MEMO

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Date: May 17, 2021
To: Gary Spackman, P.E., Director
Cc: Sean Vincent, P.G., Hydrology Section Manager
From: Jennifer Sukow, P.E., P.G.
Subject: Predicted hydrologic response in Silver Creek and the Little Wood River to curtailment of groundwater use in 2021, Basin 37 Administrative Proceeding, AA-WRA-2021-001

On May 4, 2021, the Director of the Idaho Department of Water Resources (IDWR) initiated an administrative proceeding concerning water rights in Basin 37 (Wood River Basin).[1] Because a drought is predicted for the 2021 irrigation season and the water supply in Silver Creek and its tributaries may be inadequate to meet the needs of surface water users, the Director initiated the administrative proceeding to determine whether water is available to fill junior groundwater rights within the Wood River Valley south of Bellevue. If the Director concludes water is not available to fill groundwater rights, the Director may order the groundwater rights curtailed for the remainder of the 2021 irrigation season.

This memorandum provides technical information relevant to prediction of the hydrologic response in Silver Creek and the Little Wood River to the potential curtailment of groundwater use during the 2021 irrigation season. This memorandum addresses items 1, 4, 5, 6, and 7 from the Request for Staff Memorandum dated May 11, 2021.

[1] https://idwr.idaho.gov/legal-actions/administrative-actions/basin-37.html

Hydrology and hydrogeology

The hydrology and hydrogeology of the Big and Little Wood River basin was described in a staff memorandum for a previous proceeding (Sukow, 2015).[2] The previous memorandum (Attachment A) describes the occurrence of aquifers within Basin 37 and their interaction with surface water (Figure 1). The Wood River Valley aquifer system is hydraulically connected to Silver Creek and its tributaries above the Sportsman Access gage. Water use within the Wood River Valley aquifer system affects Silver Creek reach gain from groundwater, and thus affects streamflow in Silver Creek and in the Little Wood River downstream of Silver Creek. Other aquifers within Basin 37, including the Camas Prairie aquifer system and the Eastern Snake Plain Aquifer, do not interact with Silver Creek or the Little Wood River; therefore, water use within the other aquifers does not affect streamflow in Silver Creek or the Little Wood River below Silver Creek.

Since the 2015 memorandum was written, IDWR has continued to collect water level data in both the Wood River Valley and Camas Prairie aquifer systems. Wylie (2019a)[3] provided an update on groundwater conditions in the Big Wood River Ground Water Management Area (BWRGWMA), which encompasses these aquifer systems. Moody (2018a)[4] discussed a synoptic measurement of water levels in 103 wells during late October 2018. IDWR has also performed seepage surveys to measure aquifer discharge from the Camas Prairie aquifer system to lower Camas Creek (Moody, 2018b;[5] Moody, 2020).[6] Wylie (2019a) concluded there has been a long-term groundwater level decline in the Wood River Valley aquifer system since 1968, but that water level trends appear to have stabilized since the formation of the BWRGWMA in 1991. Seepage measurements by Moody (2018; 2020) confirmed the results of previous seepage surveys, which indicate the Camas Creek aquifer system discharges to lower Camas Creek and provides inflow to Magic Reservoir.

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[2] Sukow, J., 2015, *Hydrology, hydrogeology, and hydrologic data, Big Wood & Little Wood Water Users Association delivery calls, CM-DC-2015-001 and CM-DC-2015-002.* Idaho Department of Water Resources, August 28, 2015, 25 p., https://idwr.idaho.gov/files/legal/CM-DC-2015-001/CM-DC-2015-001-20150828-WRCall-Hydro-Memo-w-Attach.pdf.

[3] Wylie, A., 2019a, *Summary of Ground Water Conditions in the Big Wood River Ground Water Management Area, 2019 Update*. Idaho Department of Water Resources, 79 p., https://idwr.idaho.gov/files/publications/20190920-Summary-Groundwater-Conditions-Big-Wood-River-GWMA-2019-Update.pdf.

[4] Moody, A., 2018a, *Wood River Groundwater Level Synoptic, Fall 2018*. Idaho Department of Water Resources, 20 p., https://idwr.idaho.gov/files/publications/20190809-Wood-River-groundwater-level-synoptic-2018.pdf.

[5] Moody, A., 2018b, *Camas Creek Seepage Survey, Fall 2017*. Idaho Department of Water Resources, 6 p., https://idwr.idaho.gov/files/publications/20180108-OFR-Camas-Creek-Seepage-Survey.pdf.

[6] Moody, A., 2020, *Camas Creek Seepage Survey, Fall 2018*. Idaho Department of Water Resources, 5 p., https://idwr.idaho.gov/files/publications/202011-OFR-Camas-Creek-Seepage-Survey.pdf.

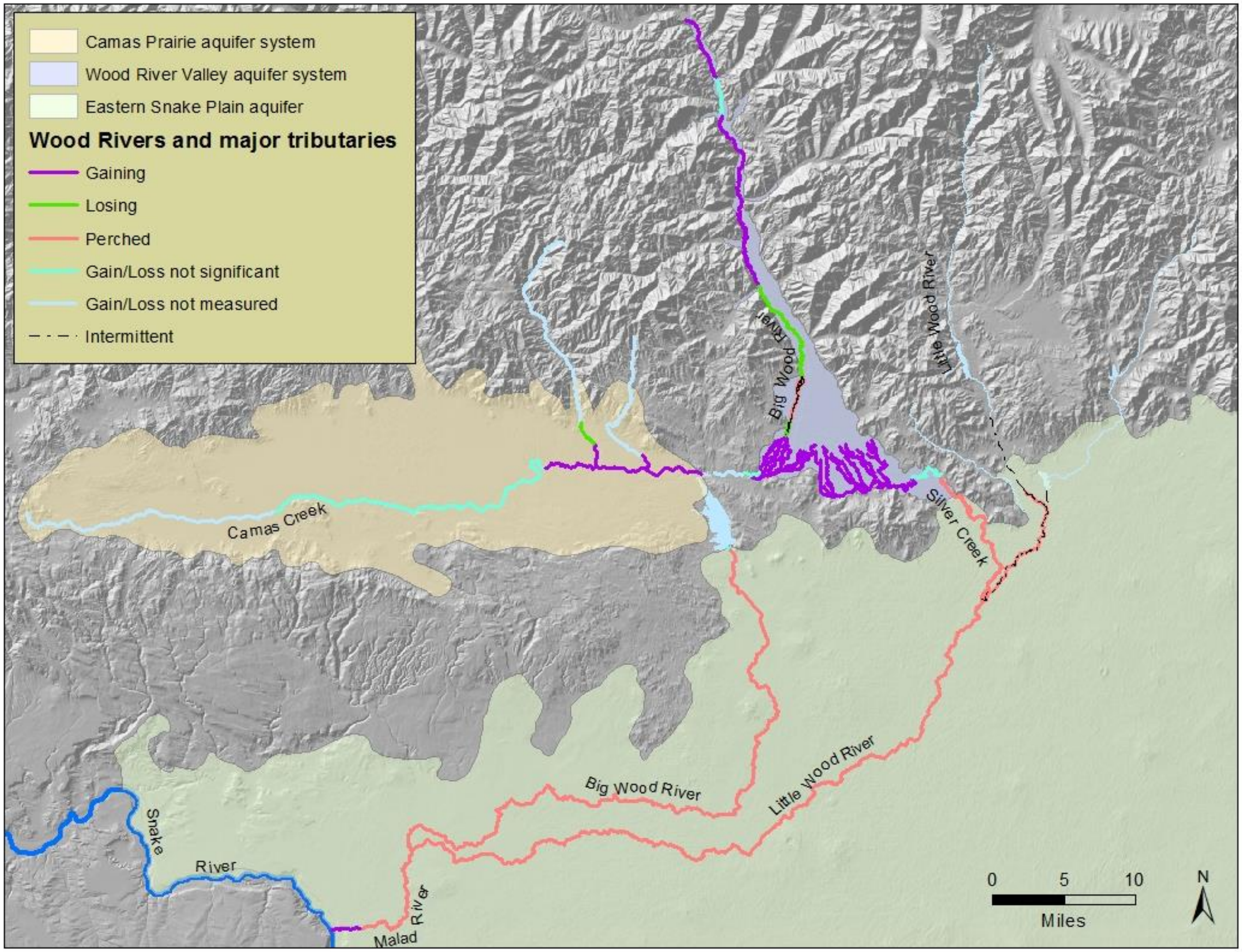

Figure 1. Generalized location of aquifers and interaction with surface water (from Sukow, 2015).

Wylie (2019a) identified four wells in the Bellevue Triangle with long water-level monitoring records beginning in the 1950s (Figure 2). Figure 3 through Figure 6 show the water level data for these four wells updated through the spring of 2021. Recent water level measurements indicate that water levels in both the unconfined and confined aquifer have declined since 2019, in response to a low water supply year in 2020. Aquifer water levels are affected by multiple sources of aquifer stress, including natural recharge from tributary underflow and infiltration of precipitation, canal seepage and incidental recharge of surface water applied in excess of crop water needs, groundwater withdrawals for irrigation, and natural discharge through evapotranspiration in wetlands and riparian areas. During years with low water supply, a combination of reduced natural recharge, reduced recharge from seepage of irrigation water, and groundwater withdrawals for irrigation all contribute to decreases in aquifer head and aquifer discharge to streams.

