FEEDBACK SOUGHT ON HARNEY GROUNDWATER STUDY KEY TAKEAWAYS:

Dear Reader:

This document captures the key takeaways and other findings that the Harney Basin Groundwater Study Advisory Committee discussed at their final meeting on December 12-13, 2019. This document includes the 3-4 key takeaways the Advisory Committee members reached agreement on as well as the other findings that were discussed. It incorporates feedback received from the Advisory Committee members on a written draft. As you read through the key takeaways, please consider the following questions and send thoughts, questions, and feedback to harmony.s.burright@oregon.gov:

- Are the findings documented here accurate and consistent with the study findings that were shared by the Groundwater Study Team?
- Does the language make sense? Is this something that your friends, neighbors, and colleagues would understand as written?
- Would you change any of the 3-4 key takeaways in each section? Would you make any of the other findings described in each section a key takeaway?
- From your perspective, are there any key takeaways or findings that are missing?
- What are the questions that you regularly hear from others? Do these key takeaways help you answer those questions?

As people ask you questions about the groundwater study, *please* pass them along (harmony.s.burright@oregon.gov) so I can add them to the bank of frequently asked questions.

Background

Since early 2016, the Oregon Water Resources Department (Department) and the U.S. Geological Survey (USGS) have been working cooperatively to better understand the groundwater system in the Harney Basin. Additionally, a Groundwater Study Advisory Committee was convened by the Department and the Harney County Court to create a forum where groundwater scientists could share data and analyses and Advisory Committee members could share data and local knowledge throughout the investigation. The final meeting of the Advisory Committee was held on December 12-13, 2019. At this meeting the USGS presented the findings and conclusions from the scientific study. The Advisory Committee worked together to develop key takeaways based on what they learned over the past 3.5 years.

Key Takeaways

The Groundwater Study Advisory Committee developed key takeaways for the purpose of consistently communicating key findings from the groundwater study with the broader community. The takeaways were reviewed by the groundwater scientists for accuracy and consistency, but were not developed by the scientists who are writing two reports for a rigorous scientific review process prior to public release in late 2020. The Advisory Committee developed the following takeaways based on 3.5 years of learning for the purpose of sharing the general conclusions from the study and also to inform current planning efforts while the reports are undergoing the scientific peer review. The key takeaways are not peer reviewed or published scientific statements. Until the reports are peer reviewed and published, the study findings are considered preliminary and subject to change based on feedback received during the peer review process.

What We Can and Can't Change

There are things we can change and things we can't change

- We can't change how much water replenishes the basin each year via rain and snow
- We can't change the underlying geology that controls groundwater storage and movement
- We *can* change how much water is used, where it is used, and how it is used

Water Budget (water that comes in, water that goes out, and changes in stored water)

Key takeaways:

1. Historically, the groundwater budget was in balance (what entered the basin through natural recharge was equal to what left the basin through natural discharge [e.g., evaporation, transpiration from plants, discharge to streams and springs, etc]). The average annual recharge is 220,000-250,000 acre feet and the average annual natural discharge is 210,000-240,000 acre feet.[1]
2. The groundwater budget was in balance until people started using water. The amount of groundwater used by people is the amount that we are out of balance. On average, people are removing about 130,000 acre feet from the basin each year.
3. Groundwater users are using (removing) "stored" groundwater, which is water that had been stored in the pore space around sub-surface rocks and sediments for hundreds or thousands of years. This is why we see declining water levels.

Other findings:

- Natural groundwater discharge in the basin occurs via outflow to springs and/or surface water, evaporation from surface water, evaporation and transpiration from areas with shallow groundwater, transpiration by natural vegetation that taps into groundwater, and a relatively small amount of groundwater flows that out to the Malheur River Basin through Virginia Valley.
- On average, the total groundwater use (total = human groundwater use + natural groundwater discharge) is 140 - 170% of what is recharging the basin each year. On average, the groundwater that people use is about 50 - 60% of what is recharging the basin each year (human water use = 130,000 acre feet, recharge = 220,000-250,000 acre feet).
- The water budget is different for each of the 3 watersheds that make up the Harney Basin (Silvies River, Silver Creek, and Donner und Blitzen River), though in each watershed discharge is greater than recharge:
    - The Silvies River watershed has the most human groundwater use. On average, the total amount of water that is used each year is about 2 times or double the amount of groundwater that is recharged each year.
        - Recharge = ~70,000-80,000 acre feet, Discharge = ~140,000 acre feet [Irrigation = ~80,000 acre feet, Natural = ~60,000-70,000 acre feet].
    - The Silver Creek watershed has the least amount of recharge. On average, the total amount of water that is used each year is about 1.25 - 2 times the amount of groundwater that is recharged each year.
        - Recharge = ~30,000-40,000 acre feet, Discharge = ~50,000-60,000 acre feet [Irrigation = ~20,000, Natural = ~30,000-40,000 acre feet].

