



Greater Harney Valley – Groundwater Study Advisory Committee Meeting
Tuesday, April 17, 2018
10:00am – 4:00pm
Harney County Community Center – 484 Broadway St., Burns, OR



April 17, 2018 - Meeting Summary

Participants

Advisory Committee Members

Allison Aldous, The Nature Conservancy
Angie Ketscher, Citizen/Landowner
Brandon Haslick, Burns Paiute Tribe
Brenda Smith, High Desert Partnership
Erin Maupin, Citizen/Landowner (not present)
Fred Otley, Citizen/Landowner
~~Herb Vloedman, Citizen/Landowner (not present)~~
Gary Ball, US Fish and Wildlife Services
JR Johnson, OWRD
~~Karen Moon, Harney County Watershed Council (not present)~~
Mark Owens, County Commission and Landowner
~~Steve Rickman, Landowner/Business Owner (not present)~~
~~Tony Hackett, Downright Drilling (not present)~~
~~Wayne Evans, Citizen/Landowner (not present)~~

Groundwater Study Team

Darrick Boschmann, OWRD
Jerry Grondin, OWRD
Justin Iverson, OWRD
~~Halley Barnett, OWRD~~
Steve Gingerich, USGS
Hank Johnson, USGS
Amanda Garcia, USGS
Nick Dosch, USGS

Others

Harmony Burrig, OWRD (Facilitator)
Jason Spriet, OWRD
Jordan Beamer, OWRD

Meeting Overview, Action Items, Recommendations, and Updates

The purpose of this meeting was to learn about key components of the groundwater study, provide updates on activities since the last Advisory Committee meeting, and brief the Committee on upcoming activities. The focus of this meeting was on elements of the water budget, including a discussion of methods and initial estimates of recharge and evapotranspiration from natural vegetation (phreatophytes) developed by the USGS as well as methods and initial estimates of evapotranspiration from irrigated crops developed by OWRD and the Desert Research Institute. During the work session, OWRD and USGS updated the Committee on activities since January as well as upcoming activities.



USGS in the field and at Advisory Committee Member Fred Otley's property taking water chemistry samples

Action Items

Who	What	When
OWRD	Send links to Eddy Covariance stations	July 17
OWRD	Follow-up with Harney County on the potential use of survey equipment.	June 1
Advisory Committee Members	Identify potential native vegetation sites for flying unmanned aerial system and connect interested volunteers with USGS	June 1
Advisory Committee Members	Identify wells/land for collecting water chemistry samples/plant tissue samples and connect interested volunteers with USGS	June 1
OWRD	Meet with the Numu Allottee Association to review the charter and discuss their membership on the Advisory Committee	July 17
OWRD and USGS	Work on a brief handout describing methods to estimate ET	April 17
Harmony B, Karen M, Angie K, and Halley B	Work on a brief handout describing the groundwater study	Outstanding
Harmony B and Karen M	Update the Harney County Watershed Council website with Groundwater Study information	Outstanding
Harmony B, Karen M and Angie K	Develop a draft outreach strategy for the Advisory Committee to consider at a future meeting	Outstanding
Mark O	Convene additional meetings of the sub-committee to continue working on local monitoring efforts	Ongoing

Decisions/Recommendations

- None

Proposed Future Discussions

- Updates on activities to estimate recharge and preliminary estimates.
- Updates on activities to estimate evapotranspiration by natural vegetation and preliminary estimates.
- Potential assistance from the GWSAC on field verification of field boundaries, irrigation technologies and crop types.
- Updates on activities to estimate evapotranspiration of crops and preliminary estimates.
- Community groundwater level monitoring.
- Presentation from TNC on proposed study of groundwater dependent ecosystems.
- Updates on water chemistry efforts and observations.

Updates

The next meeting is scheduled for Tuesday, July 17 from 10am - 4pm at the Harney County Community Center. The chair (Mark Owens) and facilitator (Harmony Burright) will develop and distribute an agenda for review prior to the next meeting. If you would like to propose discussion topics, email them to: harmony.s.burright@oregon.gov.

