

Groundwater Application Review Summary Form

Application # LL- 1872 Re-Review

GW Reviewer Joe Kemper

Date Review Completed: 10/25/2023

Summary of GW Availability and Injury Review:

Groundwater for the proposed use is either over appropriated, will not likely be available in the amounts requested without injury to prior water rights, OR will not likely be available within the capacity of the groundwater resource per Section B of the attached review form.

Summary of Potential for Substantial Interference Review:

There is the potential for substantial interference per Section C of the attached review form.

Summary of Well Construction Assessment:

The well does not appear to meet current well construction standards per Section D of the attached review form. Route through Well Construction and Compliance Section.

This is only a summary. Documentation is attached and should be read thoroughly to understand the basis for determinations and for conditions that may be necessary for a permit (if one is issued).

Approved:



MEMO

To: Kristopher Byrd, Well Construction and Compliance Section Manager
From: Travis Kelly, Well Construction Program Coordinator
Subject: Review of Water Right Application LL-1872
Date: January 4, 2022

The attached application was forwarded to the Well Construction and Compliance Section by the Groundwater Section. Mike Thoma reviewed the application. Please see Mike's Groundwater Review and the Well Reports.

Applicant's Well #1 (DESC 58167): Based on a review of the Well Report, Applicant's Well #1 seems to protect the groundwater resource.

The construction of Applicant's Well #1 may not satisfy hydraulic connection issues.

Applicant's Well #2 (DESC 53193/58039): Based on a review of the Well Reports, Applicant's Well #2 seems to protect the groundwater resource.

The construction of Applicant's Well #2 may not satisfy hydraulic connection issues.

Applicant's Well #3 (DESC 53194): Based on a review of the Well Report, Applicant's Well #3 seems to protect the groundwater resource.

The construction of Applicant's Well #3 may not satisfy hydraulic connection issues.

WATER RESOURCES DEPARTMENT

MEMO

10/25/2023

TO: Application LL- 1872 2nd Re-Review

FROM: GW: Joe Kemper
(Reviewer's Name)

SUBJECT: Scenic Waterway Interference Evaluation

- YES** The source of appropriation is hydraulically connected to a State Scenic Waterway or its tributaries
- NO**

- YES** Use the Scenic Waterway Condition (Condition 7J)
- NO**

Impacts to State Scenic Waterways are not considered for Limited License due to the short-term and temporary nature of the use.

- Per ORS 390.835, the Groundwater Section is **able** to calculate ground water interference with surface water that contributes to a Scenic Waterway. The calculated interference is distributed below
- Per ORS 390.835, the Groundwater Section is **unable** to calculate ground water interference with surface water that contributes to a scenic waterway; **therefore, the Department is unable to find that there is a preponderance of evidence that the proposed use will measurably reduce the surface water flows necessary to maintain the free-flowing character of a scenic waterway**

DISTRIBUTION OF INTERFERENCE

Calculate the percentage of consumptive use by month and fill in the table below. If interference cannot be calculated, per criteria in 390.835, do not fill in the table but check the "unable" option above, thus informing Water Rights that the Department is unable to make a Preponderance of Evidence finding.

Exercise of this permit is calculated to reduce monthly flows in [Enter] Scenic Waterway by the following amounts expressed as a proportion of the consumptive use by which surface water flow is reduced.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

PUBLIC INTEREST REVIEW FOR GROUNDWATER APPLICATIONS

TO: Water Rights Section Date 10/25/2023
FROM: Groundwater Section Joe Kemper
Reviewer's Name

SUBJECT: Application LL- 1872 Re-Review Supersedes review of 11/15/2021 Date of Review(s)

The review on 11/15/2021 incorrectly applied OAR 690-505 (Deschutes Basin Rule); OAR 690-505 rules are not applied to Limited Licenses.

PUBLIC INTEREST PRESUMPTION; GROUNDWATER

OAR 690-310-130 (1) The Department shall presume that a proposed groundwater use will ensure the preservation of the public welfare, safety and health as described in ORS 537.525. Department staff review groundwater applications under OAR 690-310-140 to determine whether the presumption is established. OAR 690-310-140 allows the proposed use be modified or conditioned to meet the presumption criteria. This review is based upon available information and agency policies in place at the time of evaluation.

A. GENERAL INFORMATION: Applicant's Name: Avion Water Co. Inc. County: Deschutes

A1. Applicant(s) seek(s) 0.67 cfs from 3 well(s) in the Deschutes Basin, Whychus Cr. subbasin

A2. Proposed use Quasi-Municipal Seasonality: Year Round (58 acre-feet per year)

A3. Well and aquifer data (attach and number logs for existing wells; mark proposed wells as such under logid):

Table with 7 columns: Well, Logid, Applicant's Well #, Proposed Aquifer*, Proposed Rate(cfs), Location (T/R-S QQ-Q), Location, metes and bounds, e.g. 2250' N, 1200' E fr NW cor S 36

* Alluvium, CRB, Bedrock

Table with 13 columns: Well, Well Elev ft msl, First Water ft bls, SWL ft bls, SWL Date, Well Depth (ft), Seal Interval (ft), Casing Intervals (ft), Liner Intervals (ft), Perforations Or Screens (ft), Well Yield (gpm), Draw Down (ft), Test Type

Use data from application for proposed wells.

