Groundwater Transfer Review Summary Form

Transfer/PA # T- **14449**

GW Reviewer **Dennis Orlowski** **Date Review Completed:** July 3, 2025 (re-review)

Summary of Same Source Review:

☐ The proposed change in point of appropriation is not within the same aquifer as per OAR 690-380-2110(2).

NOTE: this re-review revisits a previous finding of "not within the same aquifer" that was concluded in the original T-14449 review completed on February 4, 2025. The rationale for this revised conclusion is summarized in Section 2 of this re-review.

Summary of Water Level Decline Condition Review:

☐ Water levels at the original point(s) of appropriation have exceeded the allowed decline threshold defined by conditions in the originating water right.

Summary of Injury Review:

☐ The proposed transfer will result in another, existing water right not receiving previously available water to which it is legally entitled or result in significant interference with a surface water source as per 690-380-0100(3).

Summary of GW-SW Transfer Similarity Review:

☐ The proposed SW-GW transfer doesn't meet the definition of "similarly" as per OAR 690-380-2130.

This is only a summary. Documentation is attached and should be read thoroughly to understand the basis for determinations.

OREGON WATER RESOURCES DEPARTMENT

Oregon Water Resources Department
725 Summer Street NE, Suite A
Salem, Oregon 97301-1271
(503) 986-0900
www.wrd.state.or.us

Ground Water Review Form:

☐ **Water Right Transfer**
☒ **Permit Amendment**
☐ **GR Modification**
☐ **Other**

Application: T-14449 Applicant Name: City of Banks

Proposed Changes: ☐ POA ☒ APOA ☐ SW→GW ☒ RA
☐ USE ☐ POU ☐ OTHER

Reviewer(s): Dennis Orlowski Date of Review: July 3, 2025 (re-review)

Date Reviewed by GW Mgr. and Returned to WRSD: JTI 7/3/25

The information provided in the application is insufficient to evaluate whether the proposed transfer may be approved because:

☐ The water well reports provided with the application do not correspond to the water rights affected by the transfer.

☐ The application does not include water well reports or a description of the well construction details sufficient to establish the ground water body developed or proposed to be developed.

☐ Other _____

- -

1. Basic description of the changes proposed in this transfer: **This re-review supersedes the original review completed on February 4, 2025**.

   This proposed permit amendment relates to **permit G-7593** which authorizes groundwater pumped from a single authorized POA (WASH 7651, "Well 1") for municipal uses by the City of Banks (maximum instantaneous pumping rate of 0.67 cfs, ~301 gpm).

   This amendment proposes to add the following APOA to permit G-7593 (note that only one proposed APOA is an existing well (WASH 62373), whereas the others are proposed to-be-drilled (TBD) (see attached map):

   - WTP (Water Treatment Plant) well – TBD
   - AN (Aerts Rd North) well – TBD
   - AS (Aerts Rd South) well – TBD
   - Park-A (Park Primary) well – TBD
   - Park-B (Park Alternative) well – TBD
   - Park-C (Park Alternative) well – TBD
   - Well 2 (Behrman Well 2) – WASH 62373

Proposed APOA WASH 62373 ("Well-2") is also the single authorized POA for certificate 95849, which authorizes pumping (maximum 1.0 cfs) of groundwater for municipal use by the City of Banks. WASH 62373 is located only about 60 feet away from WASH 7651 ("Well-1").

2. Will the proposed POA develop the same aquifer (source) as the existing authorized POA?
☒ Yes ☐ No Comments: Authorized POA WASH 7651 ("Well 1") is 450 feet deep, with an open interval from 210 to 450 ft below land surface (bls), and obtains groundwater from water-bearing interflow and fracture zones within the Columbia River Basalt Group aquifer system (Conlon and others, 2005; Gannett and Caldwell, 1998). The well log for WASH 7651 indicates that greater than 90 percent of inflow to the well (~325 gpm) was estimated to be from a lower water-bearing zone (WBZ) from 360-415 ft bls; shallower interflow zones between 230 and 325 ft bls were estimated to provide only about 25 gpm to WASH 7651. Consequently, in WASH 7651 the lower WBZ zone between 360-415 ft bls is considered to be the primary source of groundwater to this well.

Planned construction details for the six proposed (not-yet-drilled) APOA show total well depths ranging between approximately 650 to 750 feet, with cased and sealed intervals from 0 to about 200-250 ft bls.

The relatively deeper planned construction for the six proposed APOA is similar to the seventh proposed APOA, existing well WASH 62373 ("Well 2"). WASH 62373 is 665 feet deep, with an open interval between 300 and 665 ft bls. According to the WASH 62373 well log and additional documents provided by the applicant's agent (CwM-H2O, 2018), there are two principal basalt WBZ in this well: 378-468 ft bls and 615-660 ft bls. The uppermost WBZ generally corresponds to the primary zone in authorized POA WASH 7651 (360-415 ft bls). However, the lower WBZ in WASH 62373 is not present in the shallower authorized POA (WASH 7651).

Previous Conclusion – Source Determination

The presence of two different WBZ in WASH 62373, coupled with inconclusive, incomplete, and/or contradictory information previously provided by the applicant's agent (as summarized below and in the previous T-14449 review), led to OWRD's previous conclusion that all of the proposed APOA would obtain groundwater from a groundwater source *different* from that present in authorized POA WASH 7651 (i.e., from both the shallower WBZ present in WASH 7651 in addition to the deeper WBZ present only in WASH 62373 and the other proposed APOA wells).

Additional Information and Assessment

After completion of the first review for T-14449, OWRD (1) re-evaluated additional information provided by the applicant's agent subsequent to the first review and (2) assessed longer-term water level trends in the CRBG aquifer system throughout most of the entire Tualatin Valley in an effort to improve understanding of groundwater conditions near Banks.

The following list summarizes key factors re-evaluated by OWRD that led to the revised conclusion provided in this re-review:

(1) Retraction of previous determination *by the applicant's agent* that a downhole video survey of WASH 62373 ("Well 2") did indeed show exchange of water between the two WBZ, *thus indicating two discretely different aquifer sources* (CwM-H2O, 2018).

- An attachment to the T-14449 and T-14450 applications claimed that their original interpretation of the video survey was incorrect, and that "*there is no evidence from the video survey of water movement in either direction*", thus concluding "*that the two WBZs share very similar hydraulic pressure regimes under static conditions."*
- Since completion of the first review, OWRD was provided with and examined this same video from WASH 62373, in addition to another video of WASH 50693 (the nearby Quail Valley Golf Course well with similar construction). OWRD concludes that this particular video evidence *alone* was insufficient to discern *any predominant* vertical flow direction within WASH 62373 (or WASH 50693), primarily because camera pause times were not long enough to allow turbulence caused by the vertical movement of the camera to diminish (i.e., remnant turbulent flow resulted in movement of suspended particles in generally haphazard directions).

(2) Recent provision of additional static water-level data from WASH 7651 and WASH 62373.

