Key Findings
Harney Basin Groundwater Study
November 2022

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- **Lowland groundwater discharge currently exceeds recharge by 110,000 acre-feet/year**
- **Consequently, lowland groundwater-levels are declining at varying rates**

The Oregon Water Resources Department (OWRD) and the U.S. Geological Survey (USGS) conducted a groundwater investigation of the 5,243 mi^2 Harney Basin (figure 1) to better understand how groundwater moves in the basin and to help OWRD and the community address water resource challenges. Investigation plans, progress, and findings were discussed at 17 local Groundwater Study Advisory Committee meetings during 2016-2019. Two comprehensive final reports and associated data were published in April 2022.

The reports present a groundwater budget for the uplands and the lowlands (figure 1). The budget further subdivided into three regions can be found in Garcia and others (2022). Upland groundwater recharge and discharge are equally balanced (figure 2). About 8% of the upland rain and snow (precipitation), recharges upland groundwater. Total upland recharge is about 288,000 acre-feet/year. One acre-foot is equal to 325,851 gallons, or the amount of water needed to cover an acre (roughly a football field) with one foot of water. About 83% (239,000 acre-feet/year) of the upland recharge flows relatively short distances in the subsurface and discharges to upland surface water that either evaporates or drains via rivers and streams to the lowlands. The remaining 17% (49,000 acre-feet/ year) of the upland recharge stays in the subsurface and flows to the lowlands as groundwater.

Figure 1. Harney Basin (from Gingerich and others, 2022)

In contrast to the upland groundwater recharge and discharge, which balances, the lowland groundwater recharge and discharge currently do not balance (figure 2). The lowland discharge is 283,000 acre-feet/year, which is 110,000 acre-feet/year greater than the lowland recharge of 173,000 acre-ft/yr.

Groundwater discharge in the Harney Basin includes both natural discharge (through surface water, native plants, and evaporation) and pumpage associated with groundwater development (figure 2). Most groundwater development in the basin (more than 90% of the total pumpage) is in the lowlands accounting for more than half of all lowland ground-water discharge. Most of the lowland pumpage occurs north of Malheur and Harney Lakes. Irrigated agriculture accounts for 95% of the total pumpage, and non-irrigation uses accounts for the other 5%.

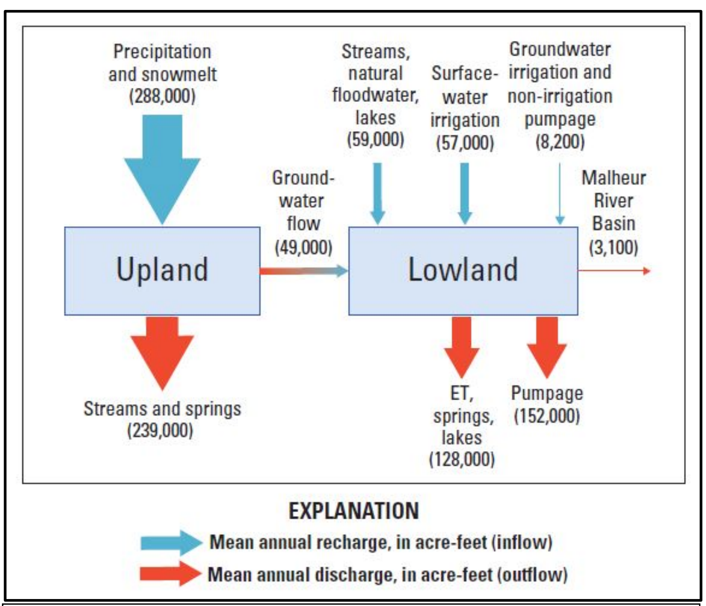

Figure 2. Harney Basin Groundwater Budget, 1982-2016 average (Garcia and others, 2022)

Groundwater within the Harney Basin is hydraulically connected (no vertical or horizontal flow barriers) and mostly ancient (about 5,000-30,000 years). Within the lowlands, groundwater-levels are declining due to the current imbalance between groundwater discharge and recharge. The rate and amount of decline in different lowland areas depends upon the volume and distribution of pumpage and the geologic deposits within and surrounding the pumping area. Groundwater flows more easily through rocks and sediments characterized as having high permeability than those characterized as having low permeability. Low permeability deposits are widespread throughout the entire basin. Higher permeability deposits are mostly concentrated around the Harney Valley perimeter and in the Riley area.

