OREGON WATER RESOURCES DEPARTMENT

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MEMORANDUM

DATE:	August 30, 2021
TO:	Deschutes Basin Water Collaborative Groundwater Mitigation Technical Committee
FROM:	Michael Thoma, Hydrogeologist Aurora Bouchier, Hydrogeologist Justin Iverson, Groundwater Section Manager Harmony Burright, Planning Coordinator
SUBJECT:	Response to Technical Assistance Request: Groundwater Mitigation Program purpose in relation to observed groundwater level trends

This memo was prepared in response to a technical assistance request from the Groundwater Mitigation Technical Committee of the Deschutes Basin Water Collaborative, as captured in a technical assistance request form dated 4/30/2021. This memo is intended to help the Technical Committee gain a common understanding of groundwater level conditions in a populated portion of the Deschutes Basin, including an overview of groundwater levels, where and why groundwater levels are declining, and what is being done or could be done to address groundwater level declines. This memo is also intended to describe the current relationship between the Deschutes Groundwater Mitigation Program and groundwater management more broadly. This information is for planning purposes only. It may be used to inform the future scope and approach of the Groundwater Mitigation Technical Committee or the Deschutes Basin Water Collaboratively more generally as they work to develop a basin-wide integrated plan.

Background:

Surface water throughout the Deschutes Basin is fully allocated or over-allocated most months of the year, and surface water is generally not available for appropriation of new out-of-stream uses or new storage. A joint study by the Oregon Water Resources Department (Department) and U.S. Geological Survey (USGS) of groundwater resources of the Deschutes Basin[1] established that there is a hydraulic connection between groundwater and surface water across the Deschutes Ground Water Study Area. Based on the conclusions of the study, the Department has determined that groundwater appropriations within the Deschutes Ground Water Study Area have the potential for substantial interference with surface water as described in OAR 690-0009, and will measurably reduce scenic waterway flows as defined in ORS 390.835, unless mitigation is provided pursuant to the rules in OAR 690-505.

Rulemaking conducted by the Department in 2002 (OAR 690-505-0500 -0630 Deschutes Mitigation Rules and OAR 690-550 Mitigation Banks) established the Deschutes Basin Groundwater Mitigation Program to mitigate the impact of groundwater development in the Deschutes Groundwater Study Area on the Deschutes State Scenic Waterway. This program allows for limited, additional groundwater development using mitigation to offset the impacts to the State Scenic Waterways and specific instream rights. The program was not designed to mitigate for other potential impacts of groundwater development such as groundwater level declines, capture of groundwater otherwise flowing to local springs or other groundwater dependent ecosystems, or hydraulic interference with other groundwater users. In addition to the Deschutes Groundwater Mitigation Program, there are other laws and policies that affect the allocation and management of groundwater that we will briefly touch on in this memo.

Observed Groundwater Level Trends

Figure 1 shows the boundary of the Deschutes Groundwater Study Area and general groundwater level elevations contours, highlighting groundwater elevations across the region (see Gannett et al., 2001[1] for further information on the regional groundwater flow system). The spatial pattern of groundwater levels shows that groundwater elevations are highest near the Cascade Mountains in the west and Newberry Volcano in the south, and decrease to the northeast and north towards the confluence of the Deschutes and Crooked rivers. Groundwater elevation differences drive groundwater to flow from areas of high recharge (e.g., Cascades, Newberry Volcano) to areas where groundwater discharges back to the land surface as springs, or baseflow for streams[2]. In addition to the regional flow pattern, groundwater levels in the central part of the Deschutes Basin are several feet to several-hundred feet below land surface, indicating that stream reaches in the central part of the basin (e.g., Deschutes River and Whychus Creek) are separated from the regional groundwater flow system by an unsaturated zone. Groundwater levels become coincident with surface level elevations near the confluence of the Crooked and Deschutes River, where large amounts of groundwater discharge back to the surface, either as springs or direct discharge to the riverbed.