Discharge from the Wood River Valley aquifer system is the primary source of water for Silver Creek and Willow Creek (Sukow, 2015). Direct precipitation and snowmelt runoff provide some additional water seasonally. Well 01S 18E 14AAB1 (Figure 2, Figure 3), which is completed in the confined aquifer, and Well 01S 19E 03CCB2 (Figure 2, Figure 4), which is completed in the unconfined aquifer, have sufficient records of measurement between 1995 and 2014 to show the relationship between the aquifers and Silver Creek reach gains (Figure 7, Figure 8). Water levels at both locations correlate well with the Silver Creek reach gain from groundwater (Figure 9). Water levels at both locations have weaker correlation with the Willow Creek reach gain from groundwater (Figure 10). Water level measurements in the unconfined aquifer within the Willow Creek drainage area would be expected to correlate well with Willow Creek reach gain, but this relationship cannot be evaluated because there are not sufficient measurements of the unconfined aquifer in this area.

Streamflow measurements from October 2012 (Figure 11) and March 2013 (Figure 12) show the relative contribution of tributaries to Silver Creek streamflow at the Sportsman Access gage (Bartolino, 2014)[7]. Nearly 80% of the aquifer discharge to the Silver Creek drainage system occurred in tributaries upstream of Highway 20. Cove Creek and Loving Creek provided over half of the streamflow during these measurement events.

[7] Bartolino, J., 2014, Stream Seepage and Groundwater Levels, Wood River Valley, South-Central Idaho, 2012-2013. U.S. Geological Survey, Scientific Investigations Report 2014-5151, 34 p., https://pubs.usgs.gov/sir/2014/5151/.

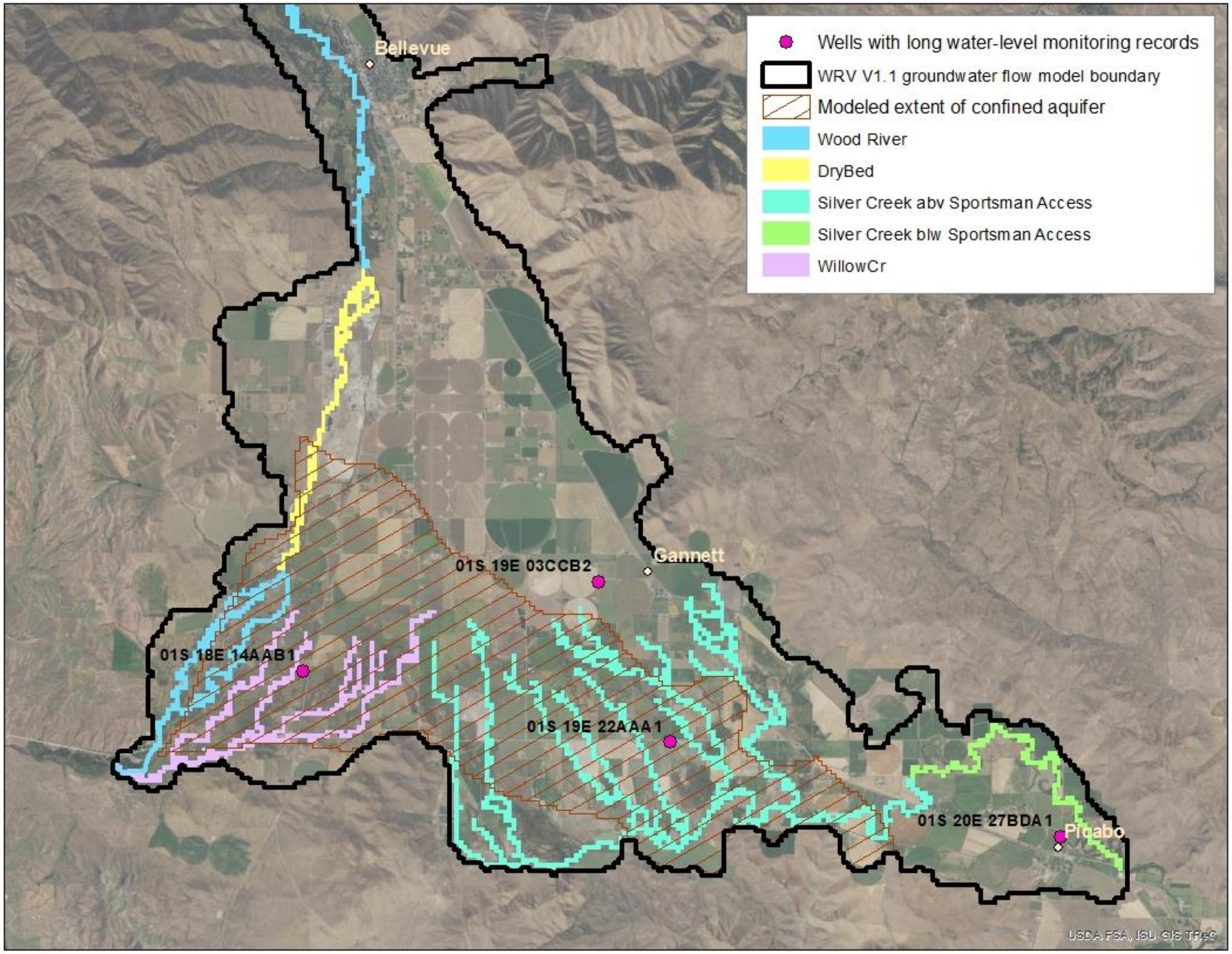

Figure 2. Wells in Bellevue Triangle with long water-level monitoring records

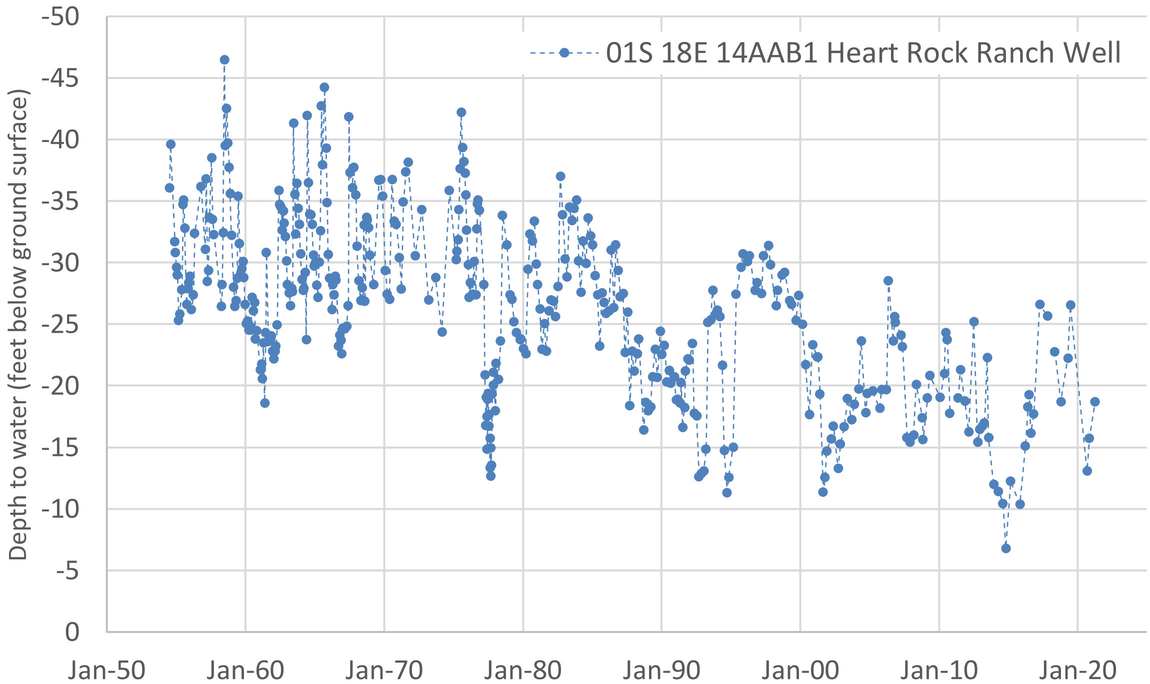

Figure 3. Updated water-level monitoring data for well 01S 18E 14AAB1 (confined aquifer)