- WASH 7651 ("Well 1"), located only about 60 feet from another City of Banks well WASH 62373 ("Well 2"). WASH 7651 is much shallower at 450 feet deep, and obtains groundwater from only the uppermost of the two primary WBZ present in WASH 62373. Historically, water level (or head) differences reported for the two wells have ranged from 15+ feet to several feet. Head differences of this magnitude are typically strong evidence that the wells tap different WBZ under markedly different hydraulic conditions, and thus each WBZ would typically be considered by OWRD to be a separate aquifer/source (OAR 690-200-0050)
- To note, even the T-14449 application listed a head difference of 2.2 feet between WASH 7651 and WASH 62373, a magnitude which strongly suggests the wells tap discretely different aquifer sources.
- Recently provided static water-level data of improved reliability indicates much smaller head differences on the order of ~0.2 to ~1 foot. While *any* head difference would suggest two different sources under different hydraulic head conditions, the generally very dynamic CRBG aquifer system in and near Banks was taken into account by OWRD for this re-evaluation (i.e., the smaller head differences might reflect transient levels between drawdown and recovery phases, despite the contention they are truly "static"). Consequently, *while also not entirely conclusive alone*, the more recent water-level measurements show much smaller differences compared to data previously provided to OWRD, and thus better support a determination of single source.

(3) Recent provision of static and dynamic spinner log survey results to OWRD.

- After completion of the first review, OWRD was provided with the results of static and dynamic spinner log surveys completed in both WASH 62373 ("Well 2") and nearby WASH 50693 (Quail Valley Golf Course well). The applicant's agent claimed the survey results suggested that (1) no vertical flow was occurring in either well, thus (2) there was no head differential between the shallow and deep WBZ, and therefore (3) the two WBZ constituted a single source aquifer.

- However, accuracy limitations of the spinner log instrumentation used for these surveys indicate that approximately 3 gpm of vertical flow could exist within the well *without* being detected by the instrumentation. The presence of *any* vertical flow in a well under static/non-pumping conditions indicates a head differential between successive WBZ, which in turn indicates that each WBZ behaves as a separate aquifer/source.
- Thus, the spinner log results *alone* are not conclusive proof a single aquifer determination, but were useful by (1) establishing relative flow contributions from each of the two key basalt interflows, and (2) effectively quantifying much additional flow from major fracture zones *apart from the basalt interflows* (as identified in the WASH 62373 and WASH 50693 well videos).

(4) OWRD assessment of long-term water-level trends in CRBG wells throughout much of the Tualatin Valley.

- Historic (~20-50 year) water-level data from many CRBG wells located throughout the Valley, with variable completion depths and elevations, exhibit (1) generally similar trends and (2) a generalized grouping of levels (heads) into two elevation zones: ~120-150 ft msl and ~180-200 ft msl. These aspects suggest a moderate to high degree of aquifer connectivity between many CRBG wells throughout the Valley.
- Static water-level measurements from both WASH 7651 ("Well 1) and WASH 62373 ("Well 2") fall within the uppermost of these two head groupings. Recently reported head differences for those two wells have been relatively small when compared to the roughly 30-foot range used to define the upper grouping. OWRD's broader assessment of much more available data suggests that CRBG "aquifer" designations within the Valley might be defined more appropriately by head groupings (with relatively minor fluctuations within each grouping), as opposed to being defined as a singular basalt interflow, the presence of which is typically inferred only from well log descriptions.

(**Note**: additional supporting documentation provided by another consultant (Summit Water Resources, 2025) made reference to spinner log and temperature survey results that "*…resulted in a single aquifer determination within the CRBG at the following locations in the Tualatin Basin:*

- *City of Beaverton: ASR 5, 2016*
- *City of Beaverton: ASR 7, 2020.*
- *City of Tigard: ASR 3, 2014.*
- *City of Cornelius, ASR well, 2017*."

The open intervals for the above wells range from 384 to 998 feet, with multiple basalt interflows/WBZ present in each interval.

Despite the consultant's reference, it is not applicable to invoke downhole survey activities performed at these wells as a precedent for decision making for the Banks wells. The Beaverton and Tigard ASR wells are located within the Cooper Mountain-Bull Mountain Critical Groundwater Area (CGWA) located about 16-18 miles southeast of Banks. The order establishing that CGWA directs OWRD to manage the entire CRBG system with the CGWA as a **single groundwater source**. This directive has been a key factor when OWRD considers how to manage ASR storage and recovery wells within the CGWA.

Thus, the results of spinner, temperature and video surveys conducted in the ASR wells was not considered by OWRD as necessary to determine whether or not commingling of discretely-different WBZ exists, because OWRD treats the entire CRBG aquifer *within the CGWA* as a single source. Instead, these surveys were required to better inform and manage ASR activities, including storage accounting and where injection and recovery can occur (i.e., within specific interflows). Therefore, these same types of survey activities performed in the ASR wells located within the CGWA were done for different purposes, and thus should not be considered directly applicable to the Banks' wells in which assessing potential commingling of different WBZ was the primary objective.

The Cornelius ASR well is not within the Cooper Mountain-Bull Mountain CGWA. However, this well (WASH 73617) is relatively very deep (1589 ft), much deeper than almost all other CRBG wells in the Valley and thus highly unlikely to affect those other wells).

Revised Conclusion – Source Determination

After evaluating the additional information provided by the applicant and also conducting a broader assessment of aquifer conditions using historic regional data, the preponderance of evidence indicates the two water-bearing zones (WBZ) developed to date by the City of Banks in WASH 62373 ("Well 2") constitute a single aquifer (same source) for the purposes of meeting minimum well construction standards and managing basalt groundwater resource in the vicinity of Banks.

At this time OWRD finds that the preponderance of evidence indicates that the authorized POA WASH 7651 and proposed APOA (which includes WASH 62373) will obtain groundwater from the same groundwater source.

To ensure that each proposed APOA obtains groundwater only from the currently-authorized aquifer source, the GW Section recommends conditioning the transfer so that all of the proposed APOA wells be limited to accessing only the two primary basalt WBZ present between approximate elevations -125 to -430 ft msl (which is based on the two general WBZ identified in WASH 62373 ("Well 2") and nearby WASH 50693 (QVGC well)).

The following technical analyses were completed assuming these construction limitations will be applied to the proposed APOA wells.

3. a) Is the existing authorized POA subject to a water level decline condition?
☐ Yes ☒ No Comments: The authorized POA, WASH 7651, is not subject to water decline conditions under permit G-7593.

b) If yes, for each POA identify the reference level, most recent spring-high water level, and whether an applicable permit decline condition has been exceeded: N/A

4. a) Is there more than one source developed under the right (e.g., basalt and alluvium)?
☐ Yes ☒ No Comments: As discussed in Section 2 of this review, at this time OWRD concludes that the authorized POA and proposed APOA – assuming recommended well construction limitations presented in Section 8 of this review are adopted - will obtain groundwater from the same source.

b) If yes, estimate the portion of the right supplied by each of the sources and describe any limitations that will need to be placed on the proposed change (rate, duty, etc.): N/A

5. a) Will this proposed change, at its maximum allowed rate of use, likely result in an increase in interference with **another ground water right**?

☒ Yes ☐ No Comments: Relative to the location of authorized POA WASH 7651, several of the proposed APOA locations are nearer to existing groundwater rights. Thus, this proposed change will likely result in an increase in interference with those rights.

b) If yes, would this proposed change, at its maximum allowed rate of use, likely result in another groundwater right not receiving the water to which it is legally entitled?

☐ Yes ☒ No If yes, explain: Each of the proposed APOA locations was evaluated for potential injury to applicable existing groundwater rights. For relevant evaluations, the Theis distance-drawdown analysis was performed to estimate the degree of additional interference at the nearest applicable existing well (Theis, 1935). The ranges of aquifer parameter values used were derived primarily from results of a 2009 aquifer test completed in proposed APOA WASH 62373 (Golder Associates, 2009) and in another separate test of WASH 50693 (QVGC well), as well as published values (Conlon et al., 2005; Gannett and Caldwell, 1998).