Long-term groundwater level records in the central part of the Deschutes Basin have shown that some areas are experiencing persistent groundwater level declines (Figure 2), particularly in an area extending from the vicinity of Bend, north toward Lake Billy Chinook, and northeast toward Redmond and Powell Butte (Figure 3). Long-term groundwater level records from select wells in this and the surrounding region were normalized to Spring-1995 levels (Figure 4). This analysis shows water level changes since Spring-1995 vary spatially and highlights different trends in different sub-areas. Table 1 lists the observed changes and rate of change for each sub-area based on least-squares fits of water level changes since Spring-2006 and Table 2 presents the total observed water level decline for those same wells. Spring-2006 was used to estimate a current rate of decline because there is an apparent change in slope in groundwater level trends around that time that appears to be consistent with the present trends.

Another collaborative OWRD-USGS study (Gannett and Lite, 2013[3]) looked at measured groundwater level changes from 1997 to 2008 and used an existing groundwater flow model[4] to simulate those changes and estimate the individual influence of major controlling hydrologic factors on observed groundwater level trends throughout the basin (trends related to those shown in Figure 2 and Figure 4). This work estimated that groundwater level changes in each of the sub-areas are due to, in order of impact, 1) climate influences (i.e., changes in precipitation and recharge), 2) increased groundwater pumping, and 3) reduced recharge through canals due to canal lining. The simulation results for each sub-area are presented in Table 1.

Hydrologic trends show a shift towards drier conditions since the later 1990s that has accompanied a warming trend in the basin (Frankson et al, 2017[5]; Mote et al, 2018; . Observed changes in precipitation and snowpack due to climate change have already been shown to impact groundwater levels in the region[3] and expected changes to the climate in the future have a high likelihood of exacerbating existing groundwater level declines. Further groundwater development, specifically in areas of large population growth, is also likely to contribute to groundwater level declines. Finally, irrigation canals have been a significant source of groundwater recharge to this region for several decades and continued lining and piping of canals (which helps to conserve surface water) is also likely to exacerbate groundwater level declines.

Implications and Recommendations

While the Deschutes Groundwater Mitigation Program has helped to maintain State Scenic Waterway flows in the Deschutes River, the program is not intended to mitigate for the impacts of groundwater development on groundwater levels. The basis for the mitigation program is that groundwater and surface water are strongly connected within the Deschutes Basin and that impacts of groundwater development on surface water at specific areas (i.e., along State Scenic Waterway reaches) can be mitigated for. Persistent, long-term groundwater level declines along groundwater flowpaths that discharge to the Deschutes and Crooked Rivers, as are observed in the central part of the Deschutes Basin, will eventually impact groundwater discharge to springs and streams, and surface water flows that rely on this groundwater discharge.

Under Oregon water law, "all water within this state from all sources of water supply belong to the public"[7]. The Department is tasked with ensuring that appropriation of groundwater is "within the capacity of available resources," assuring "adequate and safe supplies of groundwater for human consumption while conserving maximum supplies of ground water for […] other beneficial uses" and determining and maintaining "reasonably stable groundwater levels"[7]. Where there is "impairment of or interference with existing rights to appropriate surface water" or where "groundwater levels are declining," the Department encourages voluntary joint action, but is directed to act under its other authorities in the event that "voluntary joint action is not taken or is ineffective"[7]. As groundwater levels in the central part of the basin approach 50 ft of total decline from the highest-know water levels (50 feet being one of the thresholds in the current statewide definition of "excessively declined" in OAR 690-008), the Department may enforce stricter control on future groundwater allocation. This may take the form of denying new groundwater appropriation even where State Scenic Waterway mitigation credits are available, restrictively classifying new groundwater uses, or establishing a Critical Groundwater Area.