Detailed Meeting Notes

WATER BUDGET PRESENTATIONS – GROUNDWATER RECHARGE AND EVAPOTRANSPIRATION ESTIMATES

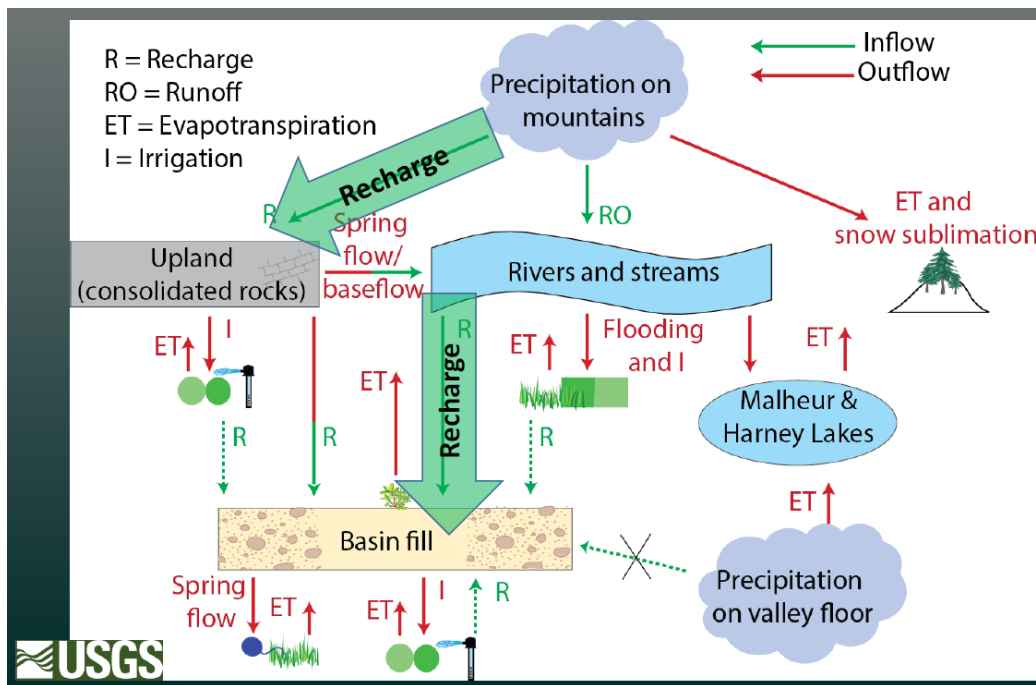
The meeting began with two presentations to begin filling in some information about the water budget (see the presentation delivered by USGS at the January meeting for a concise overview). These presentations focused on the following:

- Methods and **preliminary** estimates for upland recharge to the groundwater system – USGS led
- Methods and **preliminary** estimates for evapotranspiration by native vegetation (phreatophytes) in the “groundwater discharge zones” – USGS led
- Methods and **preliminary** estimates for evapotranspiration by irrigated crops – OWRD led

The majority of the meeting was focused on these presentations and resultant discussion.

Groundwater Recharge – Methods and Preliminary Estimates

For the full presentation, [click here](#)



Amanda Garcia from the USGS presented one method and initial estimates for groundwater recharge. The main components affecting recharge are 1) precipitation that falls in the uplands and is able to percolate into the groundwater system, and 2) water that seeps from river channels into the groundwater system. This represents total potential recharge. **Post-meeting note:** A third as yet unquantified, but potentially very important recharge source is infiltration of spring freshet floodwater.

This is different from (2) in that this recharge is not confined to the stream channels and only occurs during seasonal flooding.

Past estimates of groundwater recharge developed through earlier studies range from ~170,000 acre feet per year (Piper and others, 1939) to ~260,000 acre feet per year (Robison, 1968).

The USGS is using two well established methods to estimate groundwater recharge in upland areas. The first method is an empirical method that uses calculations, observations made in similar geographies, and information collected in the Harney Basin. The second method is a Soil Water Balance model that uses weather, land cover, and streamflow data measured in the Harney Basin. Preliminary estimates for the empirical method are shown in the image below whereas those from the Soil Water Balance model will be presented at a future meeting.

The USGS is using a residual approach to estimate groundwater recharge from streamflow loss. The residual approach incorporates streamflow measurements, surface-water irrigated crop evapotranspiration estimates, and seepage measurements made in the Harney Basin. Preliminary streamflow loss estimates are shown in the image below.