[1] The period used to develop these estimates is 1981-2016.

  - The Donner und Blitzen watershed has the greatest amount of groundwater recharge and natural groundwater discharge, and the least amount of human groundwater use.
    - Recharge = 120,000-130,000 acre feet, Discharge = 150,000-160,000 acre feet [Irrigation = ~30,000 acre feet, Natural = ~120,000-130,000 acre feet].
- Most precipitation (rain and snow) occurs in the high elevation parts of the basin. The least amount of precipitation occurs in the basin's lowest elevations, where most of the groundwater use occurs.

<u>Groundwater Levels/Declines (where we are seeing groundwater levels drop and why)</u>

Key takeaways:

1. The depth and extent of cones of depression are influenced by the rate and volume of groundwater pumping as well as the surrounding geology.
2. The major cones of depression are in the following areas: Weaver Springs, Sunset Valley-Dog Mountain, North of Crane to Windy Point, North of Highway 20 between Rattlesnake and Cow Creeks, and the Central Harney Valley. These are the areas where we see deeper, more obvious groundwater level declines ranging from 10s to greater than 100 feet over the past 30 years.
    a. Decline rate in Weaver Springs = ~7 to greater than 12 feet per year
    b. Sunset Valley-Dog Mountain = ~1 to greater than 3 feet per year
    c. North of Hwy 20 between Rattlesnake & Cow Creeks = less than 2.5 feet per year to greater than 5 feet per year
    d. North of Crane to Windy Point = ~0.5 to nearly 2 feet per year
    e. Central Harney Valley = ~1 to nearly 4 feet per year
3. Some of these areas where groundwater levels are declining the fastest (such as Weaver Springs) are where groundwater pumping wells are surrounded by lower permeability rocks and/or sediments that slow water flow to the wells and slows how quickly surrounding water can replenish the pumping area or zone where water is being removed.
4. In the Silver Creek and Virginia Valley areas, the declines are spread out over a larger area due to the more permeable geology, which allows the pumping influence to capture and more easily draw groundwater from a larger area.
    a. Decline rates in Silver Creek = ~0.5 feet per year
    b. Decline rates in Virginia Valley = ~1 feet per year

Other findings:

- There are some parts of the basin where the shallow and deep systems behave the same and some parts of the basin where they behave differently depending on the degree of vertical connection in the area. Groundwater level declines may differ between shallow groundwater and deep groundwater depending on the local geology and the depth of the groundwater pumping.
- The vertical connection between shallow and deep groundwater depends on the location and thickness of low permeability sediments that can buffer the shallow system from changes in the deep system and vice versa.
- Shallow and deep groundwater can respond similarly when the vertical permeability is high and can respond less similarly when the vertical permeability is less to very low.

Geology (the rocks and sediment beneath our feet)

Key takeaways:

1. Groundwater is flowing through various geologic materials at different rates depending on the type of rock and sediment and how permeable it is (permeability controls how easily water can move through the fractures and pore spaces of the rock and sediment).
2. The geology, the types of rocks and sediments in the basin, varies from place to place, and so the permeability of the groundwater system varies from place to place. That variability affects where groundwater moves, how fast it flows, the rate at which it can be pumped by wells, and the response of the groundwater system to pumping.
3. In general, the rocks at high elevation are older, less permeable rocks, meaning that these rocks don't let much water in and generally don't yield large quantities of water to wells. Generally speaking, the water that falls at higher elevations does not infiltrate deeply into the rock to recharge the regional groundwater system. Instead, upland groundwater recharge tends to remain shallow and discharges to nearby springs and streams close to where it infiltrates.
4. Recharge to the groundwater system happens where the rock is more permeable and also where water is available. Generally speaking, the majority of recharge to the regional groundwater system happens in a few areas in the basin, such as where the Silvies River spreads out onto the basin floor and the northern edge of Steens Mountain.

