equation (PDE) by (1) replacing the continuous domain of interest by a finite number of regular-spaced mesh-or grid-points (i.e., nodes) representing volume-averaged sub-domain properties; and (2) by approximating the derivatives of the PDE for each of these points using finite differences; the resulting set of linear or nonlinear algebraic equations is solved using direct or interactive matrix solving techniques.

flux - the volume of fluid crossing a unit cross-sectional surface area per unit time.

general head boundary – a generic MODFLOW boundary condition used to simulate groundwater flow between model domain and a constant head hydraulic source outside the model domain.

grid – a model grid comprises of cells. Cells in a grid could be uniform or different in size.

groundwater - part of the subsurface water that is in the saturated zone.

groundwater recharge - inflow of water to a groundwater aquifer from the surface. Infiltration of precipitation and its movement to the water table is one form of natural recharge. Also, the volume of water added by this process.

groundwater basin - a groundwater system that has defined boundaries and may include more than one aquifer of permeable materials, which are capable of furnishing a significant water supply.

groundwater discharge - the water released from the zone of saturation; also the volume of water released.

groundwater flow - the movement of water in the zone of saturation.

groundwater flow model - an application of mathematical model to represent a regional or site-specific groundwater flow system.

groundwater modeling code - the computer code used in groundwater modeling to represent a non-unique, simplified mathematical description of the physical framework, geometry, active processes, and boundary conditions present in a reference subsurface hydrologic system.

hydraulic conductivity - a constant of proportionality which relates the rate of groundwater flow to the hydraulic head gradient. It is a property of the porous media (intrinsic permeability) and the density and viscosity of the water moving through the porous media. It is defined as the volume of water at the existing kinematic viscosity that will move in unit time under unit hydraulic gradient through a unit area measured at right

angles to the direction of low. Estimated by, in order of preference, aquifer tests, slug tests, grain size analysis.

hydraulic gradient - the change in total hydraulic head per unit distance of flow at a given point and in the direction of groundwater flow.

hydraulic head - the height above a datum plane (such as sea level) of the column of water than can be supported by the hydraulic pressure at a given point in a groundwater system. For a well, the hydraulic head is equal to the distance between the water level in the well and the datum plane.

hydraulic properties - properties of sediment and rock that govern the entrance of water and the capacity to hold, transmit and deliver water, e.g. porosity, effective porosity, specific retention, permeability and direction of maximum and minimum permeability. Synonymous with hydrologic properties.

hydrogeologic unit - geologic strata that can be distinguished on the basis of capacity to yield and transmit fluids.

infiltration - flow of water from the land surface into the subsurface.

initial conditions - the specified values for the dependent variable (hydraulic head or solute concentration) at the beginning of the model simulation.

inverse method - a method of calibrating a groundwater flow model using a computer code to systematically vary inputs or input parameters to minimize residuals or residual statistics.

irrigation - the controlled application of water for agricultural purposes through manmade systems to supply water requirements not satisfied by rainfall.

leakage - the flow of water from one hydrogeologic unit to another. The leakage may be natural, as through semi-impervious confining layer, or human made, as through an uncased tank.

model - an assembly of concepts in the form of mathematical equations that portray an understanding of a natural phenomenon.

model construction - the process of transforming the conceptual model into a parameterized mathematical form; as parameterization requires assumptions regarding spatial and temporal discretization, model construction requires a-priori selection of computer code.

modeling - the process of formulating a model of a system of process.

m**odel input** - the constitutive coefficients, system parameters, forcing terms, auxiliary conditions and program control parameters required to apply a computer code to a particular problem.

MODFLOW-88/96/2000/2005/NWT – finite difference computer codes developed by the U.S. Geological Survey to simulate groundwater flow.