Preliminary Recharge Estimate – Empirical Method + Streamflow Loss	
~120,000 acre feet per year from upland recharge	+
~50,000-150,000 acre feet per year from streamflow losses	=
<hr/>	
~170,000 – 270,000 acre feet per year of total groundwater recharge	
PRELIMINARY – DO NOT CITE	

The USGS and OWRD are continuing to do work to improve upon these estimates. Efforts include:

- Develop estimates using the Soil Water Balance model
- Continue to conduct/improve upon seepage assessments (measuring streamflow losses)

Key Discussion Topics/Questions:

- The variation in numbers reflects variability between wet years and dry years. The recharge number will not be one consistent number – it will vary depending on the precipitation volume and timing from year to year. Surface water irrigation is supply limited and can vary greatly from year to year. Discharge to the lakes also varies from year to year.
- The flow paths of groundwater are still being examined. The travel time of water will be affected by its flowpath through the groundwater system from recharge zones to discharge zones. The impact of dry years and wet years on the groundwater system won't be immediate as travel time dampens year-to-year recharge variability. As a result of this dampening along the groundwater flow path, groundwater discharge typically is representative of long-term average recharge.

Decisions Points/Recommendations: None

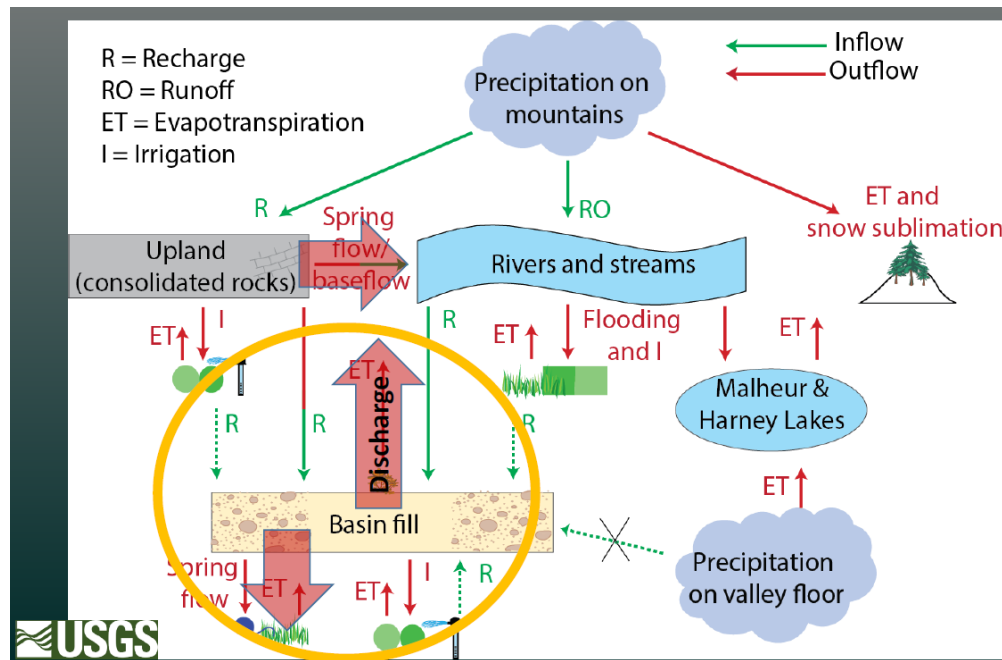
Action Items: None

Proposed Future Discussion Topics:

- Updates on activities to estimate recharge and preliminary estimates

Groundwater Evapotranspiration by Natural Vegetation – Methods and Preliminary Estimates

For the full presentation, [click here](#)



Amanda Garcia from the USGS provided an overview of the types of vegetation that tap into groundwater in “discharge zones” throughout the basin. These discharge zones are areas where phreatophytes (groundwater dependent plants) transpire, or use, groundwater to live. Phreatophytes are generally found in low lying areas within the basin, generally found around Harney and Malheur Lakes or along rivers, streams and springs.