The Deschutes Basin Collaborative has the opportunity to assist in assuring sustainable water supplies for current and future needs while maintaining reasonably stable groundwater levels by proactively addressing groundwater level declines. Some options include:

- Work with the Department to better understand the expected long-term impacts of climate change, canal lining, and groundwater development on future groundwater supplies and surface water flows.
- Advise the Department regarding future basin program rules to address groundwater development where it is expected to contribute to groundwater level declines or impact other groundwater or surface water users.
- Incorporate actions to address current and expected future groundwater level declines into a comprehensive basin plan.
- Consider the effects of any proposed actions on groundwater levels.
- Work with groundwater users to pursue and implement voluntary agreements as described in ORS 537.745.
- Examine the effects of groundwater level declines on groundwater dependent ecosystems, such as springs.

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[1] 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

[2] 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

[3] Gannett, M.W., and Lite, K.E., Jr., 2013, Analysis of 1997-2008 groundwater level changes in the upper Deschutes Basin, Central Oregon, USGS Scientific Investigations Report 2013-5092, 34 p., http://publs.usgs.gov/sir/2013/5092.

[4] 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

[5] Frankson, R., K. Kunkel, S. Champion, L. Stevens, D. Easterling, K. Dello, M. Dalton, and D. Sharp, 2017, Oregon State Climate Summary, NOAA Technical Report NESDIS 149-OR, 4 pp., https://statesummaries.ncics.org/chapter/or/

[6] Mote, Philip W., Sihan Li, Dennis P. Lettenmaier, Mu Xiao, and Ruth Engel, 2018, Dramatic declines in snowpack in the western US, Nature Partner Journals: Climate and Atmospheric Science, Volume 1, 2.

[7] ORS 537.525.

Figure 1: Map of the Deschutes Groundwater Study Area boundary and generalized groundwater level elevation contours (from Gannett et al., 2017: Page 10, Figure 4)