Table with 7 columns: POA Well, Land Surface Elevation at Well (ft amsl), Depth of First Water (ft bls), SWL (ft bls), SWL Date, Reference Level (ft bls), Reference Level Date

A4. Comments: This LL application is identical to G-19169. They are reviewed as a single request i.e., G-19169 would replace LL-1872. The proposed POAs are also on permit G-18198, which authorizes 0.67 cfs and 62 AF/yr. This application requests 98 AF/yr in addition to the authorized 62 AF/yr for a total of 160 AF/year under both water rights. The application requests that the total rate of appropriation be limited to 0.67 cfs from any and all wells under both water rights.

A5. Provisions of the Deschutes (690-505) Basin rules relative to the development, classification and/or management of groundwater hydraulically connected to surface water are, or are not, activated by this application. (Not all basin rules contain such provisions.) Comments: Despite that the proposed use is within the Deschutes Groundwater Study Area, the basin rules are not applied to Limited Licenses

A6. Well(s) #, tap(s) an aquifer limited by an administrative restriction. Name of administrative area: Comments:

B. GROUNDWATER AVAILABILITY CONSIDERATIONS, OAR 690-310-130, 400-010, 410-0070

B1. **Based upon available data**, I have determined that groundwater* for the proposed use:

- a. is over appropriated, is not over appropriated, or cannot be determined to be over appropriated during any period of the proposed use. * This finding is limited to the groundwater portion of the over-appropriation determination as prescribed in OAR 690-310-130;
- b. will not or will likely be available in the amounts requested without injury to prior water rights. * This finding is limited to the groundwater portion of the injury determination as prescribed in OAR 690-310-130;
- c. will not or will likely to be available within the capacity of the groundwater resource; or
- d. will, if properly conditioned, avoid injury to existing groundwater rights or to the groundwater resource:
 - i. The permit should contain condition #(s) 7RLA; Large Water-Use Reporting;
 - ii. The permit should be conditioned as indicated in item 2 below.
 - iii. The permit should contain special condition(s) as indicated in item 3 below;

- B2. a. **Condition** to allow groundwater production from no deeper than _____ ft. below land surface;
- b. **Condition** to allow groundwater production from no shallower than _____ ft. below land surface;
- c. **Condition** to allow groundwater production only from the _____ groundwater reservoir between approximately _____ ft. and _____ ft. below land surface;
- d. **Well reconstruction** is necessary to accomplish one or more of the above conditions. The problems that are likely to occur with this use and without reconstructing are cited below. Without reconstruction, I recommend withholding issuance of the permit until evidence of well reconstruction is filed with the Department and approved by the Groundwater Section.

Describe injury –as related to water availability– that is likely to occur without well reconstruction (interference w/ senior water rights, not within the capacity of the resource, etc): _____

B3. **Groundwater availability remarks:** The applicant’s proposed POAs would be producing from the Deschutes Fm. aquifer system near Whychus Cr between the town of Sister, OR and the confluence of Whychus Creek and the Deschutes River (T13S/R12E-7). Water levels in this area are several hundred feet below land surface and represent a water table and groundwater flowpaths that are disconnected from surface water locally. Studies have shown that groundwater moves northeast across the region from the recharge zones in the Cascades toward discharge zones near the confluence of Whychus Creek and the Deschutes River as well as along the Crooked River. Groundwater elevations are coincident with surface water elevations in the areas near Sisters and near the discharge zones, implying local hydraulic connection, but are substantially deeper than surface water elevations between these areas, suggesting no local hydraulic connection. Given this lack of local hydraulic connection, groundwater withdrawals in the area of the proposed POAs would have an impact on water levels locally and along the entire flowpath, and also have the potential to reduce long-term discharge to surface water. Impacts to surface water are addressed in the Deschutes Basin Rule (OAR 690-505) which would require mitigation for the proposed use.

Several wells to the east of the proposed POAs (referred to as the “Deep Canyon Area” in Map 1) have shown persistent year-on-year declines totaling ~13 feet from 1994 to 2023 (see Figures 3 and 4). Studies by the USGS and OWRD have attributed these long-term declines to 1) long-term climate change, 2) groundwater pumping (see Figure 2), and 3) canal lining causing reduced recharge. The nearest well (DESC 1957) exhibiting this trend is approximately five miles to the east of the proposed POAs. Wells upgradient in the groundwater system from the city of Sisters (e.g. DESC 3016 and DESC 1804) show 10-20 feet of oscillation that tracks largely with decadal climate cycles. Current groundwater levels in those wells are at or near the same elevation as 1994. Just downgradient (NE) of Sisters, water levels in DESC 2929 rise 12-13 feet

in response to the heavy precipitation of the late 1990s but respond very little to increased recharge in the early 2010s. Current water levels are ~5 feet lower than in 1994. There are no long-term observation wells immediately adjacent to the proposed POAs that show water level trends there. Because the proposed POAs are located nearly equidistant between DESC 2929 and DESC 1957 in the same groundwater system, this review assumes that water levels at the application site show an intermediate of those two trends. Specifically, water levels have likely shown declines since approximately 2000 on the order of 5-10 feet.