Other findings:

- The permeability of the different types of rocks and sediments in the basin control where and how much recharge happens:
  - If there is more and larger pore (open) space in the rocks and sediment and they are well connected, there is more space for water to fill and water can more easily flow through it. This is generally the case with young rocks and coarse sediment.
  - If the rock and/or sediment pore spaces are fewer, smaller, and/or less connected, there is less space for water to fill and it is more difficult for water to enter and flow through it. This is generally the case with older rocks and fine grained sediment that is packed close together.
- Areas of recharge in the basin are controlled by both geology and by where and how much precipitation (rain and snow) occurs (recharge can't happen without water!).
- In the Steens Mountain the rocks are more permeable and let a lot of water in, but most of the water doesn't flow very deep and is discharged into the Donner Und Blitzen River above or near the valley floor.
- Valley sediments in the basin generally transition from looser and coarser grained with higher permeability near the upland fronts at the valley margins to finer grained and more compact sediment with much lower permeability in the valley center closer to the lakes.
- Groundwater flows very slowly through fine grained sediments and in general does not yield large quantities to wells.

<u>Groundwater Flow (how groundwater moves in the basin)</u>

Key takeaways:

1. Groundwater moves from higher elevation areas in the basin to one of two lower elevation areas. Virginia Valley and Harney Lake were the historic low points in the basin where water eventually flowed to.
2. Groundwater that historically flowed towards Harney Lake now flows towards the Sunset Valley/Weaver Springs area because the groundwater use (pumping) has lowered the water table in the Sunset Valley/Weaver Springs area, making it the new "low point" in the basin.
3. Groundwater flow paths in the basin can coincide with or differ from the river drainages, depending on location. The groundwater system does not necessarily resemble or mimic the surface water system.
4. Groundwater generally moves very slowly – it is not a rushing river – it can take a long time (years, decades, centuries, or more) for water to move in the groundwater system since it has to move through available, interconnected open spaces within rocks and sediments.

Other findings:

- Water in the uplands follows shallow flow paths and discharges into springs and streambeds in the mountains, which is why there are so many springs and flowing streams in the mountains.
- Groundwater responds to changes in water pressure and elevation – it flows from areas of high pressure and elevation to areas with low pressure and elevation.
- Pumping can change the direction of groundwater flow because it lowers the pressure and water table elevation in the groundwater system near the well.
- A cone of depression, or decrease in water levels below a well because of pumping, will create a steep slope (water gradient) causing water from the surrounding area to flow back into the void space created by pumping. This cone or slope can decrease water table levels in the surrounding area as water moves towards the cone of depression.

<u>Age of Water (what water is "young" and what water is "old" and what it tells us about the system)</u>

Key takeaways:

1. Generally speaking, older groundwater is found deeper in the groundwater system and further away from recharge areas. This water can be thousands or tens of thousands of years old in some places.
2. Most of the groundwater in the basin is old, except where it is shallow and near recharge areas.
3. Shallow, young groundwater was detected where the Silvies River flows into Harney Valley and where at the bottom of Steens Mountain relatively young groundwater is leaving through Virginia Valley.

Other findings:

- Younger groundwater is found near recharge areas where there is a source of surface water and where that water can more easily infiltrate higher permeability rocks and sediments. We see younger water near where the Silvies River hits the valley floor and mixed aged water in Virginia Valley (older water from Harney Valley mixing with younger water from Steens Mountain).

- The older deeper groundwater recharged at a time when the Harney Basin looked really different than now – thousands of years ago, the basin used to contain a giant lake that was a source of recharge.

Call to Action/Next Steps

- The Harney Groundwater Study Reports will be published in late 2020 after going through USGS's peer review process.
- Visit the USGS study website for more information: https://www.usgs.gov/centers/or-water/science/harney-basin-groundwater-study.
- Visit the OWRD study website for more information: https://www.oregon.gov/OWRD/programs/GWWL/GW/HarneyBasinStudy/Pages/default.aspx
- Join the Community Based Water Planning group to continue the discussion: http://hcwatershedcouncil.com/community-based-water-planning/.
- Outreach and planning materials that help to communicate the findings of the groundwater study will be available in April.
- A public event to share the findings of the groundwater study will be held in spring 2020.
- Rulemaking to update the Basin Program Rules is anticipated in early 2021.
- Water users in the basin should be proactive in exploring actions to reduce groundwater use.
- To be added to the Department's email list, please email harmony.s.burright@oregon.gov.