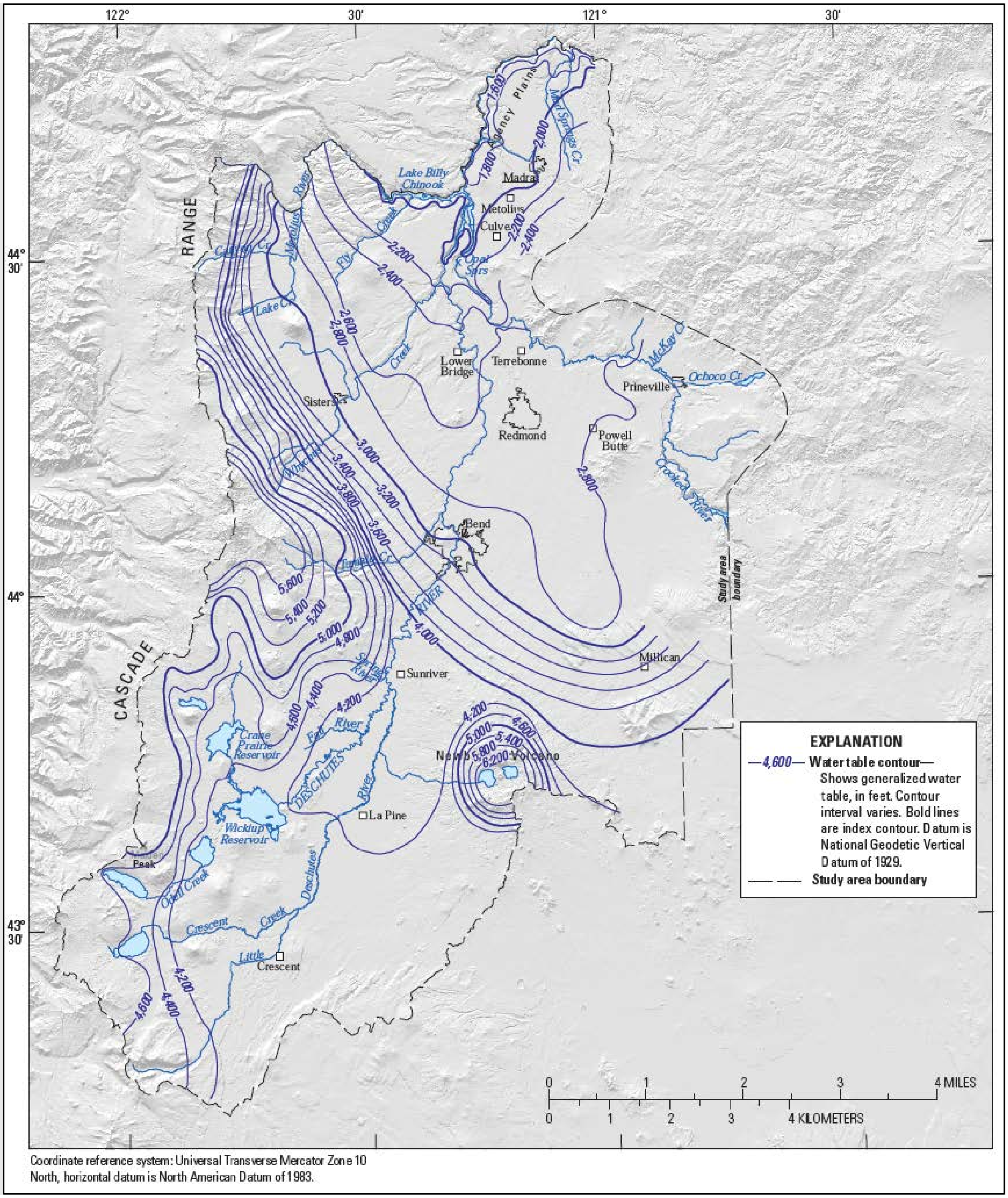

Figure 2: Hydrographs of select wells in the central part of the Deschutes Basin shown on shared elevation axis (left pane) and on individual axis (right pane); see Figure 3 for well locations.