The wells in the Deep Canyon area showing long-term water level declines are located generally down-gradient of the proposed POAs and thus farther from recharge zones for the region. Pumping under the proposed right would reduce recharge to the Deep Canyon Area by intercepting the dominate groundwater flowpaths to this area, thus exacerbating the declines there. However, considering the low-moderate magnitude of declines observed in the Deep Canyon area and assumed at the proposed POAs, the preponderance of evidence indicates that the proposed use is within the capacity of the resources. There best available water budget estimates from USGS basin study reports indicate that the resource is not over-appropriated. In light of the lack of data in the area and concern about longer term declines, the permit conditions listed in Section B(d) are strongly recommended.

There are likely multiple exempt groundwater users within a mile of the proposed POAs that could be affected by well-to-well interference from the applicant's wells. Because of the target aquifer's high storage/permeability and overall thickness, however, it is unlikely that any resulting groundwater interference from this permit would be large enough to be considered injury under current rule and statute.

Special Condition:

Prior to use under this Limited License, each POA shall be equipped with a method for measuring static water level and a reference water level must be provided to the Department. This can include an airline, measuring tube, or any other construction or equipment that allows access to report static water level measurements. The chosen water level measuring method shall be maintained in proper working order as to allow static water level measurements for the duration of the Limited License.

C. GROUNDWATER/SURFACE WATER CONSIDERATIONS, OAR 690-09-040

C1. **690-09-040 (1):** Evaluation of aquifer confinement:

Well	Aquifer or Proposed Aquifer	Confined	Unconfined
1	Deschutes Formation	<input type="checkbox"/>	<input checked="" type="checkbox"/>
2	Deschutes Formation	<input type="checkbox"/>	<input checked="" type="checkbox"/>
3	Deschutes Formation	<input type="checkbox"/>	<input checked="" type="checkbox"/>
		<input type="checkbox"/>	<input type="checkbox"/>

Basis for aquifer confinement evaluation: water levels in the area generally represent the upper surface of multiple water bearing zones within the Deschutes Formation aquifer system

C2. **690-09-040 (2) (3):** Evaluation of distance to, and hydraulic connection with, surface water sources. All wells located a horizontal distance less than ¼ mile from a surface water source that produce water from an unconfined aquifer shall be assumed to be hydraulically connected to the surface water source. Include in this table any streams located beyond one mile that are evaluated for PSI.

Well	SW #	Surface Water Name	GW Elev ft msl	SW Elev ft msl	Distance (ft)	Hydraulically Connected?			Potential for Subst. Interfer. Assumed?	
						YES	NO	ASSUMED	YES	NO
1	1	Whychus Creek	~2580	2200 - 2400	8 mi	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
2	1	Whychus Creek	~2580	2200 - 2400	8 mi	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
3	1	Whychus Creek	~2580	2200 - 2400	8 mi	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
1	1	Deschutes River	~2580	2200 - 2400	8.2 mi	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
2	1	Deschutes River	~2580	2200 - 2400	8.2 mi	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
3	1	Deschutes River	~2580	2200 - 2400	8.2 mi	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
1	1	Crooked River	~2580	2200 - 2400	11 mi	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
2	1	Crooked River	~2580	2200 - 2400	11 mi	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
3	1	Crooked River	~2580	2200 - 2400	11 mi	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Basis for aquifer hydraulic connection evaluation: Recent water level data was not available for the proposed POAs so groundwater elevation was estimated from water level data from nearby wells. SW Elevation and distance were based on the USGS studies which identified gaining reaches of Whychus Creek, the Deschutes River, and the Crooked River, and which estimated groundwater elevation contours for the regional aquifer system. One particular study had shown that wells in this area are hydraulically connected to all three streams and that pumping impacts all three (Gannett et al., 2017). This was the basis of the stream depletion analysis and the estimates in table C4 below.

Water Availability Basin the well(s) are located within: WHYCHUS CR > DESCHUTES R – AT MOUTH (ID# 70753); This WAB extends to the point of hydraulic connection identified in the table above

C3a. **690-09-040 (4):** Evaluation of stream impacts for each well that has been determined or assumed to be **hydraulically connected and less than 1 mile** from a surface water (SW) source. Limit evaluation to instream rights and minimum stream flows that are pertinent to that SW source, not lower SW sources to which the stream under evaluation is tributary. Compare the requested rate against the 1% of 80% *natural* flow for the pertinent Water Availability Basin (WAB). If Q is not distributed by well, use full rate for each well. Any checked box indicates the well is assumed to have the potential to cause PSI.