Potential Injury Evaluation: Proposed APOA "AN Well" and WASH 77444, WASH 79189, WASH 56924

Relative to authorized POA WASH 7651, the proposed APOA "AN Well" location is approximately 2500 feet nearer to WASH 77444 (WASH 73386 and WASH 73351 are also near WASH 77444). The "AN Well" *as assessed* (i.e., limited to the WBZ between elevation ~-125 to -430 ft msl) might impose additional drawdown interference in WASH 77444 and other nearby wells of similar completion.

The key WBZ in WASH 77444 (between elev. ~-20 to -105 ft msl) is above the assessed WBZ in the "AN Well" (between elev. ~-125 to -430 ft msl); nearby WASH 73386 is similarly completed (see attached **cross-section 1**). Because WASH 77444 and WASH 73386 are located at a higher ground surface elevation than the "AN Well" location, it is possible that the WBZ at those two wells is approximately the same as the uppermost WBZ (elev. -125 - -250 ft msl), but has potentially been vertically offset by faulting between the two locations (the fact that existing geologic maps do not show a fault at this location does not preclude the possible existence of one). Faults typically truncate basalt interflow zones/WBZ, which would reduce or eliminate hydraulic connection between wells on either side of the fault. Whether or not a fault is present at this location, it is likely that there is **not** an efficient hydraulic connection (or any whatsoever) between the "AN Well" and WASH 77444, WASH 73386, or other nearby wells of similar completion, and thus those wells are unlikely to be injured due to the proposed use of the "AN Well."

Farther to the east, the completion depths and open intervals of other wells (namely WASH 79189 and WASH 56924) partially overlap the approved completion interval, and are thus more likely to be adversely affected by pumping at the "AN Well" location (see attached **cross-section 2**).

Relative to the location of authorized POA WASH 7651, the proposed location for the "AN Well" is about 2700 feet nearer to WASH 79189. The results of the Theis interference analysis indicates that additional interference in WASH 79189 could potentially range from about 10 to 20 feet due to pumping the maximum rate (0.67 cfs) 24/7/365 from the "AN Well" (see attached Theis analysis results).

Limited water level data from other nearby wells (WASH 56924) indicates that the static water level in WASH 79189 likely ranges from about elevation 180 to 200 ft msl, which would provide roughly 200 feet or more of available drawdown in both it and existing wells of similar completion. This approximate range of available drawdown should be sufficient to support ongoing usage of these wells with the change proposed by this application (i.e., the change will not prevent those wells from receiving the groundwater to which they are legally entitled).

Potential Injury Evaluation: Proposed APOA "AN Well" and WASH 50693

Pumping of the "AN Well" could also affect WASH 50693, the Quail Valley Golf Course well which is an authorized POA for a supplemental irrigation water right (certificate 91527). Relative to authorized POA WASH 7651, the "AN Well" location is about 1750 feet nearer to WASH 50693 (see **cross-section 1**). However, during the 2009 aquifer test of WASH 62373, which is located about 60 feet from WASH 7651 and is constructed more like WASH 50693 (both access a key deeper WBZ that is not present in the shallower WASH 7651), only about 2 feet of additional drawdown was measured in WASH 50693 (Golder Associates, 2009). Therefore, it is unlikely that pumping of the "AN Well" would negatively affect the current usage of WASH 50693.

Potential Injury Evaluation: Proposed APOA "AS Well" and WASH 71496, WASH 73553, WASH 50693

Relative to the location of authorized POA WASH 7651, the proposed location for APOA "AS Well" is about 3600-3800 feet nearer to WASH 71496, WASH 73553 and several other domestic wells in the area. However, all of these existing wells are relatively shallow with the borehole bottoms very near, or just above, the recommended casing/seal depth elevation for all of the proposed APOA (at about -125 ft msl) (see attached **cross-section 3**). It is also notable that some of these same nearby wells only access the uppermost portions of the CRBG in this area, i.e., likely the flow top at the contact between alluvial sediments and the underlying basalt, and do not extend deeper into the same or another WBZ (such wells are considered by OWRD to be "alluvial aquifer" wells and not "CRBG aquifer" wells). Because these existing wells do not fully penetrate the upper WBZ present between approximately elevation -125 to -430 ft msl, or are considered to be "alluvial wells" despite partial penetration into the upper basalt unit, an injury determination would not be made due to the proposed use of the "AS Well."

Relative to the location of authorized POA WASH 7651, the proposed location for APOA "AS Well" is also much nearer to WASH 50693, the QVGC well. However, as discussed previously for the "AN Well", it is also unlikely that the proposed use of the "AS Well" will prevent WASH 50693 from receiving the groundwater to which it is legally entitled, for the same stated reasons.

Potential Injury Evaluation: Proposed APOA "Park-A Well" and WASH 52798, WASH 66773

Of the three "Park" wells proposed as APOA, the location for the "Park-A Well" is nearest to the known locations of existing wells. Relative to authorized POA WASH 7651, the "Park-A Well" location is approximately 3000 feet nearer to WASH 52798, an exempt domestic use well. WASH 52798 is reportedly 370 feet deep, but the log does not provide any other information related to well construction or local lithology (see attached **cross-section 4**).

However, nearby WASH 66773 is a comparable depth (410 feet deep), and like all other nearby wells of similar depth, obtains groundwater from the CRBG aquifer system. The WASH 66773 log shows a 2008 static water level elevation of 167 ft msl (depth 35 ft bgs); a similar current static water level assumed for WASH 52798 and other nearby wells indicates that these wells likely have about 200-300 feet of available drawdown. This approximate range of available drawdown should be sufficient to support ongoing usage of these wells with the change proposed by this application (i.e., pumping of the "Park-A Well" will not prevent those wells from receiving the groundwater to which they are legally entitled).

Potential Injury Evaluation: Proposed APOA "WTP Well" and WASH 8102/8089

There are several known wells relatively close to the proposed location for the "WTP Well"; however, current OWRD records indicate that these particular wells are owned by the City of Banks, and are associated with irrigation of school grounds (WASH 77871, WASH 7628, WASH 7621, WASH 3184). Consequently, it is assumed that the City can manage potential adverse interference to these existing wells resulting from pumping at the "WTP Well" location.

Relative to authorized POA WASH 7651, the proposed "WTP Well" location is approximately 2200 feet nearer to WASH 8102/8089, which is an authorized POA for quasi-municipal use by the Star Satellite Improvement District (permit G-7903). The open borehole portion of WASH 8102/8089 extends from about elevation -115 to -210 ft msl, which overlaps a portion of the -125 to -430 ft msl interval stipulated for the proposed APOA wells (see attached **cross-section 5**).

The results of the Theis interference analysis indicates that WASH 8102/8089 could potentially experience about 5 to 10 feet of additional drawdown due to pumping the maximum rate (0.67 cfs) 24/7/365 from the "WTP Well" (see attached Theis analysis results). It is unlikely that this small additional drawdown estimated for WASH 8102/8089 would prevent it or other similarly-constructed wells in the area from receiving the groundwater to which they are legally entitled.

Potential Injury Evaluation: Proposed APOA WASH 62373 and WASH 8102/8089

WASH 62373 is a current City of Banks well authorized for year-round municipal use, pumping at a maximum instantaneous rate of 1.0 cfs (~450 gpm) (certificate 95849). As a proposed APOA for this application, WASH 62373 would be authorized to pump a stacked rate of 1.67 cfs (~750 gpm).