USGS is using remotely sensed imagery as well as site-based measurements of evapotranspiration from native vegetation to estimate how much groundwater is used by these plants. Two approaches were used to develop estimates. An ET Units approach identifies units that have similar vegetation and then assigns a rate of water use for that unit. This approach has to separate out water needs met by precipitation and irrigation to try to determine how much of the water needs of the plants are met by groundwater. The second approach uses an Enhanced Vegetation Index (EVI) model which provides a measure of greenness of the vegetation that can be used to predict water consumption. Again, this model must subtract water needs met by precipitation and must also distinguish between natural vegetation and cropland.

<p>Preliminary Estimate of Groundwater Discharge by Native Vegetation – ET Units Approach Method</p> <p>~180,000-220,000 acre feet per year</p> <p>VERY PRELIMINARY – DO NOT CITE</p>	<p>Preliminary Estimate of Groundwater Discharge by Native Vegetation – ET-EVI Model</p> <p>~220,000-240,000 acre feet per year</p> <p>VERY PRELIMINARY – DO NOT CITE</p>
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The USGS is continuing to do work to improve upon these estimates. Efforts include:

- Evaluate EVI model across multiple years (the initial estimate only looked at one year)
- Refine mapped vegetation areas
 - Field verification of mapped vegetation
 - Distinguishing vegetation type using small unmanned aerial systems (sUAS) – a USGS pilot study
- Evaluate portion of surface water irrigated areas using groundwater. Post Meeting Note: Depth-to-water in SW irrigated areas is often < 10 ft. If crops are deep rooted they could access groundwater after the irrigation water has been depleted. Piper and others (1939) estimate that groundwater ET from meadows and alfalfa irrigated by SW could range from 10,000 to >40,000 AF/Y. Monthly ET estimates from METRIC and SSEBop will help refine these estimates.
- Compare/scale published ET measurements with reference ET estimates in the Harney Basin
- Take tissue samples of plants and compare stable isotopes of tissue water with groundwater to confirm groundwater use

Key Discussion Topics/Questions:

- On the valley floor sagebrush is often deep rooted and sustained by deep soil water. In Harney Basin, the prevailing thought is where sagebrush is more dominant it relies primarily on soil water from precipitation. Where sagebrush is less dominant, it could be using deep soil water replenished by capillary rise of shallow groundwater. It varies across the landscape.
- Some species are deep rooted and utilize groundwater and some do not – this is true of rabbitbrush. Green rabbitbrush is shallow rooted and not known to use groundwater, whereas rubber rabbitbrush is deep rooted and known to use groundwater. Groundwater use is typically species dependent.
- Greasewood is deep rooted and uses groundwater. Roots have been mapped to depths of more than 60 feet.
- One member noted that juniper should be accounted for in groundwater use. USGS noted that most juniper in the Harney Basin is found in the uplands, not the discharge zones. Juniper is more likely to intercept recharge water in the uplands than tap the groundwater directly. The USGS estimates for groundwater evapotranspiration by native vegetation focuses on the low-

lying natural discharge areas. Juniper continues to be a topic of interest to Advisory Committee members.

- **Question:** Are there plans to estimate ET in the upland area? **Answer:** USGS explained that the Soil Water Balance model has an ET equation embedded within it that looks at land use vegetation cover, soil depth, rooting characteristics, etc. The spatial resolution of Soil Water Balance model is 1km x 1 km. The Simplified Surface Energy Balance (SSEBop) model can also be used to tell the difference in ET from one forest stand to another. The spatial resolution of SSEBop is 100m x 100m.
- USGS is seeking volunteers who would be willing to have their land flown by a UAS (unmanned aerial system) – they are specifically seeking landowners with land in known discharge zones.
- USGS is working on an automated vegetation classification tool that can classify vegetation using vegetation datasets, Landsat and aerial imagery, LiDAR, and field observations. There are many different inputs to the classification tool, including vegetation height from lidar, greenness from Landsat-based surface reflectance data (the amount of light absorbed and reflected by a plant can tell you about the plant type and growth pattern), percent cover, color variation (derived from aerial imagery), etc. This can be used to improve current vegetation maps.

Decisions Points/Recommendations: None

Action Items:

- Advisory Committee members will help USGS identify volunteers who are willing to have their land flown by a UAS to map vegetation in discharge zones.

Proposed Future Discussion Topics:

- Updates on activities to estimate evapotranspiration by natural vegetation and preliminary estimates.