Well	SW #	Well < ¼ mile?	Qw > 5 cfs?	Instream Water Right ID	Instream Water Right Q (cfs)	Qw > 1% ISWR?	80% Natural Flow (cfs)	Qw > 1% of 80% Natural Flow?	Interference @ 30 days (%)	Potential for Subst. Interfer. Assumed?
		<input type="checkbox"/>	<input type="checkbox"/>			<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>

C3b. **690-09-040 (4):** Evaluation of stream impacts by total appropriation for all wells determined or assumed to be **hydraulically connected and less than 1 mile** from a surface water source. **Complete only if Q is distributed among wells.** Otherwise same evaluation and limitations apply as in C3a above.

	SW #		Qw > 5 cfs?	Instream Water Right ID	Instream Water Right Q (cfs)	Qw > 1% ISWR?	80% Natural Flow (cfs)	Qw > 1% of 80% Natural Flow?	Interference @ 30 days (%)	Potential for Subst. Interfer. Assumed?
			<input type="checkbox"/>			<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>

Comments: _____

C4a. **690-09-040 (5):** Estimated impacts on **hydraulically connected surface water sources greater than one mile** as a percentage of the proposed pumping rate. Limit evaluation to the effects that will occur up to one year after pumping begins. This table encompasses the considerations required by 09-040 (5)(a), (b), (c) and (d), which are not included on this form. Use additional sheets if calculated flows from more than one WAB are required.

Non-Distributed Wells													
Well	SW#	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	1	< 5 %	< 5 %	< 5 %	< 5 %	< 5 %	< 5 %	< 5 %	< 5 %	< 5 %	< 5 %	< 5 %	< 5 %
Well Q as CFS		0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67
Interference CFS		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Distributed Wells													
Well	SW#	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		%	%	%	%	%	%	%	%	%	%	%	%
Well Q as CFS													
Interference CFS													
		%	%	%	%	%	%	%	%	%	%	%	%
Well Q as CFS													
Interference CFS													
(A) = Total Interf.		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
(B) = 80 % Nat. Q		57.8	56.7	53.0	60.5	88.5	157	123	87.0	99.6	56.1	58.8	58.1
(C) = 1 % Nat. Q		0.6	0.6	0.5	0.6	0.9	1.6	1.2	0.9	1.0	0.6	0.6	0.6
(D) = (A) > (C)		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
(E) = (A / B) x 100		%	%	%	%	%	%	%	%	%	%	%	%

(A) = total interference as CFS; (B) = WAB calculated natural flow at 80% exceed. as CFS; (C) = 1% of calculated natural flow at 80% exceed. as CFS; (D) = highlight the checkmark for each month where (A) is greater than (C); (E) = total interference divided by 80% flow as percentage.

Basis for impact evaluation: Analytical stream depletion models, such and the Hunt-1999 model, would not be appropriate at this distance, so stream depletion was based on the results of modeling done as part of the USGS Scientific Investigations Report 2017-5097 (Gannett et al., 2017). Specifically, pages 61-63 describe modeling stream depletion impacts from pumping a well near the area of the proposed POAs and Figure 44 and 45 show the impacts to Whychus Creek, the Deschutes River, and the Crooked River. The analysis estimates that stream depletion will be less than 5 % after 1 year of pumping for all three surface water sources. The resolution of the figure is too coarse to confidently pick out stream depletion less than 5% and less than 1 year so those values are used in the table.

C4b. **690-09-040 (5) (b)** The potential to impair or detrimentally affect the public interest is to be determined by the Water Rights Section.

C5. **If properly conditioned**, the surface water source(s) can be adequately protected from interference, and/or groundwater use under this permit can be regulated if it is found to substantially interfere with surface water:

i. The permit should contain condition #(s) _____;

- ii. The permit should contain special condition(s) as indicated in “Remarks” below;

C6. SW / GW Remarks and Conditions: Studies in the Deschutes Basin have shown that there is strong hydraulic connected between groundwater and surface water in the area of the proposed groundwater POAs but that there is little hydraulic connection in the immediate vicinity. Instead, groundwater flows hundreds of feet below land surface in the middle part of the Deschutes Basin, an area extending from near the Sisters Fault Zone to near the confluences of the Deschutes River, Crooked River, and Whychus Creek. These same studies have shown that nearly all groundwater flowing through the area does discharge back to surface water so the total impact from pumping near the proposed groundwater POAs will, over time, likely reach 100% of the pumping. However, in the short time scale considered in this review (limited to assessing impacts within 1 year) the impact to surface water is estimated to be less than 5% of the pumping rate and so is not considered to have the Potential for Substantial Interference with surface water per OAR 690-009 rules.