The results of the Theis interference analysis indicates that WASH 8102/8089 could potentially experience about 30 to 90 feet of additional drawdown due to pumping the stacked maximum rate (1.67 cfs) 24/7/365 from WASH 62373 (see attached Theis analysis results). While this range of additional drawdown is relatively large compared to other evaluations, from available static water-level data it is likely that WASH 8102/8909 has approximately 350 to 380 feet of available drawdown. Thus it is unlikely that this additional drawdown estimated for WASH 8102/8089 would prevent it or other similarly-constructed wells in the area from receiving the groundwater to which they are legally entitled.

Conclusions – Potential Injury

The results of the potential injury evaluations completed for this review suggest that relatively low (~10-20 feet) to moderately-high (~30-90 feet) levels of additional drawdown might be imposed in area wells due to pumping of some of the proposed APOA. It should be noted, however, that these estimates were completed using very conservative operational parameters for the Theis analytical drawdown method: pumping a single well at the full allocated rate for 24 hours a day, 7 days a week, 365 days a year. Actual pump operation will likely not be this sustained, and/or could be rotated to different locations to distribute overall pumping stresses to the CRBG aquifer system.

Furthermore, from the 2009 aquifer test of WASH 62373 ("Well-2") during which that well was pumped continuously for 47 hours at 465 gpm (~1 cfs), a total of 77 feet of drawdown was observed in adjacent WASH 7651 ("Well-1"), and only 2 feet in WASH 50693 (QVGC well) which is located about 3200 feet from WASH 62373. The results from the aquifer test generally confirm the conservative approach used for the Theis drawdown assessments, and that actual additional drawdown might be somewhat less than predicted, particularly for wells that penetrate the deeper of the two primary WBZ.

6. a) Will this proposed change, at its maximum allowed rate of use, likely result in an increase in interference with **another surface water source**?

☐ Yes ☒ No Comments: With the planned cased and sealed depth of about 200-250 feet for the proposed APOA not yet drilled, and 300 feet for proposed APOA WASH 62373, water-bearing interflow zone(s) will likely be from many tens to perhaps hundreds of feet below any nearby stream reaches. Consequently, it is unlikely that the proposed change would result in an increase in interference with local surface water sources.

b) If yes, at its maximum allowed rate of use, what is the expected change in degree of interference with any **surface water sources** resulting from the proposed change?

Stream: _____ ☐ Minimal ☐ Significant

Stream: _____ ☐ Minimal ☐ Significant

Provide context for minimal/significant impact: N/A

7. For SW-GW transfers, will the proposed change in point of diversion affect the surface water source similarly (as per OAR 690-380-2130) to the authorized point of diversion specified in the water use subject to transfer?

☐ Yes ☐ No Comments: N/A

8. What conditions or other changes in the application are necessary to address any potential issues identified above: **To ensure that each proposed APOA obtains groundwater only from the currently-authorized aquifer source, the GW Section recommends conditioning the transfer so that all of the proposed APOA wells be limited to accessing only the two primary basalt WBZ present between approximate elevations -125 to -430 ft msl** (which is based on the two general WBZ identified in WASH 62373 ("Well 2") and nearby WASH 50693 (QVGC well)).

9. Any additional comments: None

References

Application T-14449 RA

Conlon, T.D., Wozniak, K.C., Woodcock, D., Herrera, N.B., Fisher, B.J., Morgan, D.S., Lee, K.K., and Hinkle, S.R., 2005, *Ground-water hydrology of the Willamette Basin, Oregon*, Scientific Investigations Report 2005-5168: U. S. Geological Survey, Reston, VA.

CwM-H2O, 2018. Banks-Green Mountain Aquifer Storage and Recovery Feasibility Study, prepared for City of Banks

Freeze, R.A. and Cherry, J.A., 1979, Groundwater, Prentice Hall, Englewood Cliffs, New Jersey, 604 p.

Gannett, M.W. and Caldwell, R., 1998, *Geologic framework of the Willamette Lowland aquifer system, Oregon and Washington*, Professional Paper 1424-A, 32 p: U. S. Geological Survey, Reston, VA.

Golder Associates, 2009. Technical Memorandum: March 2009 Well #2 Aquifer Test Data Analysis.

Personal communication (also provided instrument specifications), Mike Schumacher (Pacific Surveys) to Justin Iverson (OWRD), January 24, 2025.

Theis, C.V., 1935, The relation between the lowering of the piezometric surface and the rate and duration of discharge of a well using groundwater storage, American Geophysical Union Transactions, vol. 16, p. 519-524.

Summit Water Resources, 2025, Response to OWRD Groundwater Section Reviews, T-14449 and T-14450, memorandum dated March 28, 2025.

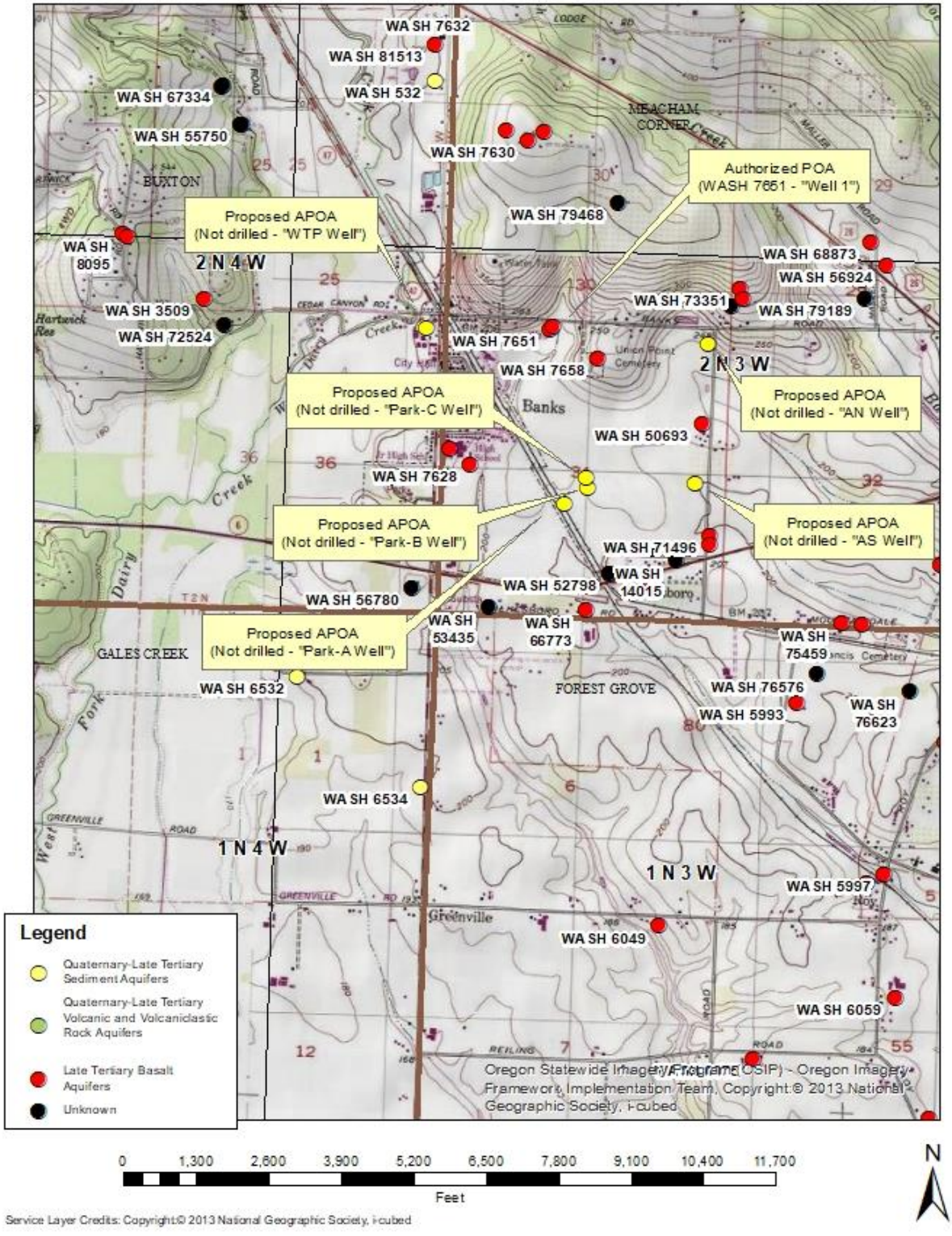
United States Geological Survey, 2013, National Elevation Dataset (NED) [DEM geospatial data]. 1/9th arc-second, updated 2013.

