Abstract


Title: Using Ground Penetrating Radar and LIDAR data to construct a Groundwater Elevation Model for the Clatsop Plains, Clatsop County, Oregon

Groundwater surface (GWS) reflections recorded in ground penetrating radar (GPR) profiles (30.3 km in distance) were gathered in January 2002 throughout the Clatsop Plains, a beach plains aquifer in northwest Oregon. Global positioning system (GPS) and Light detection and ranging (LIDAR) data were imported into ArcGIS and used to tie all GWS elevations to a single regional elevation datum (NAVD88). GWS elevations for different areas in the aquifer are compared using the Student t-test statistical analyses. Results show that variances in groundwater surface elevations occur between dune ridges and interdunal valleys, whereas comparisons between separate dune ridges and northern and southern regions show no significant variation.

The GWS elevation data, together with hydraulic parameters published for the aquifer (Frank 1970, Nielsen 2005) are used as input data in the MODFLOW numeric modeling program to portray the mid-winter GWS data as a static elevation potentiometric model. Three groundwater potentiometric models were constructed using different spacings of GWS elevation data points, at ~ 1 km, 400 m and 50 m spacing. All three models indicate that the groundwater elevations are highest in the
central region of the aquifer (6-8 m elevation NAVD88) with the hydraulic gradient sloping to the west toward the ocean shoreline (0 m elevation), to the north and south towards the bounding Columbia and Necanicum estuaries (0-1 m elevation), and to the east toward Cullaby Lake and Skipanon Creek (3-4 m elevation). Models constructed from groundwater surface elevation derived from ground penetrating radar surveys indicate that the dune ridges transfer their meteoric water to inter-ridge valleys. The largest dune ridges serve as geomorphic controls that guide the direction of shallow groundwater flow towards environmentally sensitive ‘GWS window’ lakes and streams in the interior of the beach plain aquifer.

The high spatial density of the GWS elevations provided by the GPR profiling permitted high-resolution measurements of GWS trends that would not have been observed by piezometer wells spaced at ~500 m west-east distance intervals.

Groundwater flow during winter months is directed from the dune ridge crests to the west, north and south perimeters of the beach plain. Shallow groundwater flow is also diverted into inter-ridge lakes and streams which partially discharge through the small Neacoxie and Skipanon Creeks outlets at the south and north ends of the aquifer. Seasonal lowering of the GWS in some of the dune ridges is on the order of several metes in elevation. Seasonal GPR surveys of GWS and corresponding measurements of stream discharge are needed to better constrain seasonal recharge and discharge in the Clatsop Plains beach plain aquifer.