MODFLOW-USG – an unstructured grid version of MODFLOW using a control volume finite-difference formulation to simulate groundwater flow.

node – it is the index of a model cell, but often interchangeable with cell.

no-flow boundary – a model boundary which is a specified flux boundary where the assigned flux is equal to zero.

numerical model - in subsurface fluid flow modeling, a mathematical model that uses numerical methods to solve the governing equations of the applicable problem.

numerical layer - a layer in a numerical model representing a hydrogeologic unit.

output - in subsurface fluid flow modeling, all information that is produced by the computer code.

parameter - any of a set of physical properties which determine the characteristics or behavior of a system.

peak flow - the maximum instantaneous discharge of a stream or river at a given location. It usually occurs at or near the time of maximum stage.

PEST/BEOPEST/PEST++ - PEST stands for Parameter ESTimate. It is written by Dr. John Doherty of Watermark Numerical Computing. It is widely used for model development in groundwater and other fields. BEOPEST is a special version of PEST developed by Dr. Willem Schreüder. BEOPEST makes parallel computing a lot easier by running PEST at different computers/platforms through TCP/IP/MPI. PEST++ is a special version of PEST developed by Dr. Jeremy White. PEST++ contains most of the PEST main functions and also has its unique functionalities related to model uncertainties and more.

pre/post-processing - using computer programs to assist in preparing data sets for use with generic simulation codes; may include parameter allocation, control parameter selection, and data file formatting.

precipitation - rain, snow, hail, sleet, dew, and frost.

recharge - water added to an aquifer. For instance, rainfall that seeps into the ground.

reservoir - a pond, lake, or basin, either natural or artificial, for the storage, regulation, and control of water.

residual - the difference between the model-computed and field-measured values of a variable, such as hydraulic head or groundwater flow rate, at a specific time and location.

river - a natural stream of water of considerable volume, larger than a brook or creek.

river basin: the total area drained by a river and its tributaries.

river boundary - a MODFLOW boundary condition used to simulate the interaction between a hydraulic feature (such as river) and groundwater. The river boundary could gain water from or lose water to an aquifer.

runoff - part of the precipitation, snow melt, or irrigation water that appears in uncontrolled surface streams, rivers, drains or sewers. Runoff may be classified according to speed of appearance after rainfall or melting snow as direct runoff or base runoff, and according to source as surface runoff, storm interflow, or ground-water runoff.

sensitivity analysis - a procedure based on systematic variation of model input values (1) to identify those model input elements that cause the most significant variations in model output; and (2) to quantitatively evaluate the impact of uncertainty in model input on the degree of calibration and on the model's predictive capability.

simulation - in groundwater modeling, one complete execution of a groundwater modeling computer program, including input and output. Simulation is sometimes also used broadly to refer to the process of modeling in general.

specific storage - the volume of water released from or taken into storage per unit volume of the porous medium per unit change in head.

specific yield - the quantity of water released due to gravity drainage from unit volume of water table or unconfined aquifer.

specified flux boundary - a model boundary condition in which the groundwater flux or mass flux is specified; also called fixed or prescribed flux, or Neumann boundary condition.

spring - area where there is a concentrated discharge of ground water that flows at the ground surface.

steady state condition - a condition in which system inputs and outputs are in equilibrium so that there is no net change in the system with time.

storage coefficient - the volume of water an aquifer releases from or takes into storage per unit surface are of the aquifer per unit change in head. For a confined aquifer, the

storage coefficient is equal to the product of the specific storage and aquifer thickness. For an unconfined aquifer, the storage coefficient is approximately equal to specific yield.

storativity - see storage coefficient.

Subsidence – ground subsidence is often due to groundwater withdrawal or oil/gas extraction.

transient condition - a condition in which system inputs and outputs are not in equilibrium so that there is a net change in the system with time.

transmissibility (groundwater) - the capacity of a rock or sediment to transmit water under pressure.

transpiration - the loss of water vapor from plants.

water budget (mass balance) - an inventory of the difference source and sinks of water in a hydrogeologic system. In a well-posed model, the sources and sinks should balance.

water table - the top of the water surface in the saturated part of an aquifer.