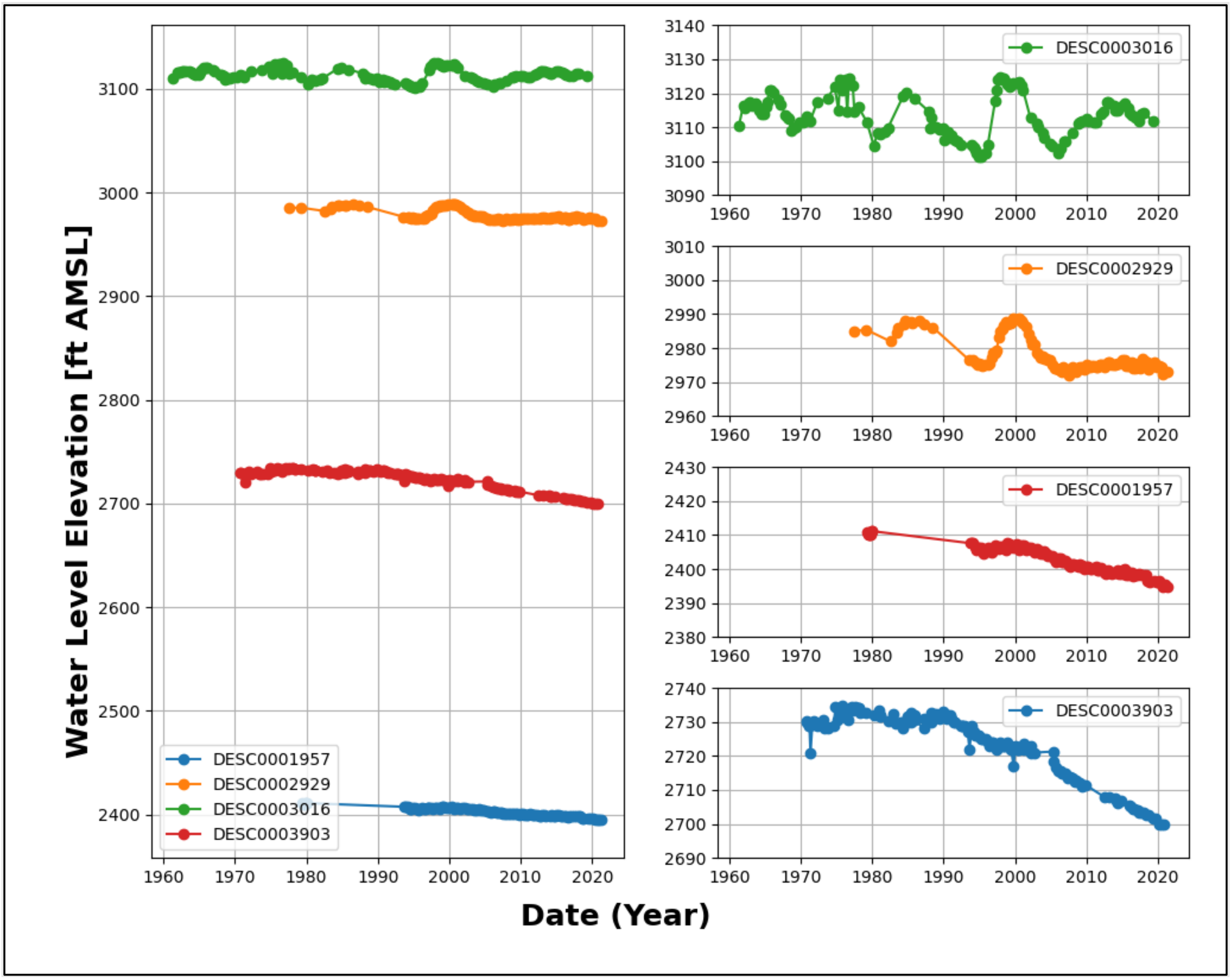

Figure 3: Map showing select wells with long-term groundwater level records, color-coded by the observed rate of decline; inset map shows Deschutes Groundwater Study Area boundary and extent of larger map.