References Used:

Gannett, M. W. and Lite, K. E., 2004, Simulation of Regional Ground-Water Flow in the Upper Deschutes Basin, Oregon, USGS Water Resources Investigation Report 2003-4195, 84 p., <https://pubs.er.usgs.gov/publication/wri034195>

Gannett, M. W. and Lite, K. E., 2013, Analysis of 1997-2008 Groundwater Level Changes in the Upper Deschutes Basin, Central Oregon, USGS Scientific Investigations Report 2013-5092, 34p., <https://pubs.er.usgs.gov/publication/sir20135092>

Gannett, M. W., Lite Jr, K. E., Morgan, D. S., and Collins, C. A., 2001, Ground-Water Hydrology of the Upper Deschutes Basin, Oregon, USGS Water-Resources Investigations Report 00-4162, 74 p., <https://pubs.usgs.gov/wri/wri004162/pdf/WRIR004162.pdf>

Gannett, M.W., Lite, K.E., Jr., Risley, J.C., Pischel, E.M., and La Marche, J.L., 2017, Simulation of groundwater and surface-water flow in the upper Deschutes Basin, Oregon: U.S. Geological Survey Scientific Investigations Report 2017-5097, 68 p., <https://doi.org/10.3133/sir20175097>.

Lite, K. E. and Gannett, M. W., 2002, Geologic Framework of the Regional Ground-Water Flow System in the Upper Deschutes Basin, Oregon. USGS Water-Resources Investigation Report 02-4015, 44 p., <https://pubs.er.usgs.gov/publication/wri024015>

Sherrod, D. R., Taylor, E. M., Ferns, M. L., Scott, W. E., Conrey, R. M. and Smith, G. A., 2004, Geologic Map of the Bend 30-x-60-Minute Quadrangle, Central Oregon. U. S. Geological Survey Geologic Investigations Series Map I-2683. 49p., <https://pubs.usgs.gov/imap/i2683/>

D. WELL CONSTRUCTION, OAR 690-200

D1. Well #: _____ Logid: _____

D2. **THE WELL does not appear to meet current well construction standards based upon:**

- a. review of the well log;
- b. field inspection by _____;
- c. report of CWRE _____;
- d. other: (specify) _____

D3. **THE WELL construction deficiency or other comment is described as follows:** _____

D4. **Route to the Well Construction and Compliance Section for a review of existing well construction.**

Water Availability Tables

WHYCHUS CR > DESCHUTES R - AT MOUTH
 DESCHUTES BASIN

Water Availability as of 6/15/2022

Watershed ID #: 70753 ([Map](#)) Exceedance Level: 80% ▾
 Date: 6/15/2022 Time: 7:49 AM