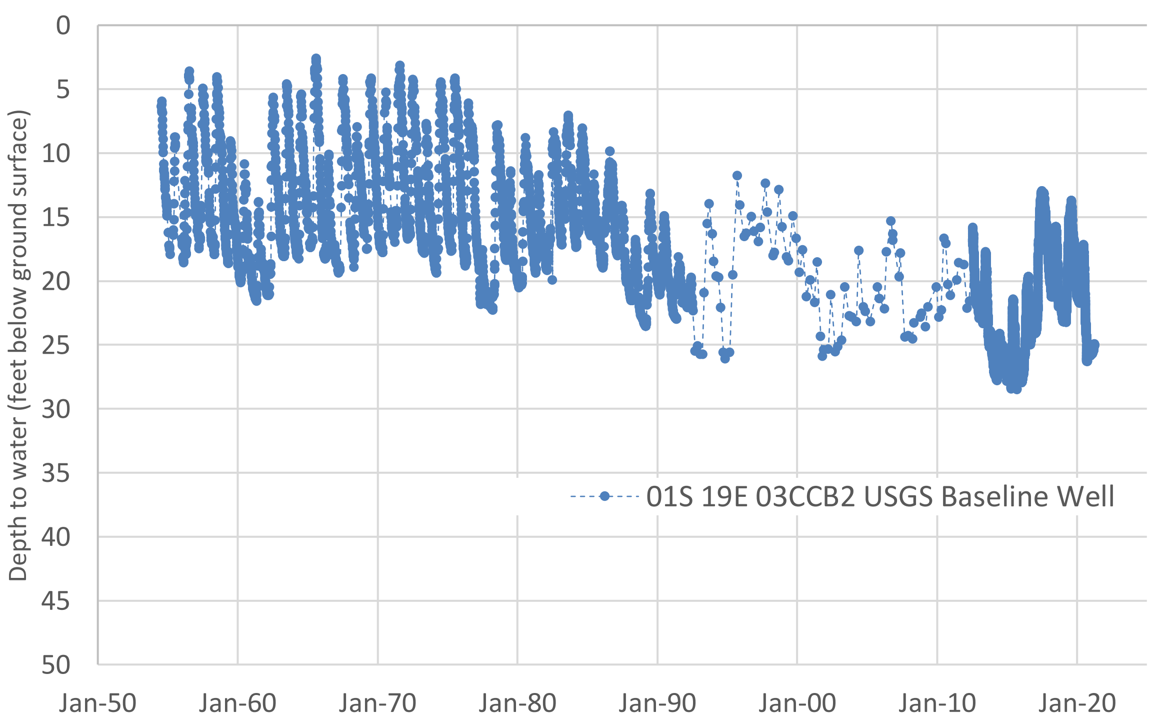

Figure 4. Updated water-level monitoring data for well 01S 19E 03CCB2 (unconfined aquifer)

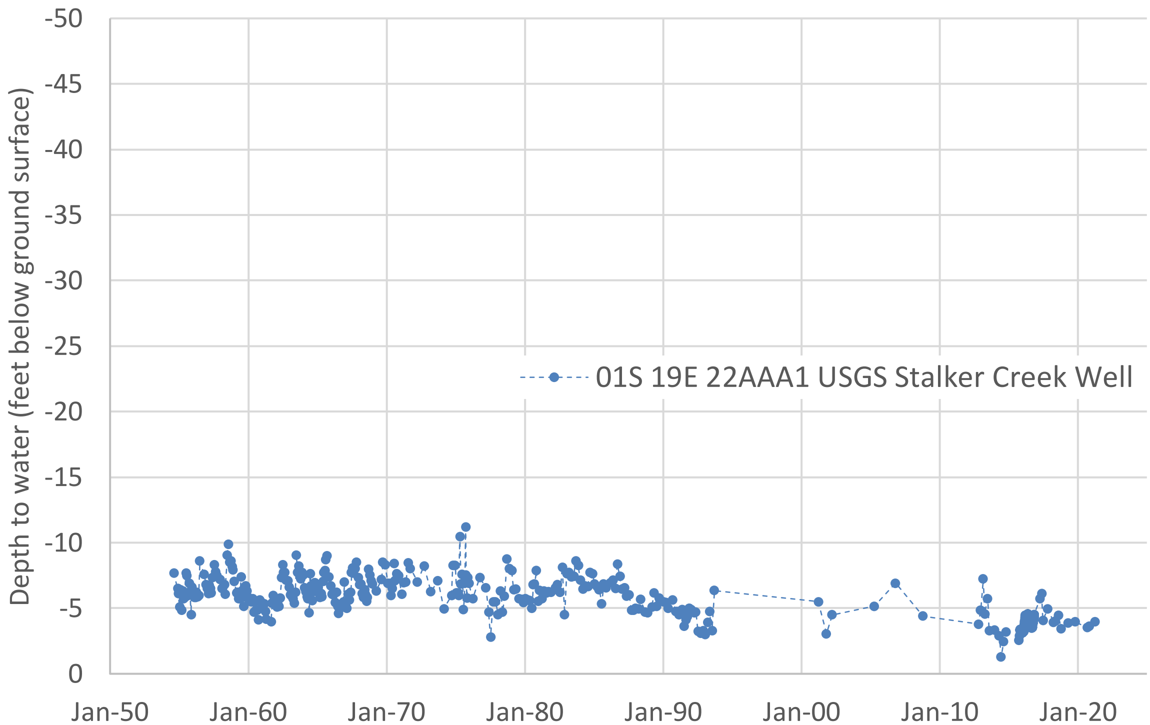

Figure 5. Updated water-level monitoring data for well 01S 19E 22AAA1 (confined aquifer)

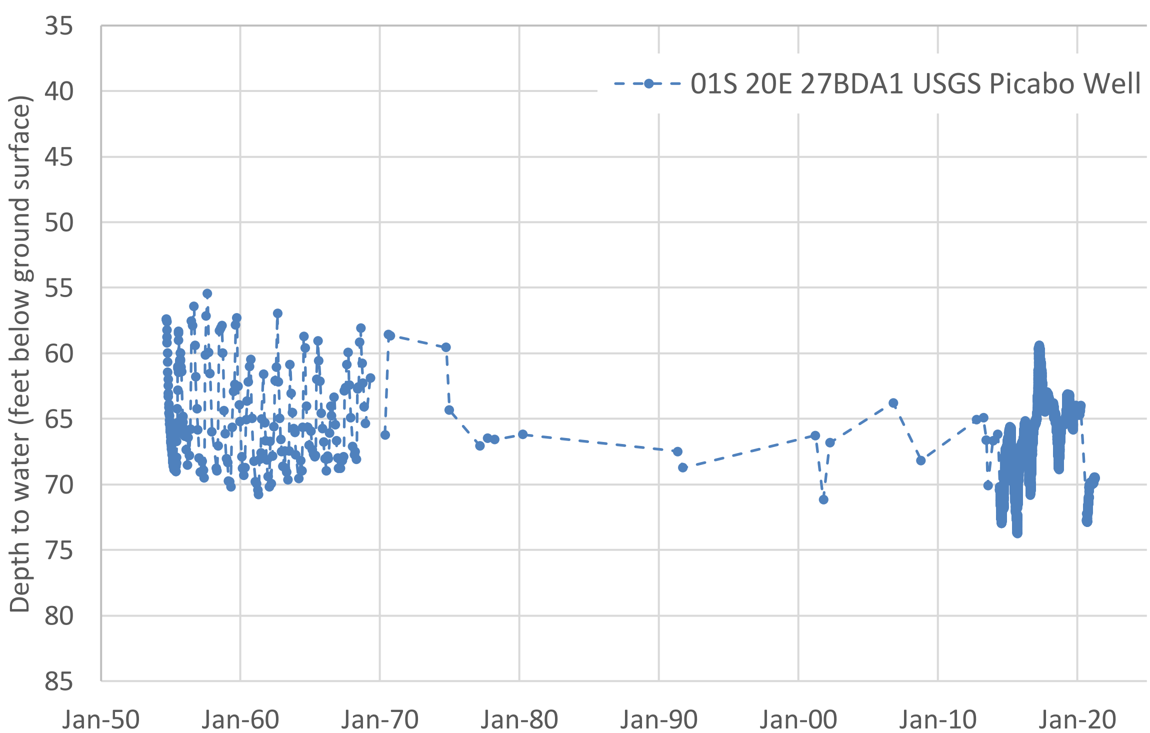

Figure 6. Updated water-level monitoring data for well 01S 20E 27BDA1 (unconfined aquifer)