Evapotranspiration by Crops – Methods and Preliminary Estimates

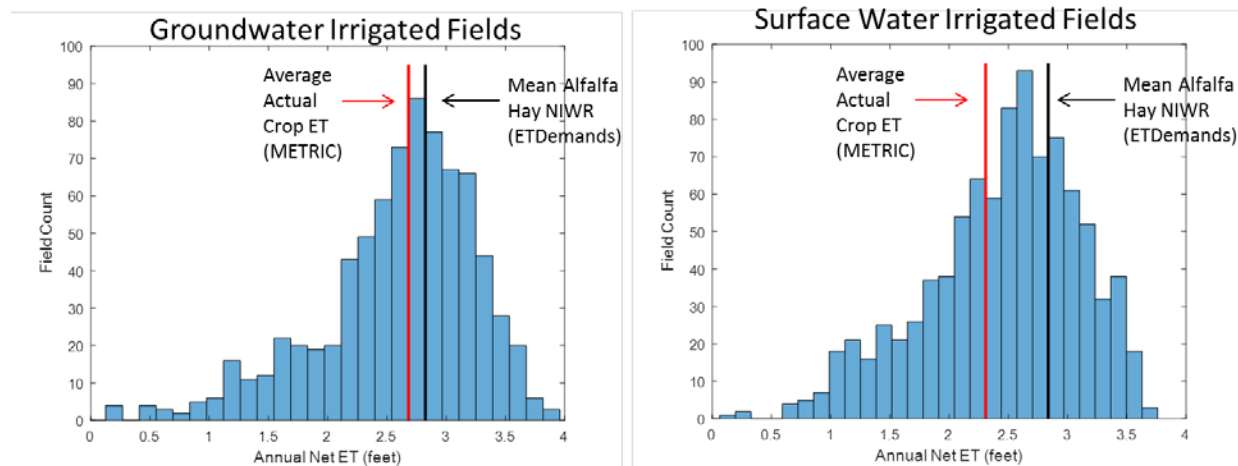
For the full presentation, [click here](#)

Jordan Beamer from OWRD provided an overview of different methods used to estimate potential and actual evapotranspiration by crops and shared some preliminary estimates. The groundwater study needs accurate estimates of pumpage and water used by irrigation – it is an important piece of the overall water budget. Information about actual water use is limited. Without a direct estimate of water use across the basin we need to use indirect techniques for getting at water use.

Multiple methods are used to understand both potential and actual evapotranspiration of crops. Potential evapotranspiration is estimated using published figures (e.g., Cuenca), calculations made using data from Agrimet stations, or an ET Demands model developed by the Bureau of Reclamation that can look at crop consumptive needs under current and future conditions. These assume “well-watered” conditions and do not account for water supply constraints. OWRD is applying the ET Demands model to the Harney Basin to get at *potential* evapotranspiration.

Actual evapotranspiration can be measured using Eddy Covariance Stations or Bowen Ratio Stations. These stations make point measurements of ET at the field-scale or vegetation stand scale. This is spatially limited. Remote sensing from satellites is used to measure actual ET across a larger area. OWRD has partnered with the Desert Research Institute to use the METRIC (Mapping Evapotranspiration at high Resolution using Internalized Calibration) Model to estimate *actual* evapotranspiration.

Surface water ET peaks in June and tapers off and groundwater ET peaks in July/August. The average actual ET for groundwater irrigated crops (estimated using METRIC) is closer to the potential ET (estimated using the ET Demands model). Surface water irrigated crops have a lower actual ET when compared to potential ET due to water supply limitations.



Preliminary Estimate of Groundwater Discharge by Crops – METRIC Model

**62,200 irrigated acres x 2.64 mean net ET rate
= ~164,100 acre feet per year in net ET**

PRELIMINARY – DO NOT CITE

Jordan concluded that the initial results are promising – the remote sensing of ET (METRIC) approach computes a mean net ET rate very similar to the irrigation water estimated from ET-Demands model for 2016. OWRD will perform METRIC analysis for a total of 10 years of Landsat imagery in the basin.

OWRD is continuing to do work to improve upon these estimates. Efforts include:

- Tying the field level ET data to water rights and wells.
- Field validation of field boundaries, crop types, and irrigation methods.
- Field validation of actual ET using measurements from the Eddy Covariance station and water use records (ET stations and water use records provide ground-truth data for METRIC ET estimates).