Water Availability Calculation

Consumptive Uses and Storages

Instream Flow Requirements

Reservations

Water Rights

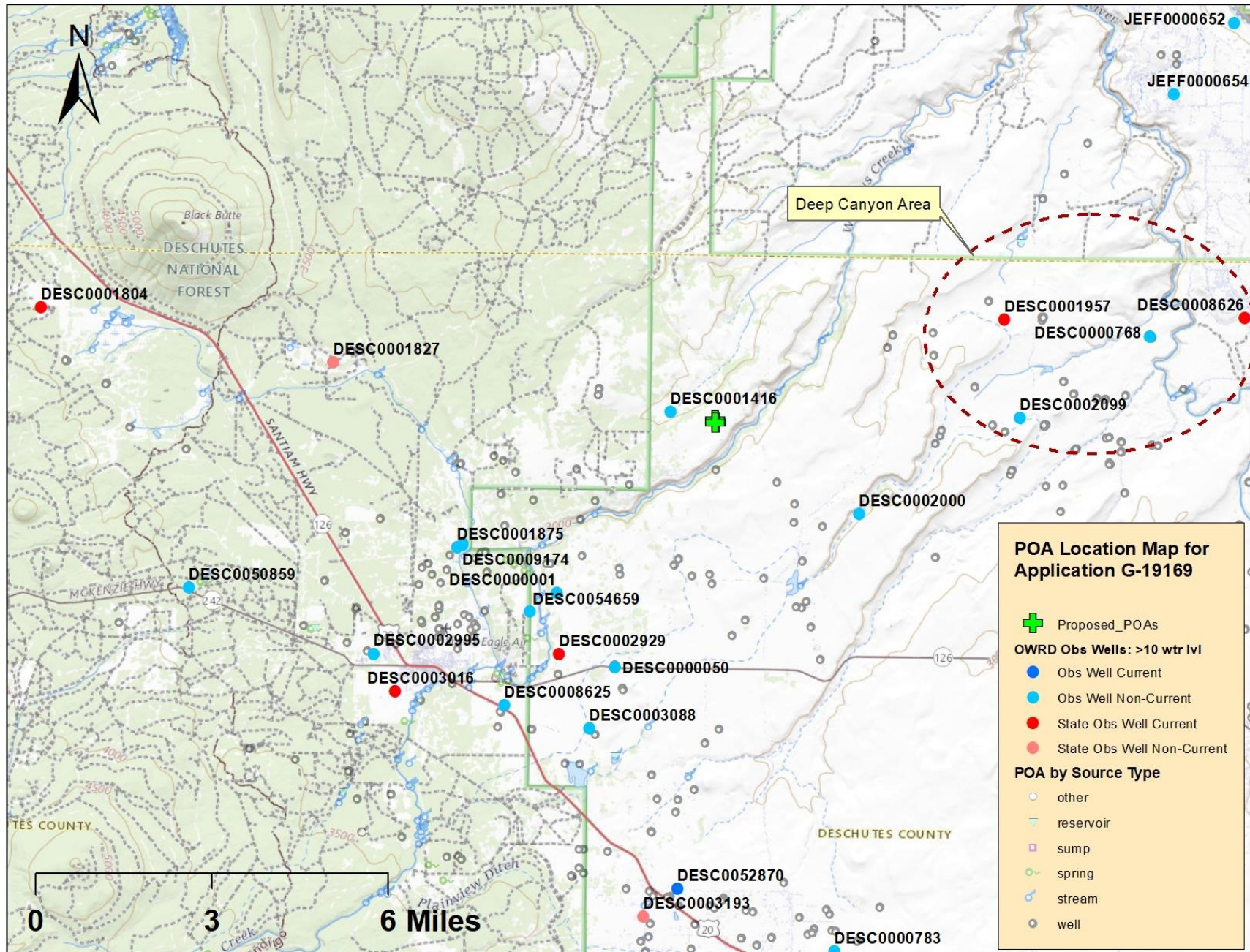
Watershed Characteristics

Water Availability Calculation

Monthly Streamflow in Cubic Feet per Second
 Annual Volume at 50% Exceedance in Acre-Feet

Month	Natural Stream Flow	Consumptive Uses and Storages	Expected Stream Flow	Reserved Stream Flow	Instream Flow Requirement	Net Water Available
JAN	57.80	10.50	47.30	0.00	33.00	14.30
FEB	56.70	14.20	42.50	0.00	33.00	9.50
MAR	53.00	25.70	27.30	0.00	50.00	-22.70
APR	60.50	46.80	13.70	0.00	50.00	-36.30
MAY	88.50	96.70	-8.23	0.00	50.00	-58.20
JUN	157.00	141.00	16.10	0.00	33.00	-16.90
JUL	123.00	116.00	6.96	0.00	33.00	-26.00
AUG	87.00	79.90	7.13	0.00	33.00	-25.90
SEP	66.90	55.80	11.10	0.00	33.00	-21.90
OCT	56.10	36.10	20.00	0.00	33.00	-13.00
NOV	58.80	18.20	40.60	0.00	33.00	7.64
DEC	58.10	13.40	44.70	0.00	33.00	11.70
ANN	73,900.00	39,600.00	34,300.00	0.00	27,000.00	10,600.00

Well Location Maps



Water-Level Measurements in Nearby Wells

Figure 2. Hydrograph of groundwater elevations from the Sisters area through the Deep Canyon area. DESC 2000 and DESC 1416 are 0.8 and 2.9 miles from the proposed POAs, respectively.