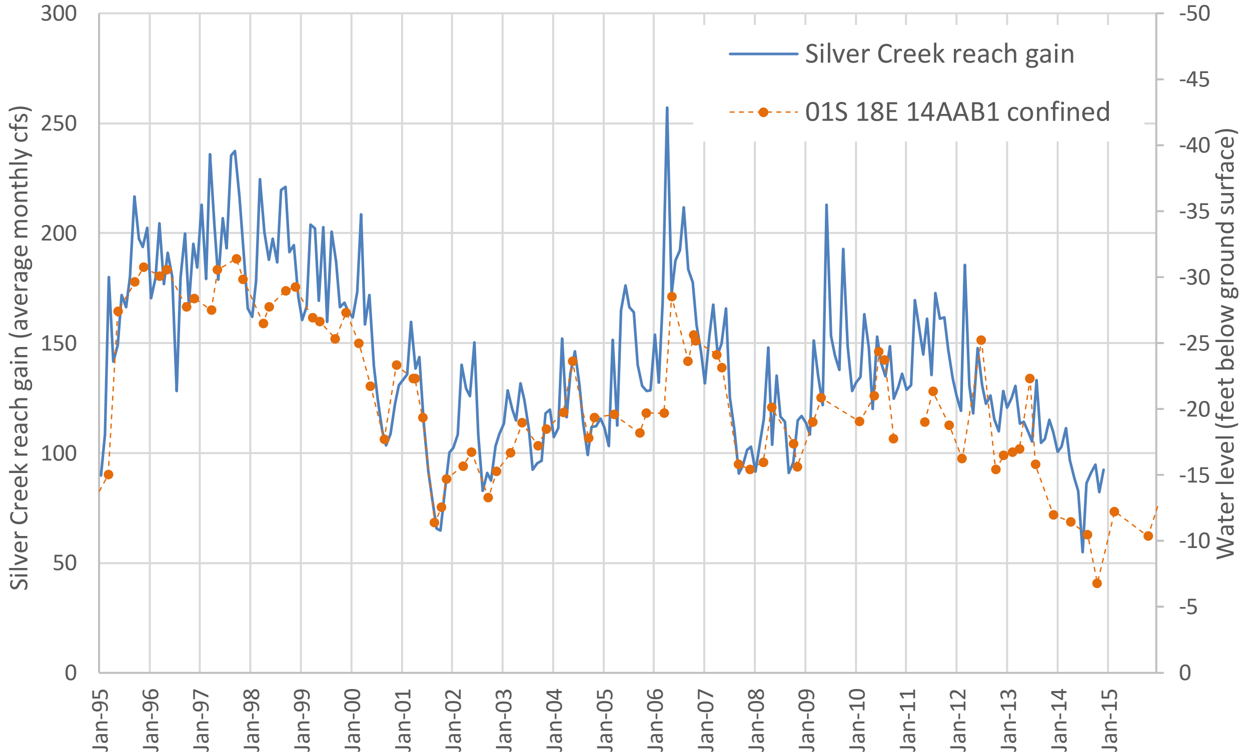

Figure 7. Silver Creek reach gain and water level in well 01S 18E 14AAB1 (confined aquifer)

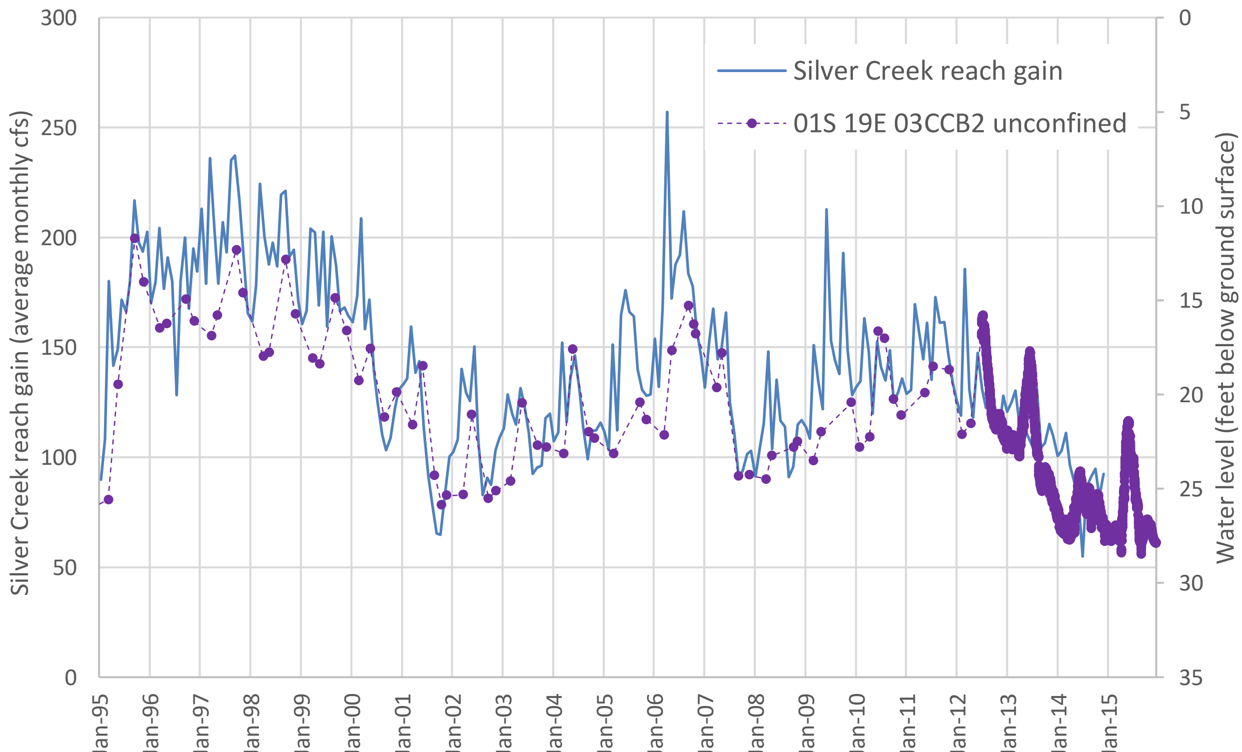

Figure 8. Silver Creek reach gain and water level in well 01S 19E 03CCB2 (unconfined aquifer)