Key Discussion Topics/Questions:

- An Advisory Committee member noted that the temperature in riparian areas, irrigated fields and bare ground can vary greatly. For instance, logged temperature in a riparian area can be 64 degrees and within a few hundred feet it can be 130 degrees on bare ground/rock surface. This variability can greatly affect evapotranspiration. Irrigation of fields keeps the nearby air cool, which can have an effect on evapotranspiration. In addition, evapotranspiration will change when a field is growing versus when it is harvested due to many different factors. Evapotranspiration is influenced by management decisions. Jordan noted that potential evapotranspiration assumes consistent, well-watered conditions and doesn't necessarily account for management decisions. Measuring actual evapotranspiration helps us to see what water is actually used and how that changes with different management practices.
- Advisory Committee members expressed an interest in seeing evapotranspiration at different timescales. The current estimates are annual ET, but it could be helpful to see these figures at different timescales (e.g., monthly). There is a high degree of interest in making this useful to real-time decision-making. Jordan mentioned that getting the data at the spatial and temporal scale to be useful for basin-level and field-scale planning is a goal of the project team he is working with.
- There was also interest in better understanding how much applied water is lost to evapotranspiration and how much returns to the groundwater system through percolation. Surface water irrigators rely primarily on flood irrigation methods which provide benefits to wildlife and is also thought to help recharge the groundwater. It would be interesting to know how much irrigation is actually helping to recharge the groundwater. This is a difficult thing to measure especially if we lack information about how much water is diverted or pumped, which is an important piece of the puzzle. We have the consumptive use (evapotranspiration), but we don't know the total amount diverted/pumped and the efficiency of the different systems – the difference between these could be percolation. Percolation will also vary greatly by region due to geology (e.g., low infiltration where there is heavy clay), weather, and the timing and distribution of the release.

Decisions Points/Recommendations: None

Action Items:

- OWRD will send out link to the data collected by the Eddy Covariance stations.
 - Native Vegetation Site: <https://www.wrcc.dri.edu/cgi-bin/rawMAIN.pl?orolwn>
 - Alfalfa Center Pivot Site: <https://wrcc.dri.edu/cgi-bin/rawMAIN.pl?orocrn>

Proposed Future Discussion Topics:

- Potential assistance from the GWSAC on field verification of field boundaries, irrigation technologies and crop types.
- Updates on activities to estimate evapotranspiration of crops and preliminary estimates.

Overall Discussion Topics/Questions:

- USGS, OWRD and members of the Advisory Committee noted that the updated estimates don't seem to be appreciably different from past estimates.
- Advisory Committee members expressed appreciation that USGS and OWRD were sharing preliminary results.
- Advisory Committee members are interested in seeing an updated bar graph that shows some of the preliminary estimates. They indicated that this would be a useful communication tool.

Decisions Points/Recommendations: None

Action Items: See above

Proposed Future Discussion Topics: None

MEMBERSHIP UPDATE

OWRD and Harney County received a request from the Numu Allottee Association to join as a member of the Groundwater Study Advisory Committee. There is currently a vacancy that can be filled with a joint appointment by OWRD and the County as per the charter. A representative of the Numu Allottee Association informed the Advisory Committee of their interest in joining the Committee. Existing members were invited to ask questions and express support or concern. Members expressed support for adding a member of the Numu Allottee Association to the Committee indicating that they have already been attending and continually add value to the conversations. OWRD and the County intend to move forward with an appointment in July.

Key Discussion Topics/Questions:

Decisions Points/Recommendations: None

Action Items:

- OWRD will meet with the Numu Allottee Association to review the charter and discuss their membership on the Advisory Committee.

Proposed Future Discussion Topics: None

OWRD PROJECT MANAGEMENT UPDATES

Justin Iverson provided several updates to the group:

- **Project Schedule** – OWRD and USGS are reviewing the Gantt chart provided as a part of the Plan of Study and will provide a full status update at the July meeting. Generally speaking, the Study

Team is on track to finish the study on schedule. Some of the individual tasks may take longer to complete than originally anticipated, but this should not affect the overall schedule.