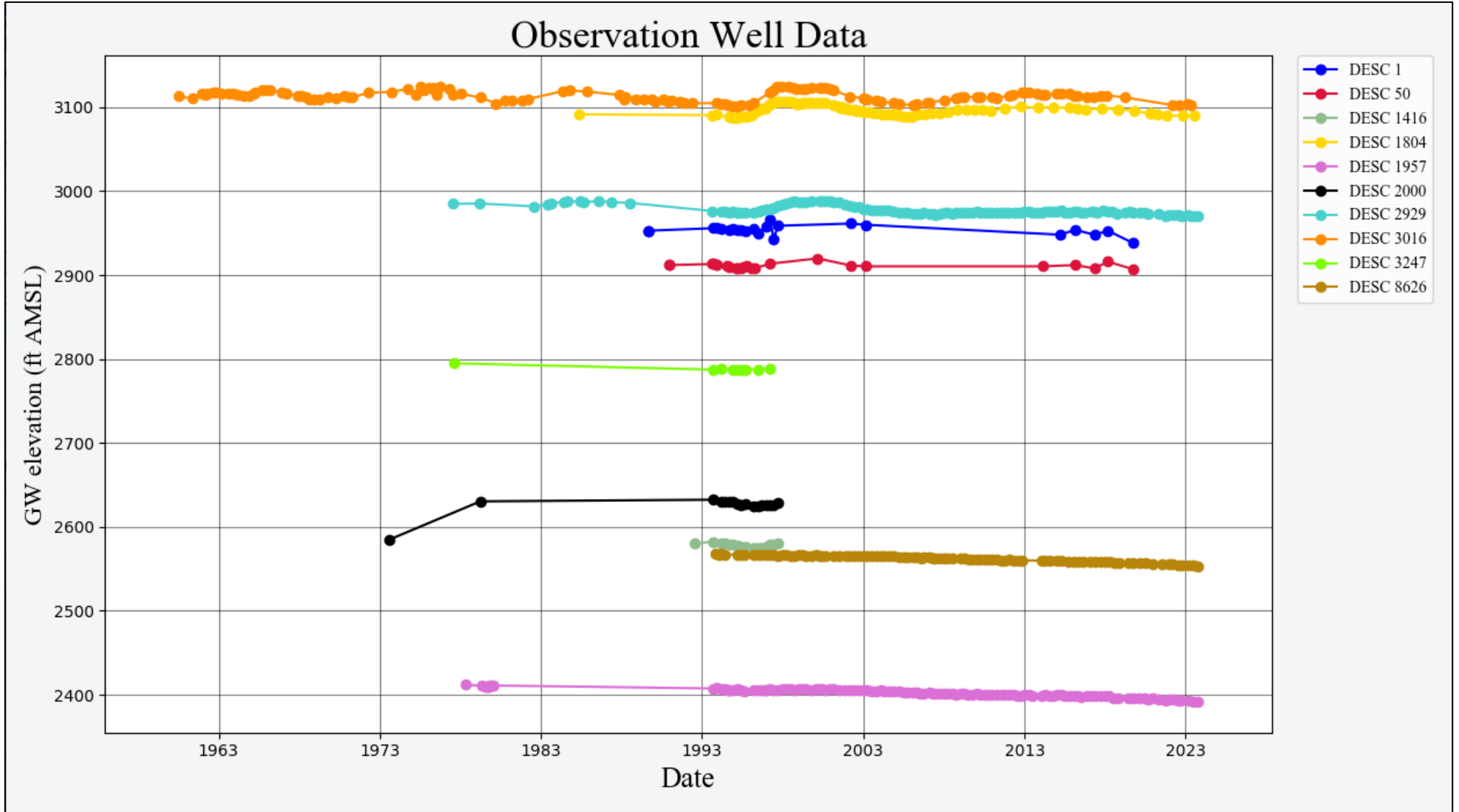


Figure 3. Common-datum hydrograph that shows relative change in groundwater levels in selected observation wells from 1994 to 2023. DESC 3016 is WSW of Sisters and DESC 1804 is SW of Black Butte; oscillations track with decadal climate fluctuations and show no persistent decline at this time scale. DESC 1957 and DESC 8626 show persistent year-on-year declines in the Deep Canyon area. DESC 2929 is just ENE of the city of Sisters.