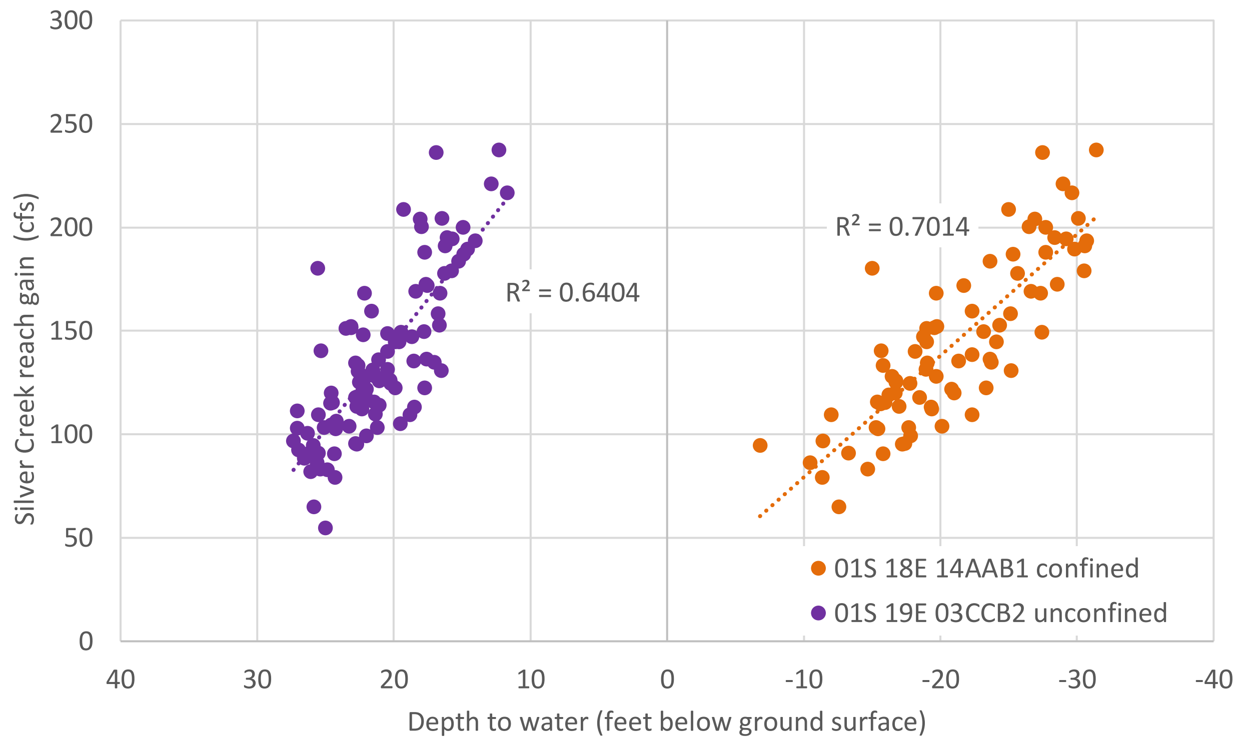

Figure 9. Correlation between Silver Creek reach gain and water levels

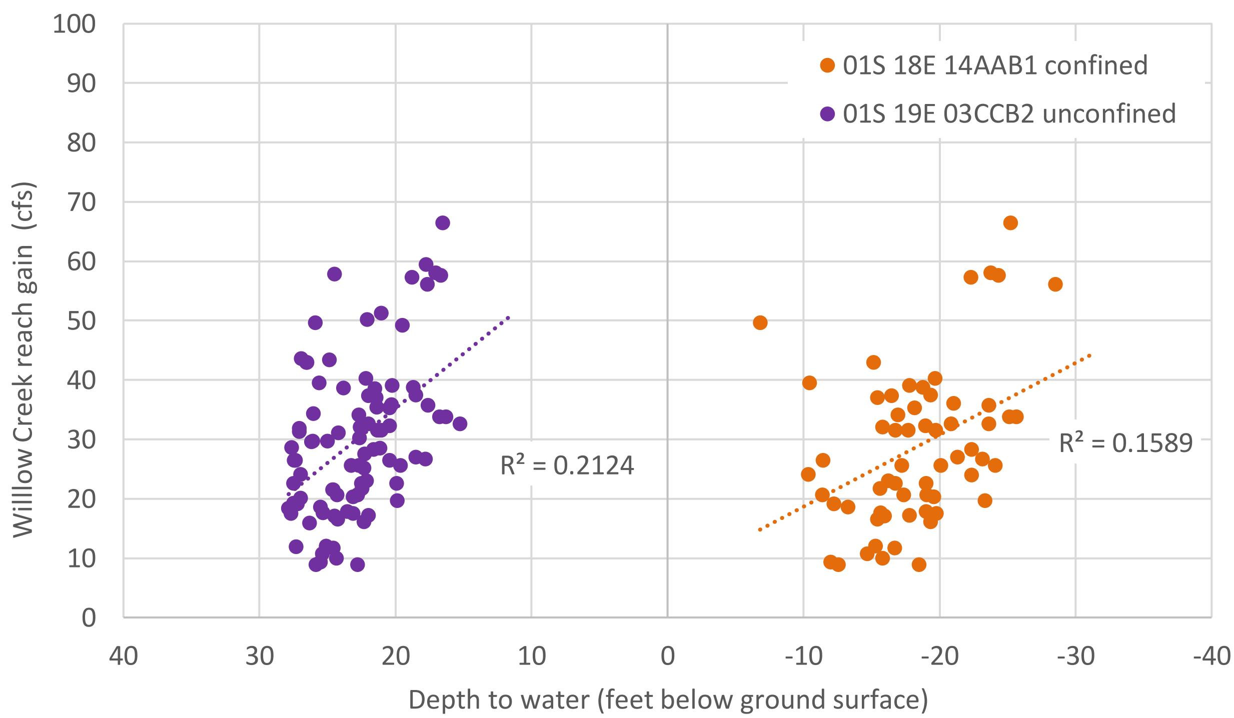

Figure 10. Correlation between Willow Creek reach gain and water levels

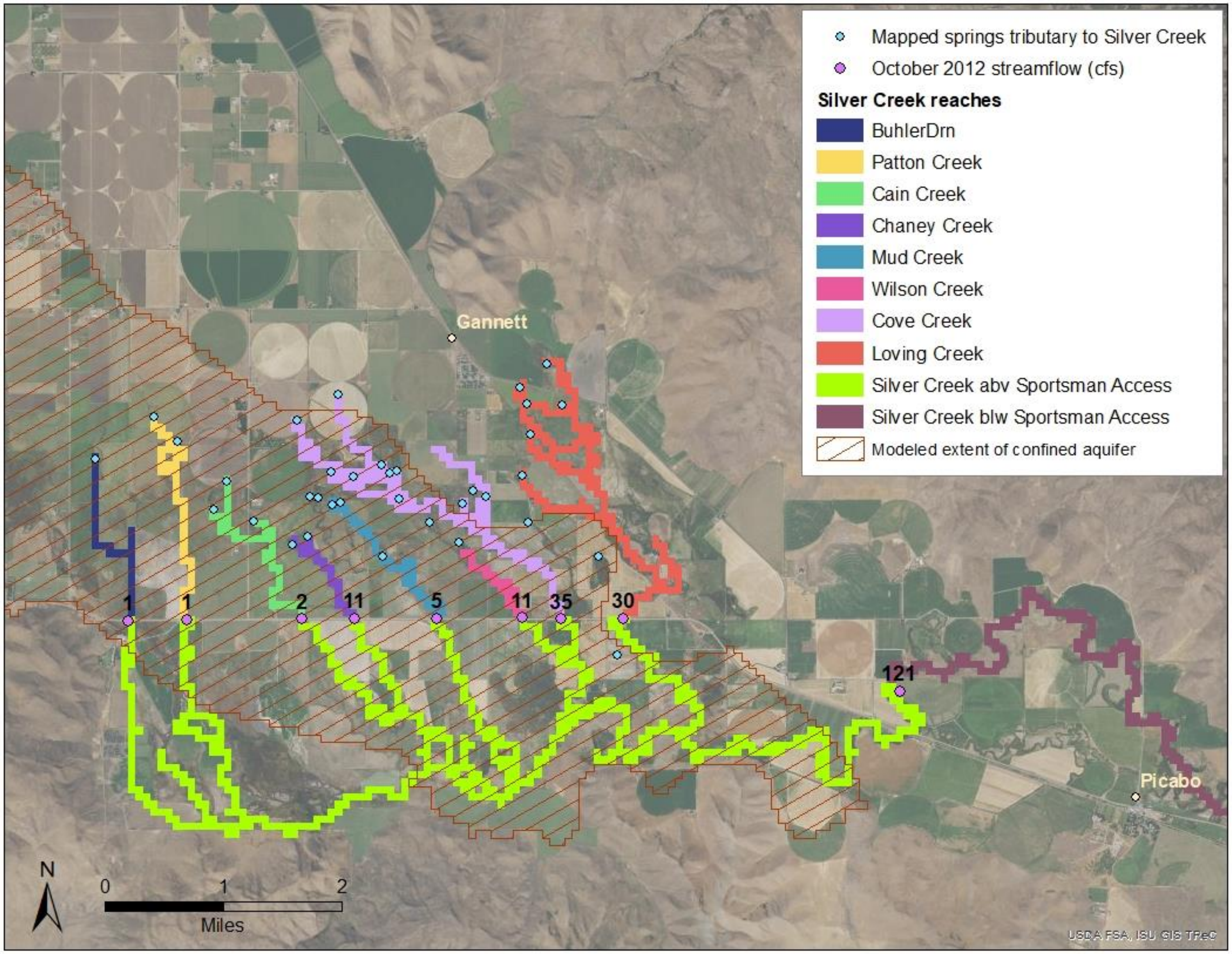

Figure 11. October 2012 streamflow measurements above Sportsman Access

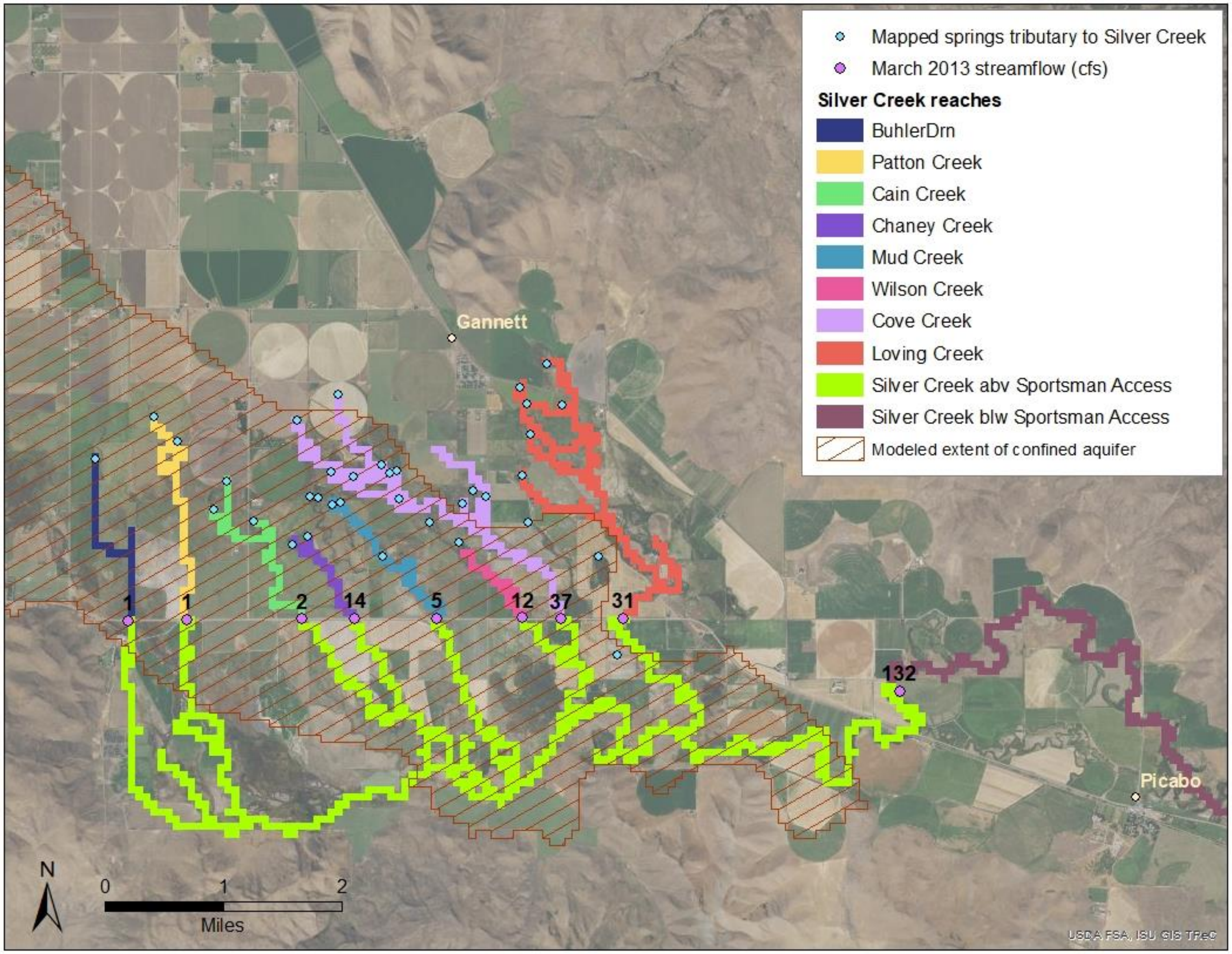

Figure 12. March 2013 streamflow measurements above Sportsman Access

Development of groundwater use

Groundwater development in the Camas Prairie aquifer system was discussed in Sukow (2015). As previously noted, the Camas Prairie aquifer system is not hydraulically connected to Silver Creek or the Little Wood River, and is not discussed further in this memorandum. Water right priority dates in the Wood River Valley aquifer system (Figure 13) provide a basis for evaluating historic groundwater development trends. Although Figure 13 shows groundwater rights for approximately 16 cfs with priority dates senior to 1900, those water rights were originally developed from a surface water source and are conditioned such that, "*Diversion of groundwater is limited to those times water is available for diversion under this right and priority from [surface water source]*." The groundwater rights with priority dates prior to 1900 are mitigated by non-use of the original surface water source, and are administered in priority with other surface water rights by Water District 37.