United States Geological Survey, 2017, Forest Grove *quadrangle*, Oregon [map], 1:24,000, 7.5 minute topographic series, U.S. Department of the Interior, Reston, VA.

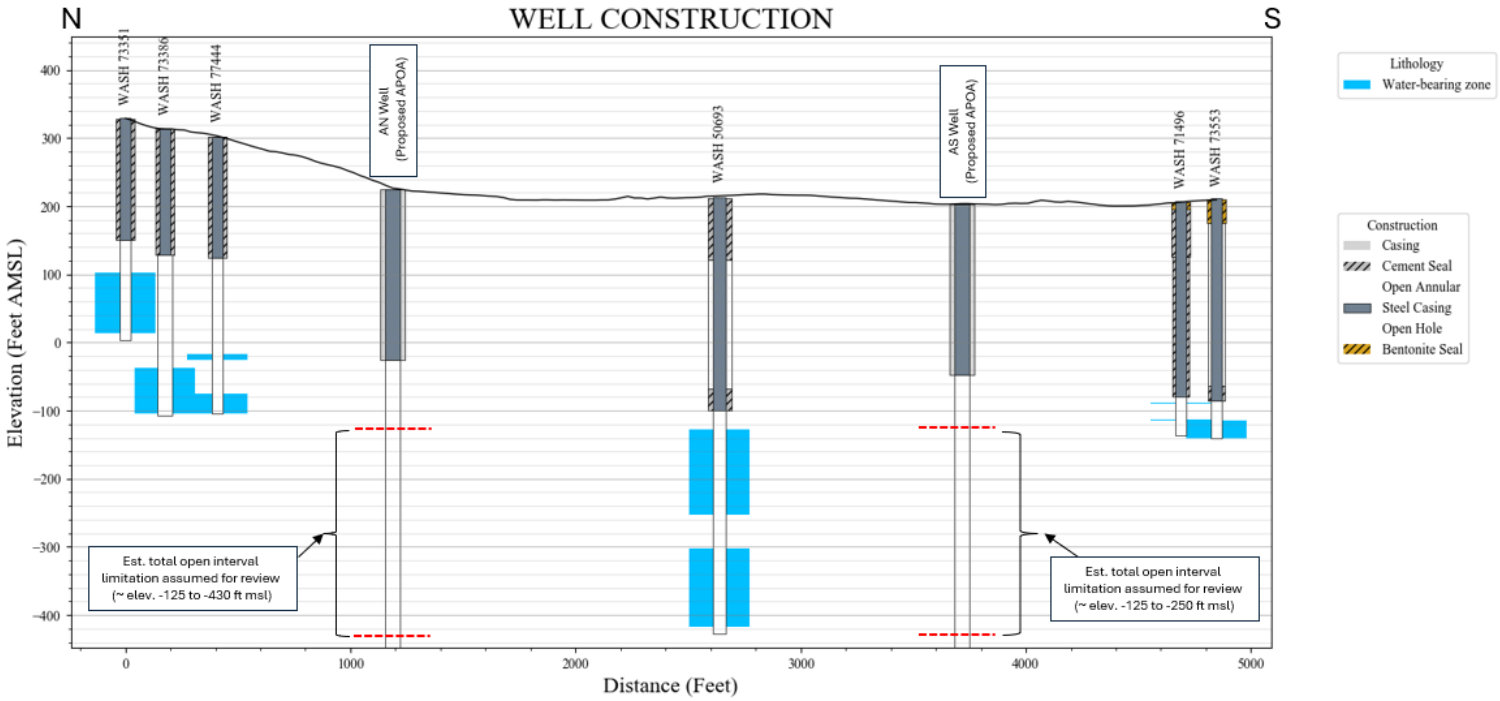
Watershed Sciences, 2009, *LIDAR remote sensing data collection, Department of Geology and Mineral Industries, Willamette Valley Phase I, Oregon*: Portland, OR, December 21.

Woodward, D.G., Gannett, M.W., and Vaccaro, J.J., 1998, Hydrogeologic framework of the Willamette Lowland aquifer system, Oregon and Washington: U.S. Geological Survey Professional Paper 1424-B, 82 p.

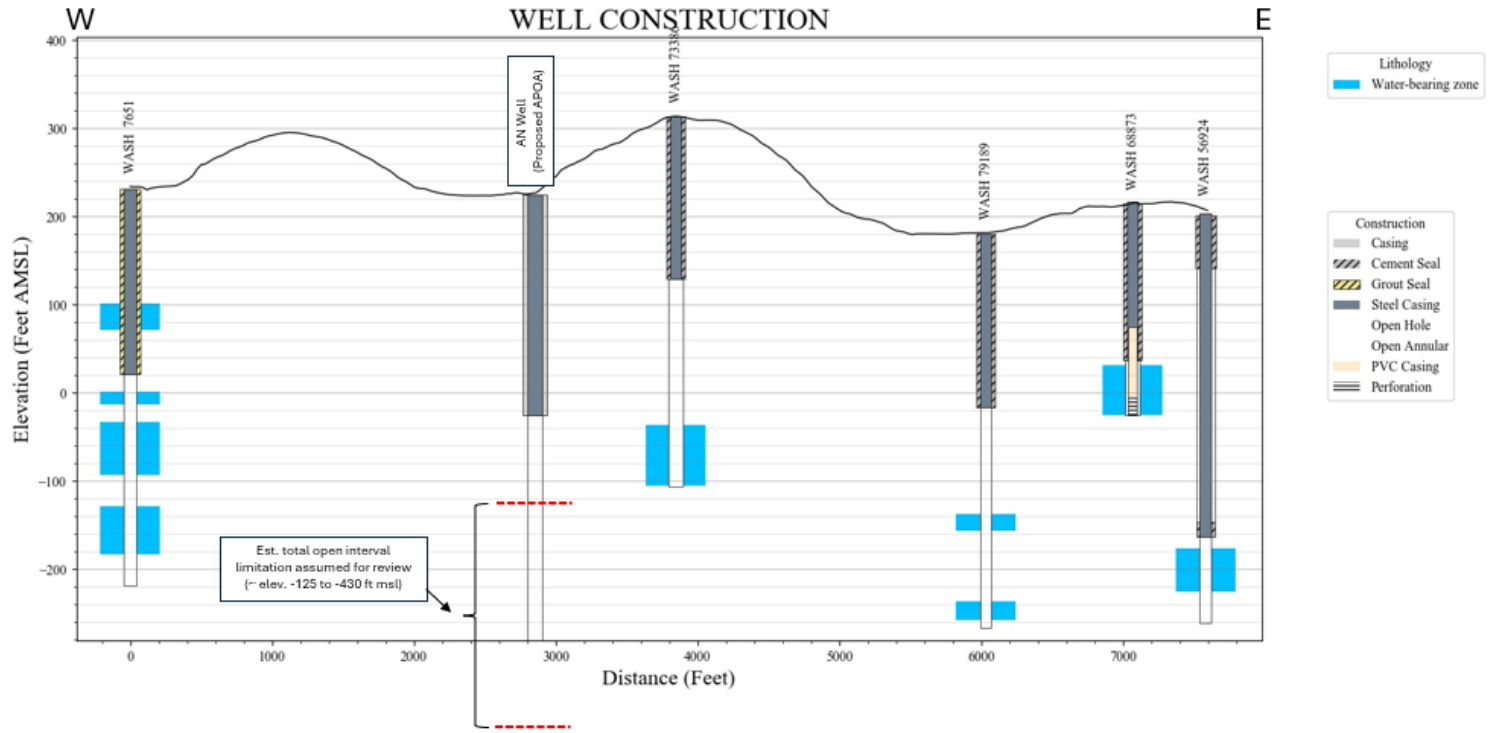
Application T-14449, City of Banks
T2N, R3W