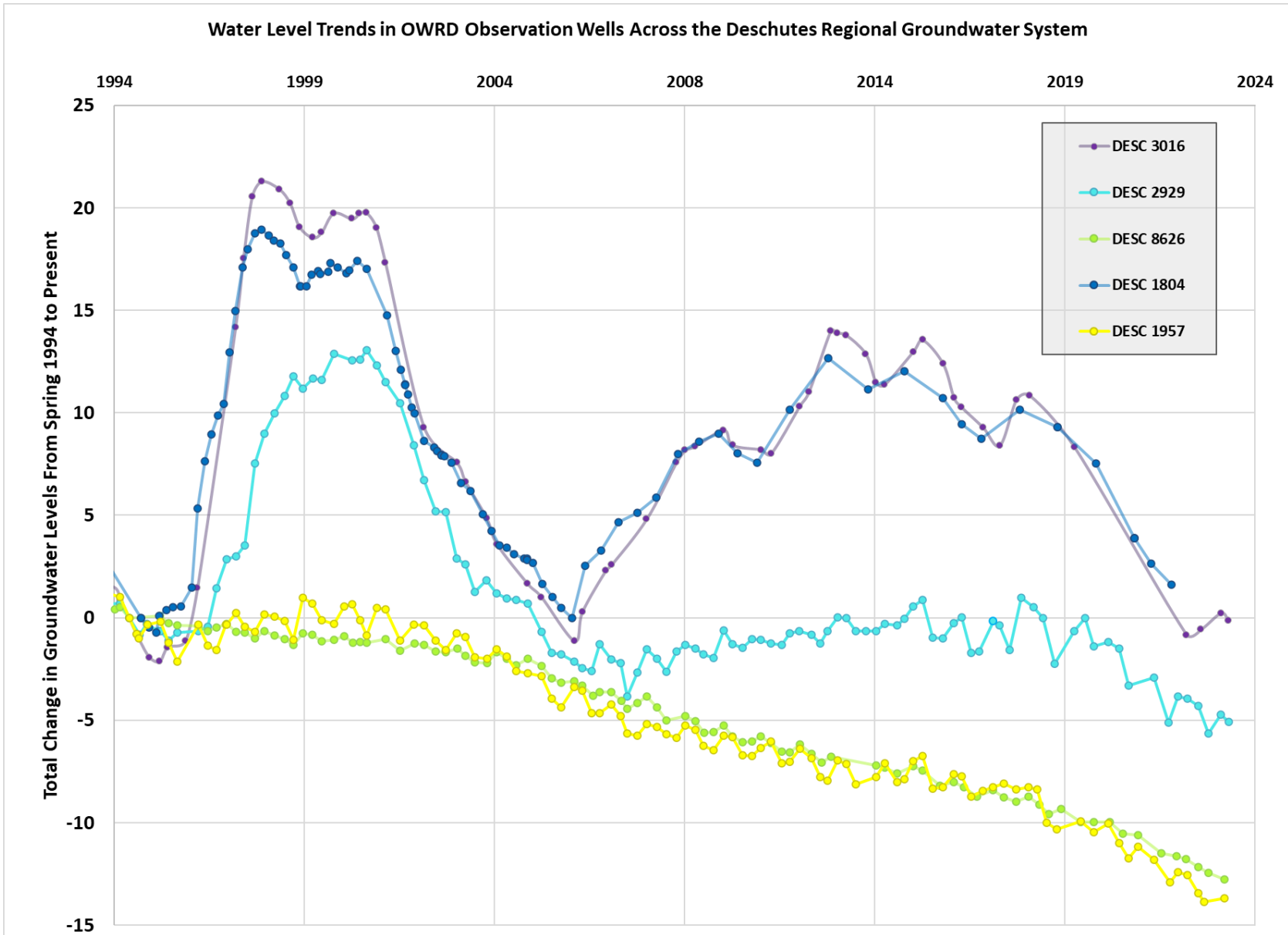


Figure 5: Extract from Gannett et al. (2017); results of modeling impacts from pumping a well completed in the Deschutes Formation aquifer on nearby surface water reaches; purple squares show the impacted model stream cells.

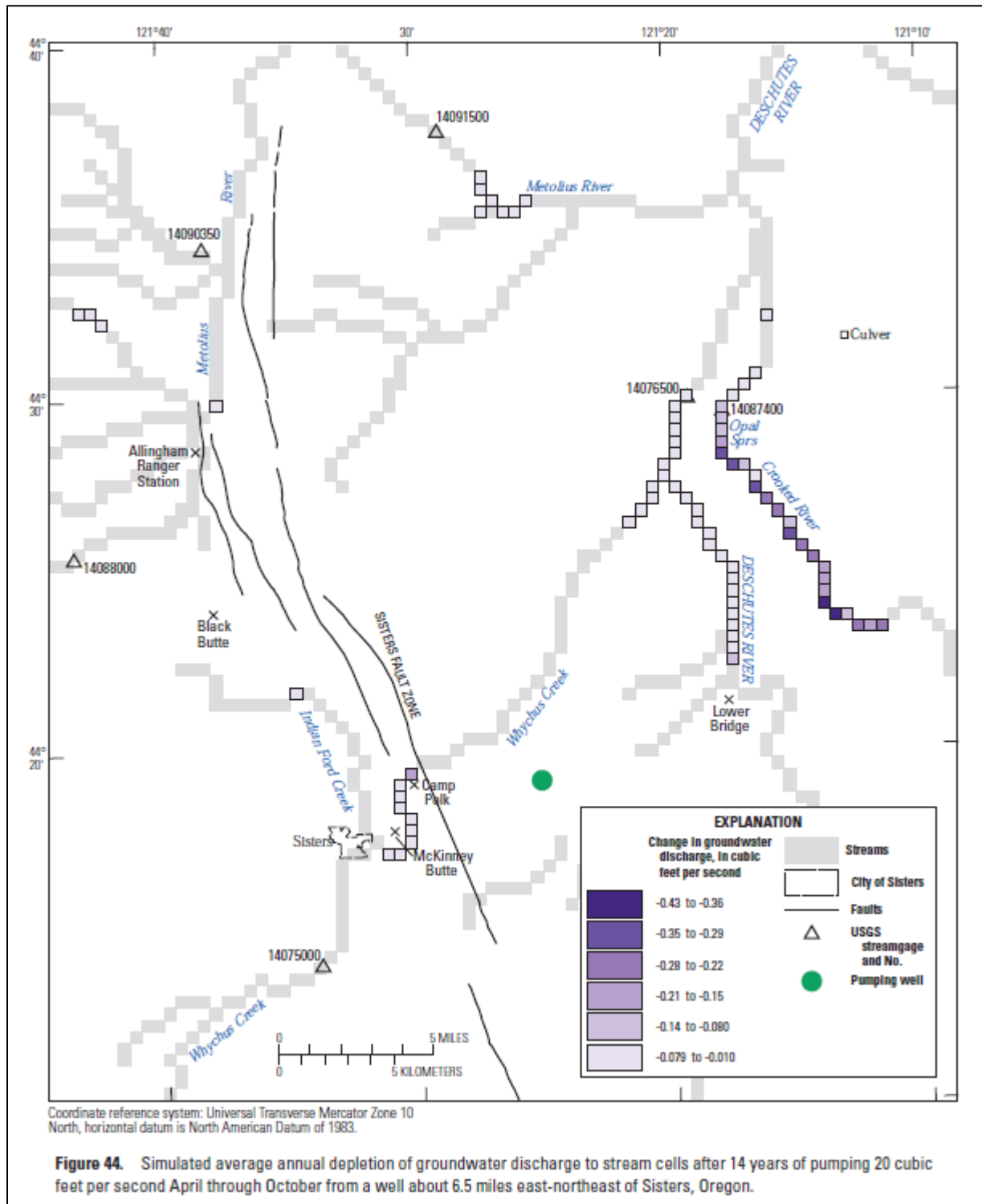


Figure 6: Extract from Gannett et al. (2017) showing graphical representation of stream depletion from pumping a well completed in the Deschutes Formation aquifer on nearby surface water reaches; this graph shows the cumulative impact over time on the Deschutes River, the Crooked River, and Whychus Creek