Based on priority dates for water rights where groundwater was the original source, groundwater development in the Wood River Valley aquifer system for municipal use began around 1907 when the Cramer Water Company in Hailey constructed a well equipped with two triplex electric pumps.[8] Groundwater development for irrigation use began around 1912 when two hand dug wells were constructed near Broadford Road and equipped with Parma Water Lifter pumps.[9] Groundwater development for irrigation in the Bellevue Triangle began around 1930. Significant development of the confined aquifer for irrigation began in the late 1940s. In 1961, the Idaho Department of Reclamation (predecessor to IDWR) designated the Silver Creek Critical Ground Water Area in the Bellevue Triangle in response to concerns about reduced pressure head in flowing artesian wells. The designation was rescinded in 1966 (IDWR, 2020).[10]

[8] Documentation of water use and priority date for water right 37-22670, https://idwr.idaho.gov/apps/ExtSearch/DocsImages/yb5w01_.PDF.

[9] Adjudication claim file for water right 37-22243, https://idwr.idaho.gov/apps/ExtSearch/DocsImages/nt4_01_.PDF.

[10] IDWR, 2020, *Historical review of Big Wood River Ground Water Management Area*. Presentation to the BWRGWMA Advisory Committee, November 18, 2020, https://idwr.idaho.gov/files/groundwater-mgmt/big-wood-gwma-advisory-comm/20201118-Big-Wood-GWMA-Advisory-Committee-Meeting-Materials.pdf.

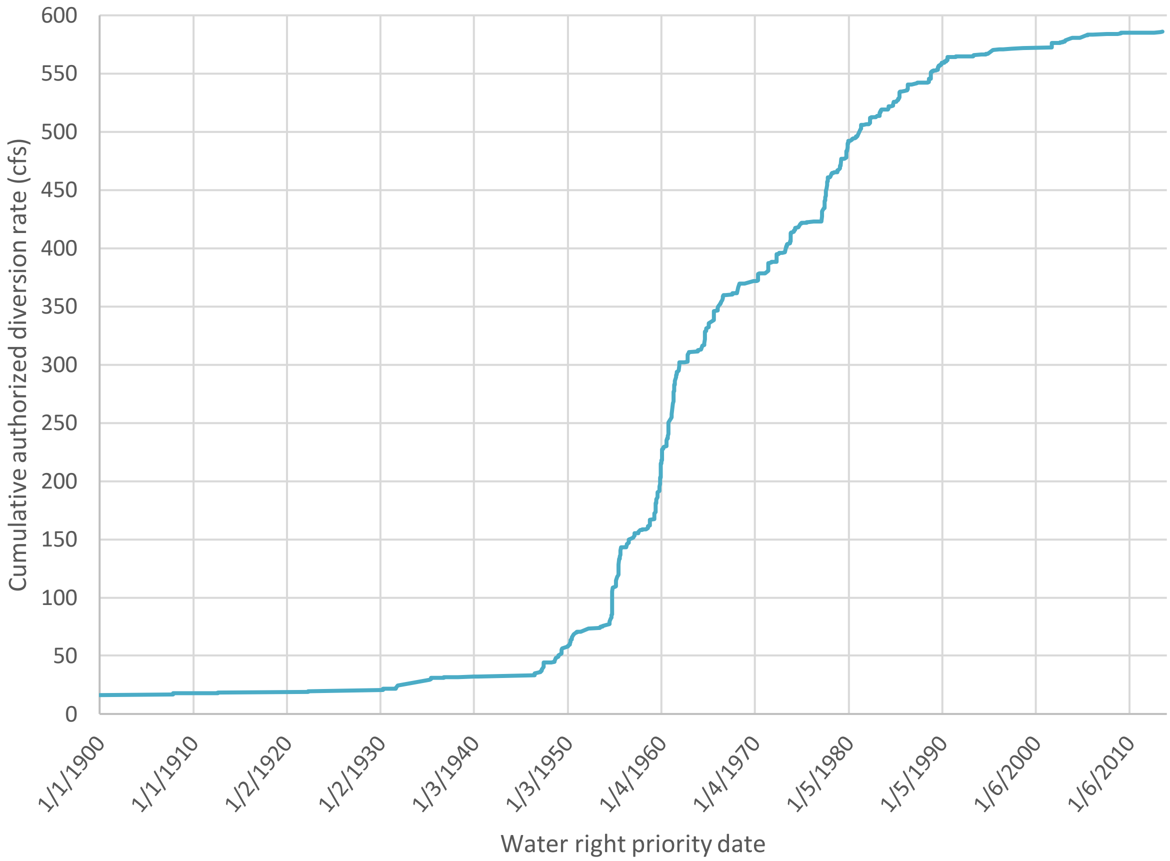

Figure 13. Cumulative authorized groundwater diversion rate for irrigation and municipal uses within the WRV1.1 model boundary

Figure 13 shows groundwater development increased steadily between the late 1940s and 1991. The BWRGWMA was designated by IDWR in 1991 because of concerns about the impacts of groundwater use on senior water users who rely on streamflow or inflow to Magic Reservoir.[11] Following the 1991 designation, the approval of new groundwater uses within the Wood River Valley aquifer system has generally been limited to non-consumptive or fully-mitigated uses. This is consistent with Wylie (2019a), who observed long-term water level trends in the Wood River Valley aquifer system declined between 1968 and 1991, while groundwater development was continuing to increase, then stabilized after 1991 when additional development was restricted.

Between 1995 and 2014, an average of approximately 42,000 acres of land in the Wood River Valley were irrigated for agriculture or partially irrigated for residential or urban uses.

[11] https://idwr.idaho.gov/files/legal/orders/1991/19910628-Big-Wood-River-GWMA-Order.pdf

Groundwater was the sole source of supply for approximately 9,000 acres and a second source of supply for approximately 27,000 acres (Sukow, 2017).[12]

Groundwater flow model development

Sukow (2015) mentioned the pending development of a groundwater-flow model of the Wood River Valley aquifer system. The U.S. Geological Survey (USGS) published the first version of the Wood River Valley groundwater flow model in 2016 (Fisher et al., 2016).[13] During development of the first version of the model, IDWR and the USGS expanded monitoring of aquifer water levels and streamflow to address data gaps. IDWR released a recalibrated version of the groundwater flow model in 2019 (Wylie et al., 2019),[14] which superseded the first version. The primary purpose of the model recalibration was to incorporate additional time-series data for aquifer head and streamflow that were measured between 2011 and 2014, with the intent of improving the model's ability to predict the timing of aquifer head and streamflow responses to aquifer stress. The model recalibration also refined the representation of the Dry Bed of the Big Wood River to facilitate prediction of streamflow responses above and below the Dry Bed. The model representation of the eastern extent of the confining layer and confined aquifer was also improved during the recalibration. The recalibrated model is referred to as Version 1.1 of the Wood River Valley groundwater flow model (WRV1.1).

Both versions of the model were constructed using MODFLOW-USG, a numerical model for simulating three-dimensional transient groundwater flow, and were calibrated using PEST, an automated parameter estimation program. Both versions of the model were developed with the input of a Modeling Technical Advisory Committee (MTAC), which was established to provide transparency in model development and to serve as a vehicle for stakeholder input (Bartolino and Vincent, 2013; Fisher et al., 2016; Wylie et al., 2019). Twenty-two MTAC meetings were convened between March 2013 and January 2019 to facilitate a transparent and open process of data collection, model construction, and model calibration.[15]

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[12] Sukow, 2017, Preliminary updated water budget for calibration of Wood River Valley groundwater model version 1.1. Presented to the Wood River Valley Modeling Technical Advisory Committee, https://idwr.idaho.gov/files/projects/wood-river-valley/20170524-WaterBudgetUpdates.pdf.

[13] Fisher, J.C., J.R. Bartolino, A.H. Wylie, J. Sukow, M. McVay, 2016, *Groundwater flow model for the Wood River Valley aquifer system, south-central Idaho.* U.S. Geological Survey Scientific Investigations Report 2016-5080, 84 p., https://pubs.er.usgs.gov/publication/sir20165080.