- **Water Use Measurement Cost-Share Program** – OWRD is now able to offer cost-share to install water measurement devices for groundwater users (it was previously only available to surface water users). Justin provided packets of information to those that were interested and left a stack of packets with JR (the District 10 Watermaster). Reporting of water use is voluntary and encouraged. Understanding how much water is pumped will help OWRD and USGS better understand how much applied water is lost through evapotranspiration and how much applied water may percolate back into the groundwater system.
 - **Discussion:** Self-reported water use data is variable and may not be reliable, but it is the best we have right now.
- **Update to the Water Resources Commission** – OWRD is providing an update on the Groundwater Study to the Water Resources Commission at their June meeting. Members are encouraged to attend or to share their thoughts and feedback with Harmony, Justin, or Mark who will share them with the Commission.

Decisions Points/Recommendations: None

Action Items:

- Members will share their thoughts and feedback with Harmony, Justin, or Mark who will share them with the Commission at the June meeting.

Proposed Future Discussion Topics: None

OWRD TECHNICAL UPDATES

Jerry Grondin and Darrick Boschmann with OWRD updated the Committee on activities they have accomplished since April as well as upcoming activities, including:

- **Synoptic** – Final spring synoptic – attempted 230 wells – measured 210 wells. Working to enter this information into the database. There are some groundwater levels that are so close in elevation – within elevation error – need to survey elevation points before plotting them on a map.
- **Well Elevation** – A critical task this summer will be to improve accuracy of well elevations – this is a high priority. There are approximately 200 wells that need improved elevation measurements. Intend to get the margin of error to less than a foot – right now it is 5-10 feet. Once this is done, OWRD will develop a potentiometric map showing groundwater level contours. May need to purchase some new equipment (survey grade GPS units) to get elevation or contract it with someone. Possible approaches for completing this work include: OWRD purchases or borrows equipment; Contract with DOGAMI; Contract with USGS; Contract with a private consultant.
 - **Discussion:** Harney County may have equipment that OWRD can borrow.

- **Seepage Runs** – Some seepage runs were completed last summer/fall. Not able to do others due to weather conditions or access issues. Some sites need to be revisited. Intend to finish seepage runs this summer/fall.
- **Observation Wells** – The bids to drill an observation well at the Agricultural Research Station are in – the RFP is closed and in the evaluation stage. DEQ sampled the shallow observation wells last week and will be renting high capacity pumps to sample the deep observation wells. They have well established protocols that they will be using to ensure quality samples.
- **Geologic Map** – A recently published USGS geologic map compilation (Sherrod & Keith, 2018) includes the Harney Basin study area. Will likely use this map since it will be peer reviewed and published in time for the study.

Sherrod, D.R. and Keith, M., 2018. *GIS Database and Discussion for the Distribution, Composition, and Age of Cenozoic Volcanic Rocks of the Pacific Northwest Volcanic Aquifer System Study Area* (No. 2018-1030). US Geological Survey.

The map is available for download at: <https://pubs.er.usgs.gov/publication/ofr20181030>

- **Hydrogeologic Units** – Distinguishing different hydrologic units based on driller's reports is proving to be very difficult.
- **Evapotranspiration Measurements** – OWRD is working with the Desert Research Institute to move the Eddy Covariance Station measuring evapotranspiration of native vegetation to a new site at the Malheur Wildlife Refuge in June.

Decisions Points/Recommendations: None

Action Items: None

- OWRD will follow-up with Harney County regarding survey equipment that may be useful for taking well elevations.

Proposed Future Discussion Topics: None

USGS TECHNICAL UPDATES

Hank Johnson and Steve Gingerich with the USGS updated the Committee on activities they have accomplished since July as well as upcoming activities, including:

- **Geochemistry** – USGS presented some preliminary observations about water chemistry samples – [click here](#) to see the presentation. The main tools/techniques that the USGS uses are stable isotopes, tritium, carbon dating, and conductivity (salinity and total dissolved solids). Stable isotopes can help identify the original source of the water. Tritium and carbon dating can be used to date water and determine how long it has been in the ground. Total dissolved solids and overall mineral content can provide information about how long water has been in the ground – the longer the water is in the ground, the more dissolved minerals it picks up. All of this

information can also provide clues about how the water moves underground (i.e., flowpaths). Initially, USGS is evaluating the sources of water for three key areas:

- Buchanan-Crane–New Princeton corridor
- Weaver Springs/Sunset Valley
- Warm Springs Valley

Initial Observations

- Stable isotope ratios in water samples from upland springs and baseflow reflect the average annual precipitation, and can be used to identify unique precipitation and recharge regions across the Harney Basin.
- Stable isotope ratios in some samples are much more negative than modern precipitation. Our current working hypothesis is that this water was recharged in the distant past.
- Water without measurable tritium was identified in warm springs near Double O ranch and in wells near New Princeton. Most of the water in those samples was likely recharged prior to 1950. USGS will follow up with carbon-14 dating at some sites to better constrain the age of the tritium-free water.