Pumping from low-permeability deposits, or from high-permeability deposits surrounded by low-permeability deposits, generally results in the development of "deep" groundwater declines across narrow areas that appear somewhat like a cone ("cones-of-depression"). Areas with "deep" cones-of-depression include Weaver Spring to Dog Mountain (as much as 8-feet/year), the Prater Creek to Mahon Creek floodplain north of U.S. 20 (about 5-feet/year), and Crane (about 1 to 2-feet/year) (see areas A, B, and C in figure 3).

In contrast, pumping within areas dominated and surrounded by higher-permeability deposits generally results in "shallow" and nearly uniform groundwater-level declines across broad areas. Broad areas with a nearly uniform groundwater-level decline include Silver Creek Valley (about 0.5-foot/year) and Virginia Valley (about 1-foot/year) (see areas F and G in figure 3).

To date, lowland pumping has primarily pulled water from groundwater storage with limited impact to the natural groundwater discharge through springs and native groundwater-dependent plants. However, without reductions, ongoing pumping and related groundwater-level declines will likely reduce natural groundwater discharge in lowland areas.

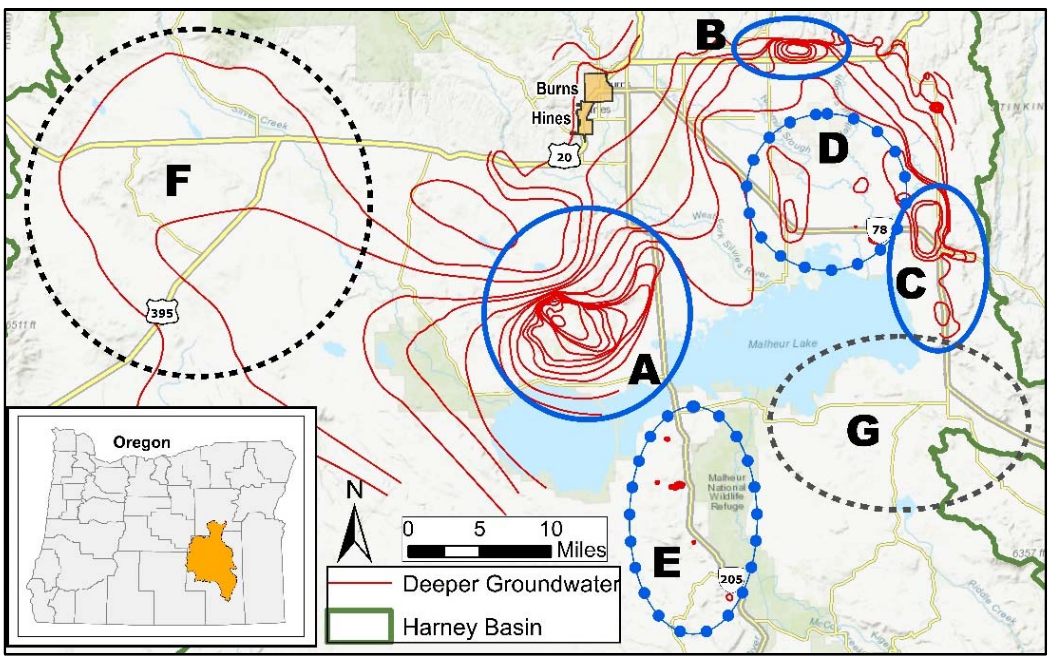

Figure 3. Harney Basin lowland groundwater-level decline areas
[Areas A (Weaver Springs to Dog Mountain), B (Prater Creek to Mahon Creek floodplain north of Highway 20), and C (Crane) are significant cone of depression areas where groundwater flow has changed; Areas D (north of Malheur Lake) and E (Blitzen Valley) are developing cone of depression areas; and Areas F (Silver Creek Valley) and G (Virginia Valley) are broad areas of near uniform decline; "deeper groundwater" level lines are based on measurements at wells deeper than 150 feet]