Cross-section 1: N-S, proposed APOA "AN Well" and "AS Well" and WASH 77444, WASH 50693



Cross-section 2: W-E, proposed APOA "AN Well" and WASH 79189, WASH 56924

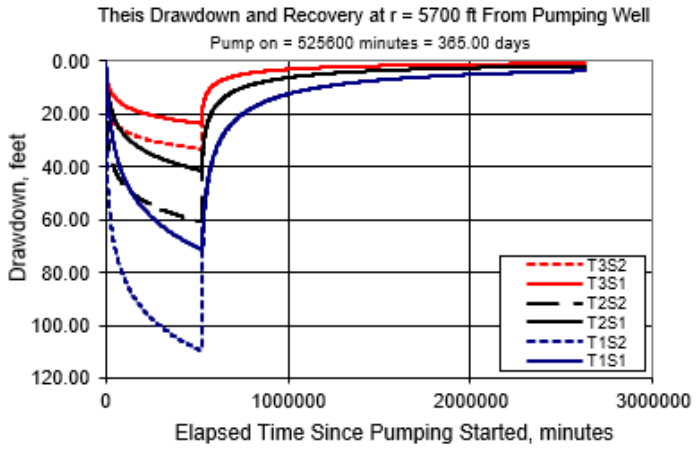


Theis Drawdown Analysis, Authorized POA WASH 7651 to WASH 79189

Theis Time-Drawdown Worksheet v.5.00
Calculates Theis nonequilibrium drawdown and recovery at any arbitrary radial distance, r, from a pumping well for 3 different T radial distance, r, from a pumping well for 3 different T values and 2 different S values.
Written by Karl C. Wozniak September 1992. Last modified December 17, 2019

Input Data:	Var Name	Scenario 1	Scenario 2	Scenario 3	Units	
Total pumping time	t		365		d	
Radial distance from pumped well:	r		5700		ft	Q conversions
Pumping rate	Q		0.67		cfs	300.70 gpm
Hydraulic conductivity	K	5	10	20	ft/day	0.67 cfs
Aquifer thickness	b		55		ft	40.20 cfm
Storativity	S_1		0.0001			57,888.00 cfd
	S_2		0.00001			1.33 af/d
Transmissivity Conversions	T_f2pd	275	550	1100	ft2/day	
	T_ft2pm	0.190972	0.381944	0.763889	ft2/min	Recalculate
	T_gpdpft	2057	4114	8228	gpd/ft	

Use the Recalculate button if recalculation is set to manual

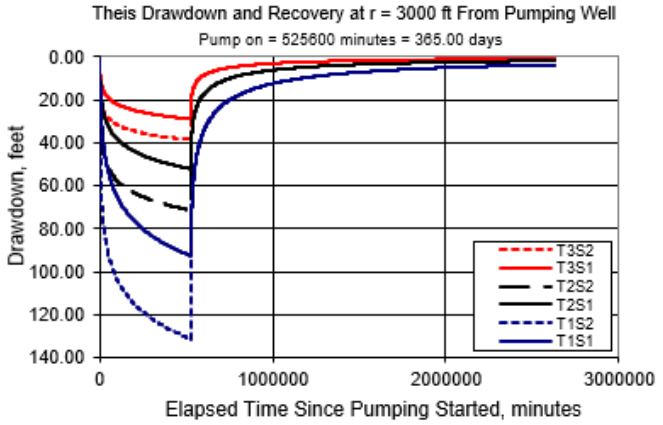


Theis Drawdown Analysis, Proposed APOA "AN Well" to WASH 79189

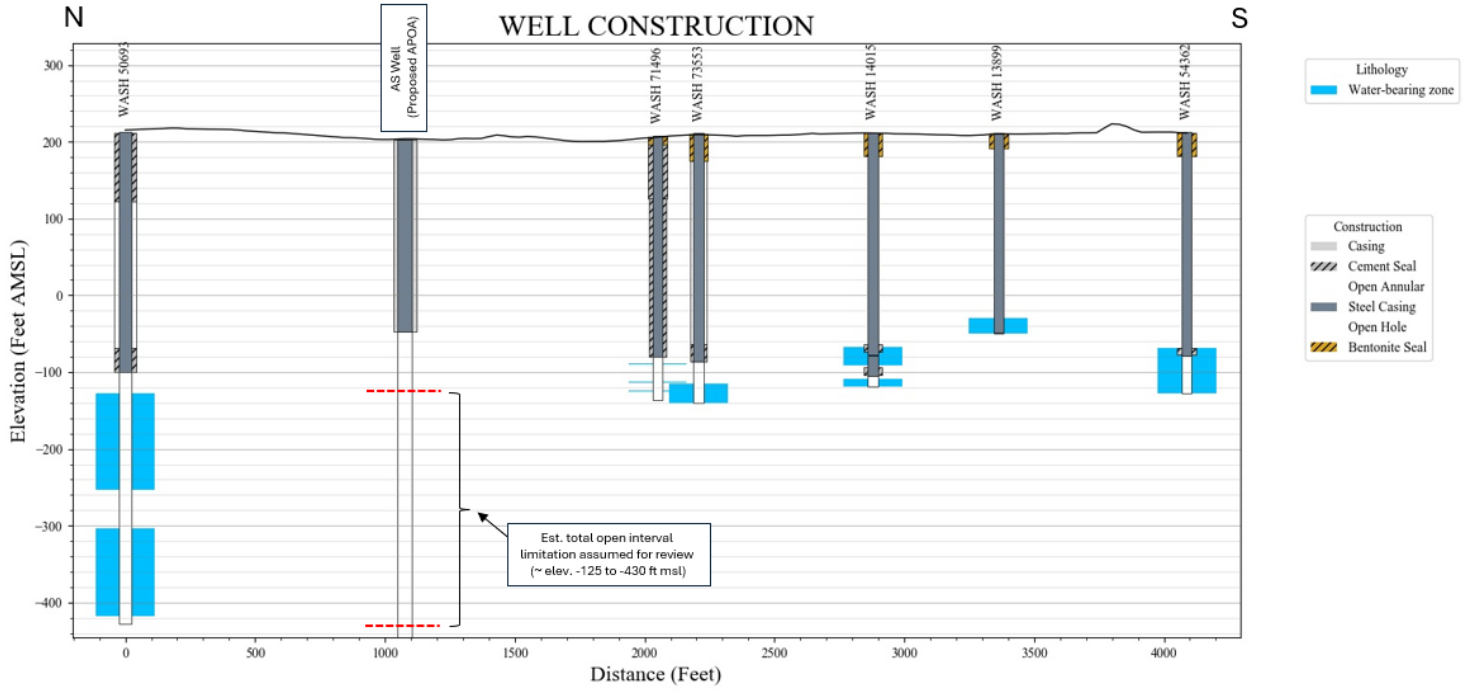
Theis Time-Drawdown Worksheet v.5.00
Calculates Theis nonequilibrium drawdown and recovery at any arbitrary radial distance, r, from a pumping well for 3 different T radial distance, r, from a pumping well for 3 different T values and 2 different S values.
Written by Karl C. Wozniak September 1992. Last modified December 17, 2019