USGS plans to connect with the Crane High School students who have also been taking water chemistry samples. The USGS is also coordinating with DEQ who is taking water samples that can benefit the study.

- **Question:** How hard is it to get a good sample? Stable isotopes and tritium are very forgiving – very hard to pollute the samples. Long shelf life. Need to sample at the well and need to be able to purge the well or have a well with good flow – this ensures we can get a good sample.
- **Well Elevation** – USGS will be helping OWRD get accurate well elevations this summer.
- **Water Budget** – USGS will continue to work on and refine elements of the water budget.

Decisions Points/Recommendations: None

Action Items:

- USGS is looking for volunteers who will allow access to their wells to collect chemistry samples or access to their land to collect tissue samples from plants.

Proposed Future Discussion Topics:

- Updates on water chemistry efforts and observations.

PARTNER UPDATES

- **Community Based Water Planning (CBWP)** – The meeting of the full Community Based Water Planning collaborative will be held on April 18. Justin and Harmony are invited to give an update to the full group.

- **US Fish and Wildlife Service** – USFWS is installing a lake level monitoring device at the end of April as well as reviving measurement flumes at OO springs.
- **Community Groundwater Level Monitoring** – Angie, who is heading up the community groundwater level monitoring effort for the Harney County Watershed Council will deliver a presentation at the next Advisory Committee meeting on her efforts.
- **The Nature Conservancy** – TNC’s work to characterize groundwater dependent ecosystems in the basin will rely very heavily on existing work in the basin – lots of complementary activities going on. TNC will need help in making connections between the different efforts to avoid redundancy and duplication.
- **Department of Environmental Quality** – DEQ did its first round of sampling in March and the samples are being analyzed. The second round of sampling is planned for fall and they are still accepting volunteers.

Decisions Points/Recommendations: None

Action Items: None

Proposed Future Discussion Topics:

- Community groundwater level monitoring
- Presentation from TNC on proposed study of groundwater dependent ecosystems

OBSERVATIONS AND REFLECTIONS

Advisory Committee and Study Team members were invited to share their observations and reflections with the group:

- Mind is full of information – appreciative of what was shared and how it was shared
- Water chemistry work is really interesting and can be helpful when trying to piece together information about where water is coming from and where it is going
- Appreciate sharing of preliminary results and observations
- Really appreciate OWRD and USGS sharing preliminary results and observations – very interesting and helpful
- Need to think about how best to present information and analyses to the broader community – how can we best accomplish that?
- Appreciate the great questions and interest in the material
- Appreciate the great presentations
- Anxious to get out and collect more samples
- Very interested in the water chemistry work
- Follow-on discussions in small groups would be helpful – there was a lot of information presented and not sure I absorbed it all
- Difficult to tie water rights to wells – this is really important and will be really challenging to sort out

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- Good scientific investigations lead to more questions – we need to give the study the time it needs to get the right information – all great presentations today that led to more questions – not looking for a shortcut to conclusions
- Lots of information communicated today and lots of good conversation – how can we communicate this out so it's not an echo chamber?
- Struck by the variability in precipitation and how drastically that can affect the water budget
- Enjoyed presentations – very stimulating – appreciate time to learn and think
- Appreciate all the thought provoking questions – there are points we may or may not have thought about – grateful for the new perspectives
- Data mapping tool is up online and ready to use – feedback welcome
- Grateful for participation from the group and a good exchange of ideas
- The inputs are very complex – neat to see it all coming together – raised some really good questions
- Lots of information – kind of dense, but all really interesting and helpful – may need to revisit concepts and information to make sure it sinks in

Decisions Points/Recommendations: None

Action Items: None

Proposed Future Discussion Topics: None