A modeling analysis of the effects of production-well location in a large-scale groundwater system

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ABSTRACT
Unit-basin groundwater flow models of the plains regions of Alberta, Canada, are analyzed by numerical simulation. The relationship between the location of water wells, and well yield and basin stability in a large-scale groundwater system is evaluated. Two basin hydrologic parameters, namely transitional basin yield (TBY) and sustainable basin yield (SBY), are employed to measure the development potential of the system's groundwater resources under continuous production. TBY is the net cumulative inflow of water into the system, induced by and during development at a particular site, from an initial to a final steady-state condition. SBY, on the other hand, is the amount of water captured from precipitation due to production at a particular site under the newly established steady-state conditions.
The models produced key relations in optimizing the development potential of the groundwater resources in extensive unconfined basins. TBY is found to be highest for well locations in the discharge area and decreases gradually as the sites are moved toward the recharge area. On the other hand, SBY is greater if the wells are located in recharge areas than if they are in the discharge areas. The models show also that under conditions of restricted rainfall, a recharge-area development results in unstable basin hydrological conditions sooner than when development takes place in the discharge area. It is suggested that regional groundwater exploitation should be initiated in discharge areas and moved towards recharge regions gradually, and only for compelling reasons.