Groundwater Model Description

Groundwater flow in the Chambers–Clover Creek Watershed and vicinity was simulated using the U.S. Geological Survey modular three-dimensional finite-difference groundwater-flow model, MODFLOW-2000. The model was designed to simulate steady-state and transient conditions. Steady-state groundwater flow represents a groundwater system that is in a state of equilibrium: inflows into and outflows from the system are constant and equal, resulting in no changes in groundwater storage. Transient groundwater flow represents a dynamic system, in which variable inflows, outflows, and groundwater storage change with time. The model area was subdivided, horizontally and vertically, into rectilinear blocks called cells. The hydraulic properties of the material in each cell are assumed to be homogeneous.

A model grid of 146 rows, 132 columns, and 11 layers was used to represent the groundwater-flow system. The model grid is aligned 45° counterclockwise from the north to allow model boundaries to more closely approximate the locations of Puget Sound, and the Puyallup and Nisqually River valleys. The bottom of the model (typically the bottom of model layer 11) is an implicit no-flow boundary and coincides with the top of bedrock. The model simulates both steady-state and transient conditions. The steady-state condition simulates average recharge, discharge, and water levels for the study period (September 2006–August 2008). The transient simulation period (September 2006–August 2008) was divided into 24 monthly stress periods to represent temporal variations in recharge, discharge, and other groundwater-flow system processes.

The model presented in this report is a simplified mathematical representation of the complex natural groundwater-flow system in the CCCW and vicinity. Intrinsic to the model is the error and uncertainty associated with the approximations, assumptions, and simplifications that must be made. model is most applicable to analysis of groundwater issues at the subbasin scale (see fig. 9). Local-scale heterogeneity in hydrologic properties, recharge, and discharge that occur at a scale of one model cell or less (1,000 ft or less) are not adequately represented by the regional-scale groundwater-flow model constructed for this study.

The calibrated model was used to derive components of the groundwater budget and to estimate the response of the regional system to new stresses, such as increased groundwater withdrawals. Water-resource managers can use this information to make informed decisions when planning for future groundwater development. The calibrated steady-state groundwater model budget can be used to make general observations about the flow system. Total flow through the groundwater system was about 607,050 acre-ft/yr in the model area. Precipitation was the primary source of water recharging the groundwater system (77 percent); recharge from streams and lakes (and a minor amount from Puget Sound) was 21 percent of the total recharge. Groundwater discharge to streams, lakes, springs, seeps, and Puget Sound was 559,192 acre-ft/yr, or 92 percent of the total discharge from the groundwater system. Withdrawals from wells were about 8 percent of discharge.

Model Simulation	Recharge (precipitation and return flows)	Withdrawal amount (public and residential)	Withdrawal location
Simulation 1 Steady-State	Decrease precipitation recharge by 20 percent	No change	No change
Simulation 2 Steady-State	Increase return flows by 15 percent	Increase public and residential withdrawals by 15 percent	No change
Simulation 3 Steady-State	Increase return flows by 15 percent	Increase public and residential withdrawals by 15 percent	Deepen all public and residential withdrawals
Simulation 4 Steady-State	Increase return flows by 15 percent	Increase public and residential withdrawals by 15 percent	Deepen only group A public withdrawals
Simulation 5 Transient	Increase monthly return flows by 15 percent	Increase monthly public and residential withdrawals by 15 percent	No change
Simulation 6 Transient	Increase monthly return flows by 15 percent	Increase monthly public and residential withdrawals by 15 percent	Deepen only group A public withdrawals during summer months

ftp://ftpext.usgs.gov/pub/wr/wa/tacoma/cccw/ - the link to the Chambers-Clover Creek Groundwater Model data sets on the USGS ftp site