Input Data:	Var Name	Scenario 1	Scenario 2	Scenario 3	Units	
Total pumping time	t		365		d	
Radial distance from pumped well:	r		3000		ft	Q conversions
Pumping rate	Q		0.67		cfs	300.70 gpm
Hydraulic conductivity	K	5	10	20	ft/day	0.67 cfs
Aquifer thickness	b		55		ft	40.20 cfm
Storativity	S_1		0.0001			57,888.00 cfd
	S_2		0.00001			1.33 af/d
Transmissivity Conversions	T_f2pd	275	550	1100	ft2/day	
	T_ft2pm	0.190972	0.381944	0.763889	ft2/min	Recalculate
	T_gpdpft	2057	4114	8228	gpd/ft	

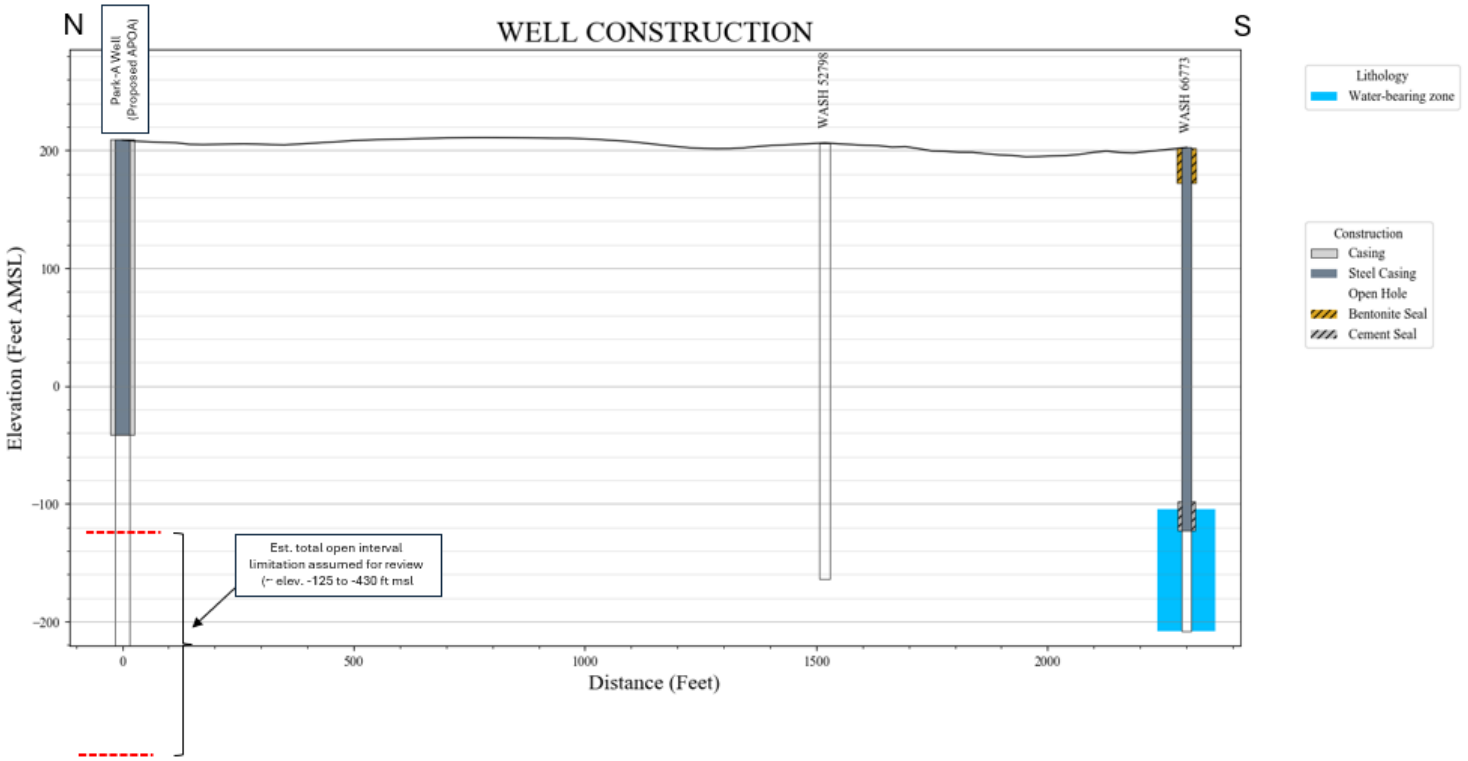
Use the Recalculate button if recalculation is set to manual



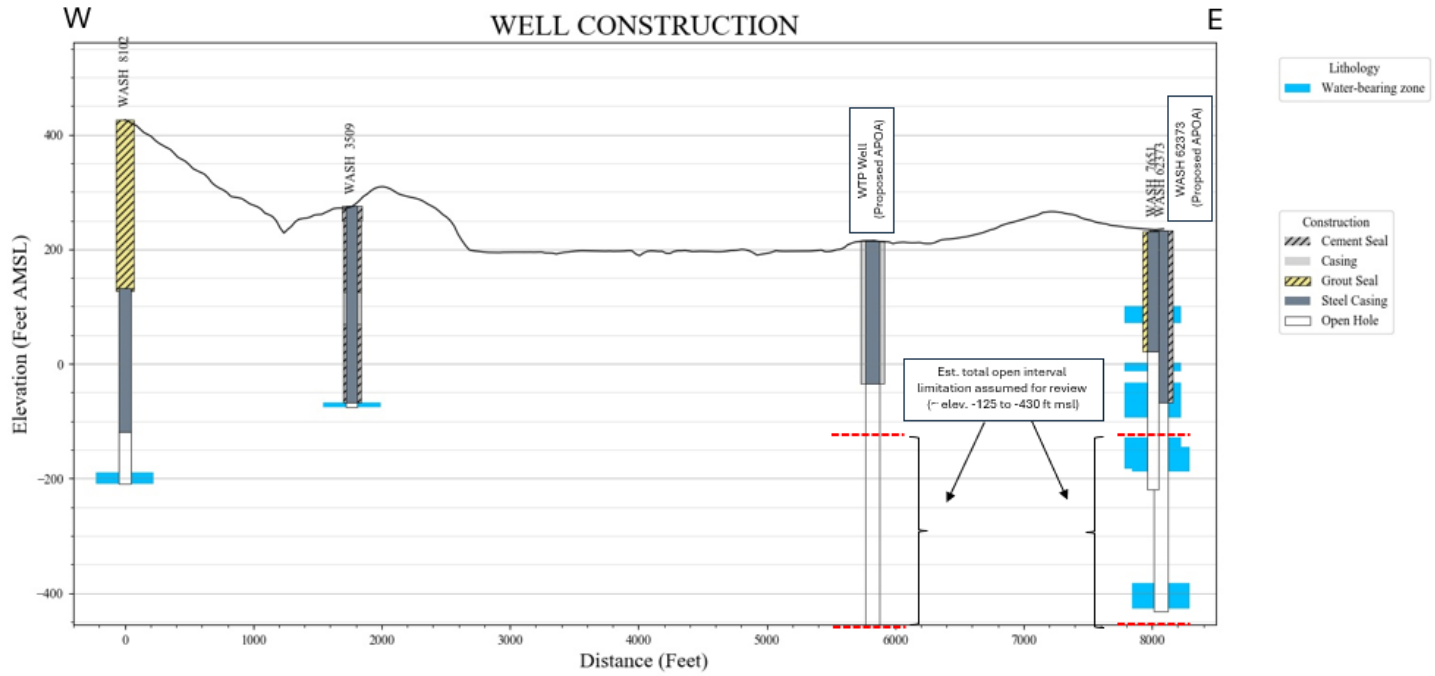
Cross-section 3: N-S, proposed APOA "AS Well" and WASH 50693, others