[14] Wylie, A., J. Sukow, M. McVay, J. Bartolino, 2019, *Groundwater flow model for the Wood River Valley aquifer system, Version 1.1.* Idaho Department of Water Resources, 39 p., https://idwr.idaho.gov/files/projects/wood-river-valley/20190627-Groundwater-Flow-Model-forthe-Wood-River-Valley-Aquifer-System.pdf.

[15] https://idwr.idaho.gov/water-data/projects/wood-river-valley/meetings.html

Both versions of the model were developed to serve as a tool for water rights administration and water resource management and planning (Bartolino and Vincent, 2013;[16] IDWR and USGS, 2014;[17]. Fisher et al., 2016). Wylie et al. (2019) provided the following statement regarding the use of WRV1.1 as a tool for evaluating groundwater and surface water interactions in the model area.

> *"Although every groundwater model is a simplification of a complex hydrologic system, WRV Aquifer Model Version 1.1 is the best available tool for evaluating the interaction between groundwater and surface water in the Wood River Valley. The science underlying the production and calibration of the WRV Aquifer Model Version 1.1 reflects the best knowledge of the aquifer system available at this time. The WRV Aquifer Model Version 1.1 was calibrated to 1,314 aquifer water-level measurements and 1,026 river gain-and loss-calculations. Calibration statistics indicate a good fit to the observed data, providing confidence that the updated model provides an acceptable representation of the hydrologic system in the Wood River Valley."*

Because every groundwater model is a simplification of complex hydrologic system, there is uncertainty in all groundwater model predictions. An evaluation of the predictive uncertainty of the WRV1.1 model was performed and documented by Wylie (2019b).[18] The evaluation included five analyses, in which the injection of water into a single model cell was simulated for a period of 10 months and the predictive uncertainty of the streamflow response at a selected river reach was evaluated. The predictive uncertainty ranged from +/- 0.54% to +/- 22% of the volume recovered in the target reach. The lowest predictive uncertainty was for an analyses where water was injected at a location north of Hailey. The highest predictive uncertainty was for three analyses where water was injected at locations south of Bellevue (+/- 15% to +/- 22% of the recovered volume).

Because the model was developed to serve as a tool to inform the conjunctive management and administration of groundwater and surface water, a curtailment scenario was performed and

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[16] Bartolino, J. and S. Vincent, 2013, *Groundwater Resources of the Wood River Valley, Idaho: A Groundwater-Flow Model for Resource Management*. U.S. Geological Survey Fact Sheet 2013-2005, 4 p., https://pubs.usgs.gov/fs/2013/3005/.

[17] IDWR and USGS, 2014, *Design Objectives, Wood River Valley Aquifer System Groundwater-Flow Model*. Draft by the USGS/IDWR Modeling Team, January 14, 2021, 3 p., https://idwr.idaho.gov/files/projects/wood-river-valley/20140131-WRV-Design-Objectives.pdf.

[18] Wylie, A., 2019b, *Wood River Valley Aquifer Model Version 1.1 Uncertainty Analysis*. Idaho Department of Water Resources, 20 p., https://idwr.idaho.gov/files/projects/wood-river-valley/20190702-WRV-Uncertainty-Analysis-v11.pdf.

documented by IDWR (Sukow, 2019).[19] The curtailment scenario simulated the cumulative impacts of the consumptive use of groundwater on streamflow from 1995 through 2014. The effects of curtailing groundwater use for a single irrigation season during the water years of 2007 and 2012 were also simulated. The curtailment simulations excluded groundwater use mitigated by non-use of surface water and exempt domestic water use with irrigation of less than ½-acre. Where groundwater diversion data were lacking, the consumptive use of groundwater was estimated by calculating the groundwater irrigation demand from land use, evapotranspiration, precipitation, and surface water diversion data as described in the model documentation (Fisher, et al., 2016; Sukow, 2019). Where measured surface and groundwater diversions to a service area exceeded the irrigation demand, groundwater consumptive use was estimated by multiplying the ratio of groundwater diversions to total diversions by the total consumptive use. Figure 14 shows the volume of curtailed consumptive use simulated in the Sukow (2019) scenario.

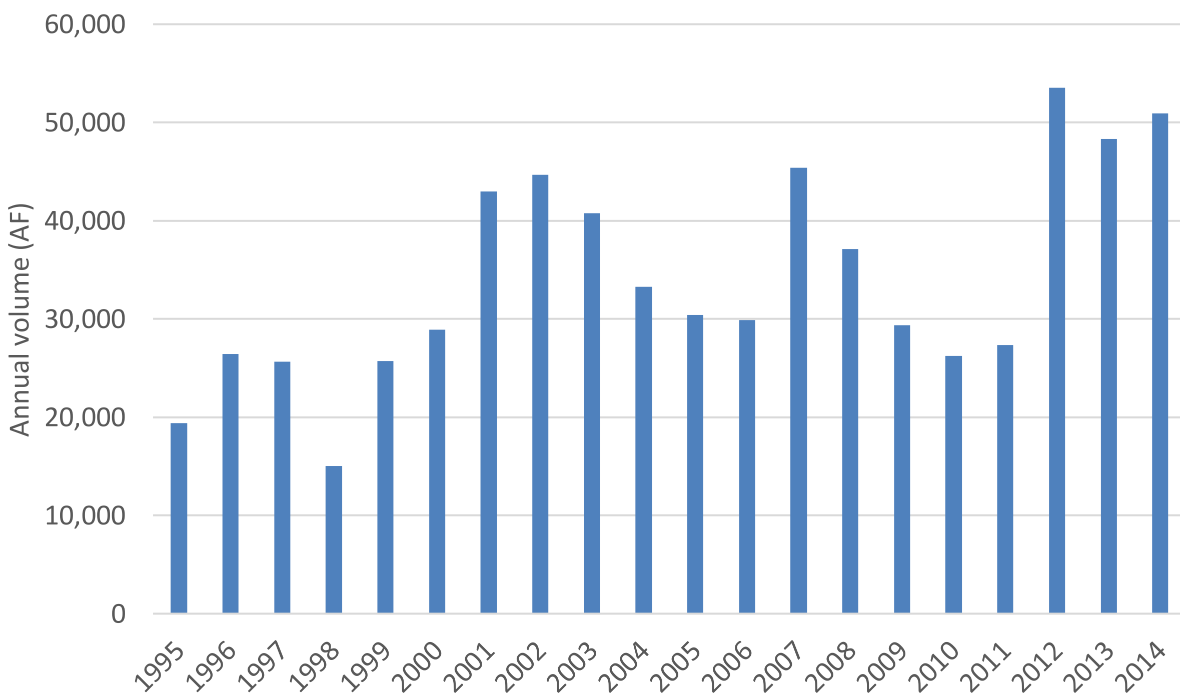

Figure 14. Volume of curtailed consumptive use simulated in Sukow (2019)

[19] Sukow, J., 2019, *Groundwater-Flow Model for the Wood River Valley Aquifer System, Version 1.1, Simulated Curtailment of Groundwater Use*. Idaho Department of Water Resources, July 31, 2019, 19 p., https://idwr.idaho.gov/files/projects/wood-river-valley/20190731-Report-WRV-V11CurtailSim.pdf.

Analyses for 2021 Basin 37 Administrative Proceeding

The WRV1.1 model was used to simulate the impact of curtailing consumptive use of groundwater for agricultural, municipal, residential, and commercial irrigation during the 2021 irrigation season. The year 2002 was used as a baseline dry year for the model simulation. Exempt self-supplied domestic water use for irrigation of less than 1/2-acre was excluded from the curtailment simulation. Groundwater use that is already mitigated by non-use of surface water or is otherwise already regulated in priority with surface water diversions by Water District 34 was also excluded from the curtailment simulation. Methods and pre-processing tools used to model the curtailment are described in detail by Sukow (2019).

Curtailment of irrigation was simulated with different starting dates of May 1, June 1, July 1, and August 1. Results for all four starting dates are provided in Attachment B and the supporting files. Because the hearing for the Basin 37 Administrative Proceeding is scheduled for June 7-11, 2021, results from the simulated curtailment starting July 1 are discussed in the text of this memorandum. Curtailment was simulated within two areas (Figure 15). The first area was the WRV1.1 model boundary. Although the effects of the curtailment were simulated with the model for a period of approximately 12 years, the WRV1.1 model predicts most of the impacts to streamflow are realized in less than 2 years (Figure 16). Because the Basin 37 Administrative Proceeding was initiated to address water delivery during the 2021 irrigation season, the results presented in the text of this memorandum focus on the hydrologic responses that are predicted to occur by the end of September.

While a significant portion (66%) of the curtailed water use remains in aquifer storage on October 1, the predicted July through September increases in streamflow are also significant (Table 1). Predicted increases to the average monthly streamflow during the 2021 irrigation season range from 23 to 28 cfs in Silver Creek, 10 to 16 cfs in the Big Wood River above the Dry Bed, and 2 to 7 cfs in the Big Wood River below the Dry Bed. Increases in streamflow in Silver Creek would be available for diversion in priority to water users on Silver Creek and the Little Wood River. Potential seepage losses within the Silver Creek and Little Wood River system are discussed later in this memorandum.