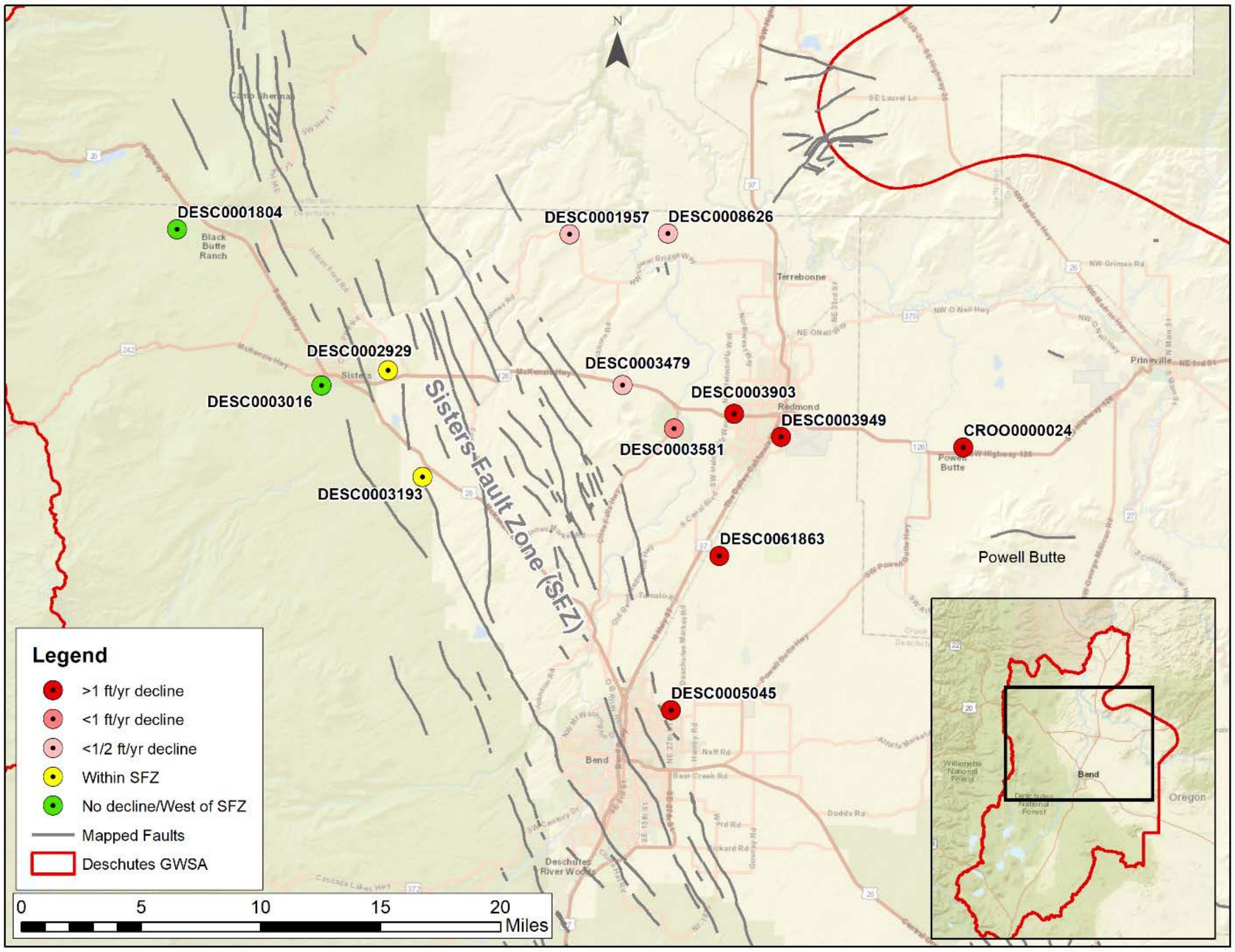

Figure 4: Groundwater level changes since Spring-1995 for wells shown in Figure 3 (excludes DESC0061863 which has an intermittent period of record)