Cross-section 4: N-S, proposed APOA "Park-A Well" and WASH 52798



Cross-section 5: W-E, proposed APOA "WTP Well", WASH 62373 and WASH 8102/8909



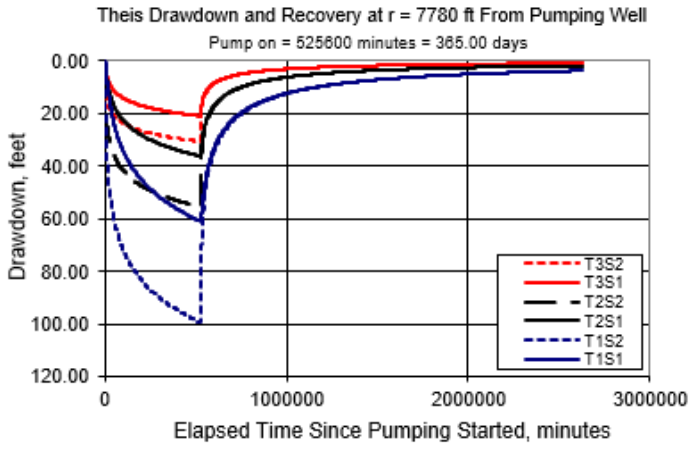
Theis Drawdown Analysis, Authorized POA WASH 7651 to WASH 8102/8909

Theis Time-Drawdown Worksheet v.5.00

Calculates Theis nonequilibrium drawdown and recovery at any arbitrary radial distance, r, from a pumping well for 3 different T values and radial distance, r, from a pumping well for 3 different T values and 2 different S values.
Written by Karl C. Wozniak September 1992. Last modified December 17, 2019

Input Data:	Var Name	Scenario 1	Scenario 2	Scenario 3	Units	
Total pumping time	t		365		d	
Radial distance from pumped well:	r		7780		ft	Q conversions
Pumping rate	Q		0.67		cfs	300.70 gpm
Hydraulic conductivity	K	5	10	20	ft/day	0.67 cfs
Aquifer thickness	b		55		ft	40.20 cfm
Storativity	S_1		0.0001			57,888.00 cfd
	S_2		0.00001			1.33 af/d
Transmissivity Conversions	T_f2pd	275	550	1100	ft2/day	
	T_ft2pm	0.190972	0.381944	0.763889	ft2/min	Recalculate
	T_gpdpft	2057	4114	8228	gpd/ft	

Use the Recalculate button if recalculation is set to manual

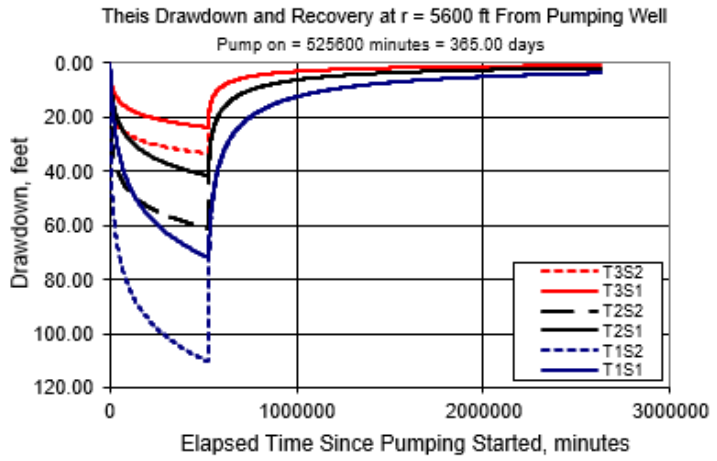


Theis Drawdown Analysis, Proposed APOA "WTP Well" to WASH 8102/8909

Theis Time-Drawdown Worksheet v.5.00
Calculates Theis nonequilibrium drawdown and recovery at any arbitrary radial distance, r, from a pumping well for 3 different T values and radial distance, r, from a pumping well for 3 different T values and 2 different S values.
Written by Karl C. Wozniak September 1992. Last modified December 17, 2019

Input Data:	Var Name	Scenario 1	Scenario 2	Scenario 3	Units	
Total pumping time	t		365		d	
Radial distance from pumped well:	r		5600		ft	Q conversions
Pumping rate	Q		0.67		cfs	300.70 gpm
Hydraulic conductivity	K	5	10	20	ft/day	0.67 cfs
Aquifer thickness	b		55		ft	40.20 cfm
Storativity	S_1		0.0001			57,888.00 cfd
	S_2		0.00001			1.33 af/d
Transmissivity Conversions	T_f2pd	275	550	1100	ft2/day	
	T_ft2pm	0.190972	0.381944	0.763889	ft2/min	Recalculate
	T_gpdpft	2057	4114	8228	gpd/ft	

Use the Recalculate button if recalculation is set to manual



Theis Drawdown Analysis, Proposed APOA WASH 62373 to WASH 8102/8909

Theis Time-Drawdown Worksheet v.5.00
Calculates Theis nonequilibrium drawdown and recovery at any arbitrary radial distance, r, from a pumping well for 3 different T values and radial distance, r, from a pumping well for 3 different T values and 2 different S values.
Written by Karl C. Wozniak September 1992. Last modified December 17, 2019

Input Data:	Var Name	Scenario 1	Scenario 2	Scenario 3	Units	
Total pumping time	t		365		d	
Radial distance from pumped well:	r		7780		ft	Q conversions
Pumping rate	Q		1.67		cfs	749.50 gpm
Hydraulic conductivity	K	5	10	20	ft/day	1.67 cfs
Aquifer thickness	b		55		ft	100.20 cfm
Storativity	S_1		0.0001			144,288.00 cfd
	S_2		0.00001			3.31 af/d
Transmissivity Conversions	T_f2pd	275	550	1100	ft2/day	
	T_ft2pm	0.190972	0.381944	0.763889	ft2/min	Recalculate
	T_gpdpft	2057	4114	8228	gpd/ft	

Use the Recalculate button if recalculation is set to manual