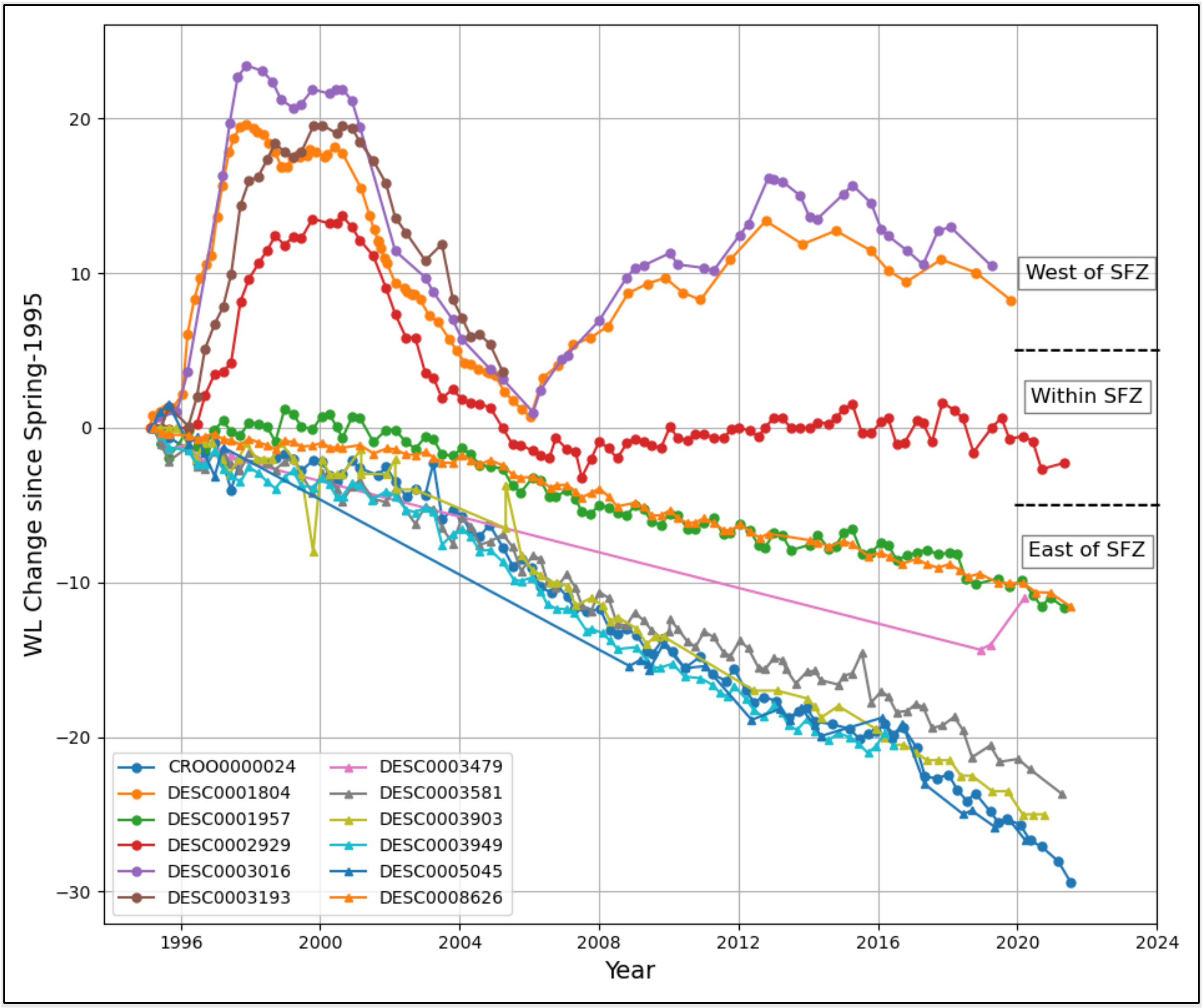

Table 1: Summary of Observed Groundwater Level Declines by Sub-Area

Sub-Area as Described in USGS Report[2]	Observed Water Level Change (this memo)		Simulated Decline and Drivers from USGS Report[2] for period of record 1997-2008			
	Avg. Decline Since 1995 (feet)	Decline Rate* 2006 - 2020 (ft/yr)	Decline (feet)	Climate Influences (%)	Pumping (%)	Canal Lining (%)
Redmond to Powell Butte: CROO0000024 DESC0003903 DESC0003949 DESC0005045	25.1	1.04	13-14	60-65	25-30	10
Cline Buttes to Redmond: DESC0003581	23.7	0.83	12-14	60-70	20-25	5-10
Lower Bridge: DESC0001957 DESC0003479 DESC0008626	11.1	0.45	5-6	60-70	20-30	10
Sisters: DESC0001804 DESC0002929 DESC0003016 DESC0003193	-	-	22	80	13	7
* Decline rate is the average of the decline rate for all wells in a sub-area						

Table 2: Summary of Observed Water Level Declines by Well

Well	Total Decline	Full Period of Record	Avg. Rate of Decline since 1995	Years to 50 ft Total Decline	Comment
CROO0000024	33.3	1994 - 2020	1.04	16	
DESC0003903	34.8	1975 - 2020	1.04	14	
DESC0003949	29.8	1980 - 2016	1.04	19	well abandoned in 2016
DESC0005045	44.1	1979 - 2020	1.04	6	
DESC0003581	24.8	1994 - 2020	0.83	30	
DESC0001957	16.5	1979 - 2020	0.45	74	
DESC0003479	21.5	1979 - 2019	0.45	63	
DESC0008626	11.6	1994 - 2020	0.45	85	
DESC0001804	--	1993 - 2019	NA		trends with climate
DESC0002929	--	1977 - 2020	NA		trends with climate through 2006
DESC0003016	--	1961 - 2019	NA		trends with climate
DESC0003193	--	1978 - 2005	NA		trends with climate; discontinued in 2005