Increases in streamflow in the Big Wood River above the Dry Bed would likely be diverted in priority by water users with Big Wood River diversions above Glendale Road or off of the Bypass Canal system. If the additional predicted Big Wood River streamflow of 10 to 16 cfs (Table 1) is diverted onto the Bellevue triangle, this would likely provide some additional in-season streamflow in Silver Creek because a portion of the diversions will be lost to the aquifer via canal seepage and on-field infiltration. However, any additional benefit to streamflow in Silver Creek would be dependent on the inefficiency of senior surface water users, who cannot be required to "waste" water to benefit other water users downstream.[20] Prediction of potential additional benefits to Silver Creek would require predicting where, when, and how efficiently the additional water would be applied, and was not attempted for this analysis.

Increases in streamflow in the Big Wood River below the Dry Bed reach, which includes Willow Creek and its tributaries, is expected to result in an increase in inflow to Magic Reservoir. Kevin Lakey, Water District 37 Watermaster, indicated during the March 24, 2021 meeting of the BWRGWMA Advisory Committee that diversion demands are generally already met in this part of the system, and that any increases in reach gains are likely to result in additional inflow to Magic Reservoir.

[20] Idaho case law has established that downstream water users cannot compel upstream users to continue wasting water. *Hidden Springs Trout Ranch v. Hagerman Water Users*, 101 Idaho 677, 680-681 (1980).

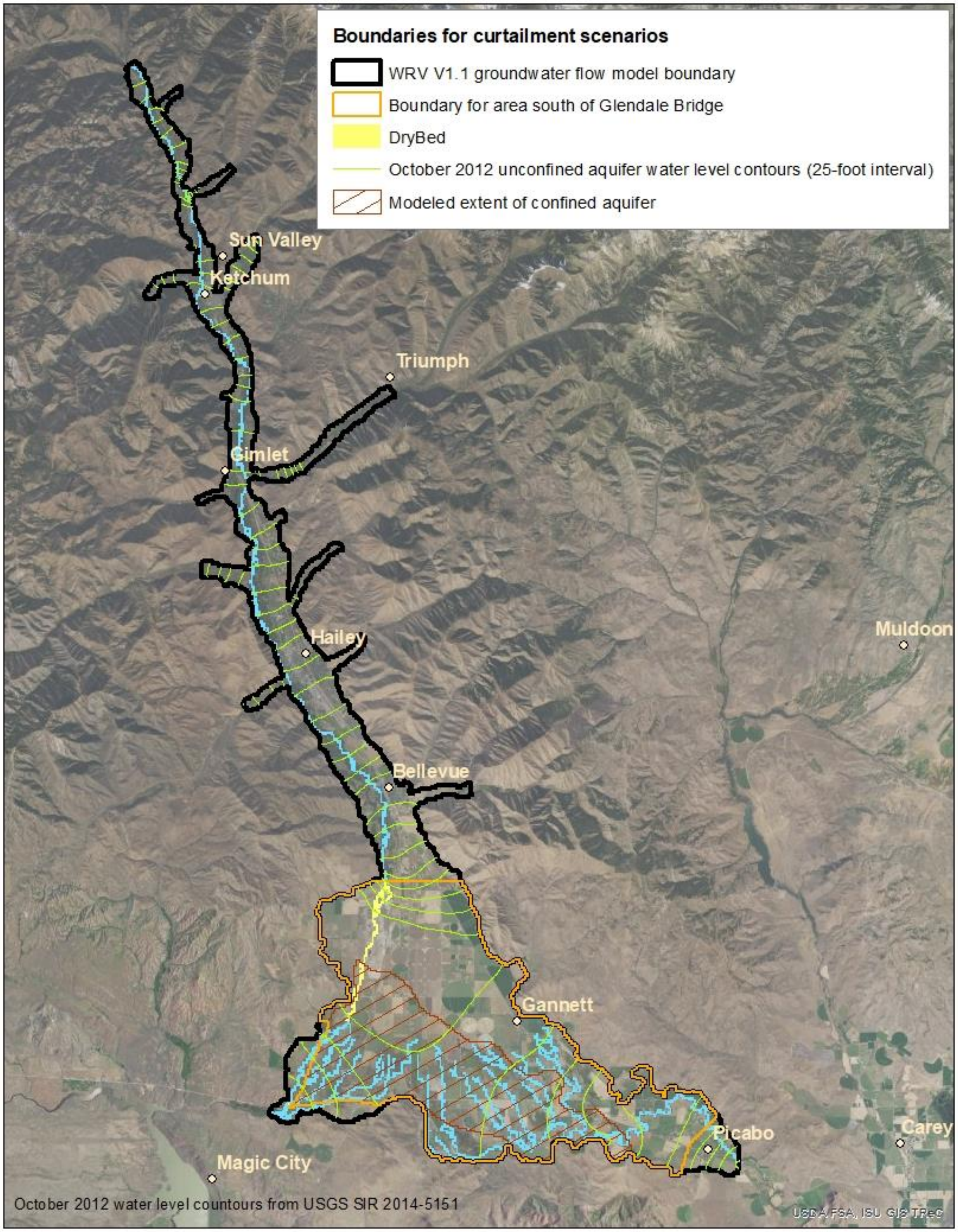

Figure 15. Areas of curtailment simulated with WRV1.1

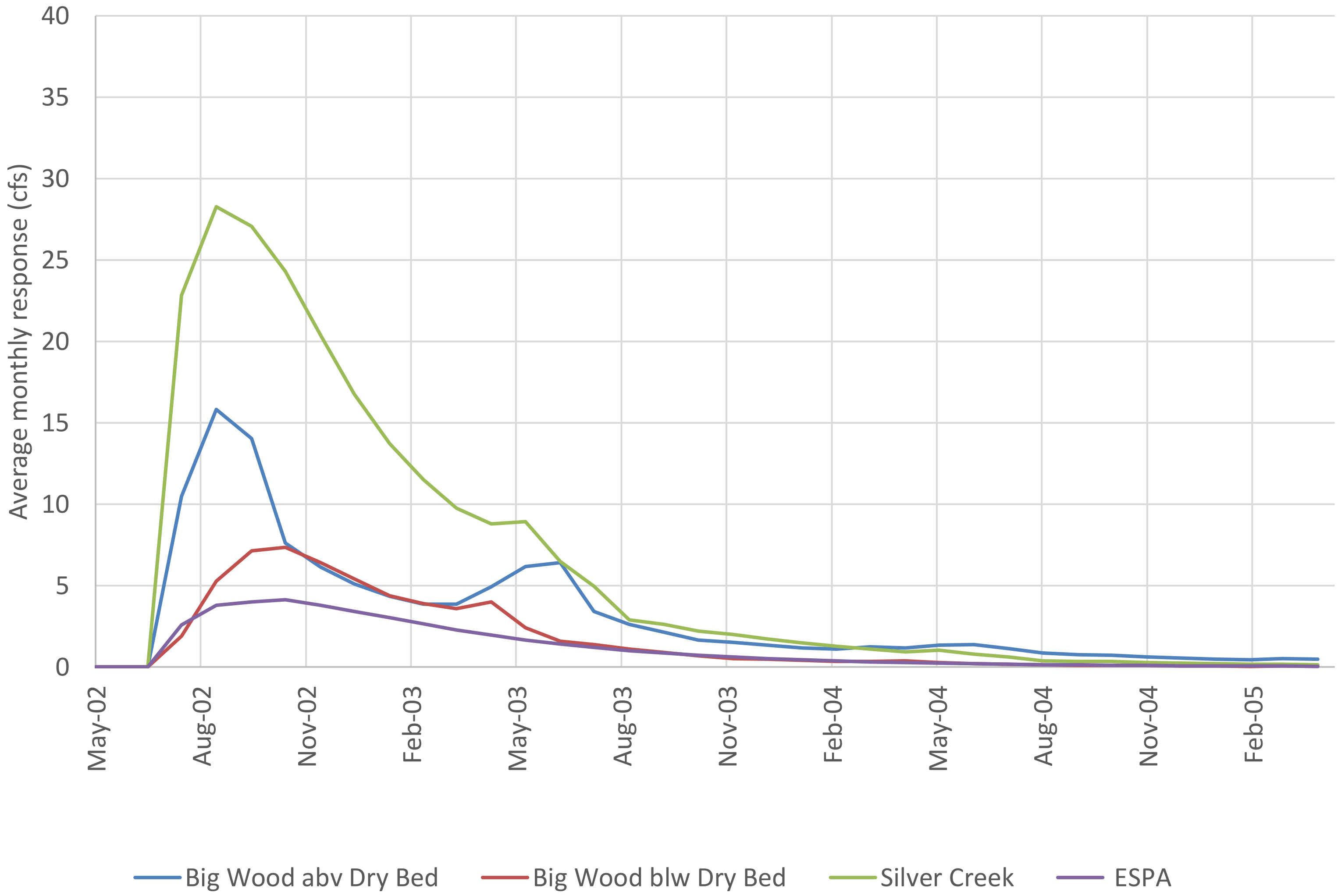

Figure 16. Predicted increase in aquifer discharge resulting from curtailment starting July 1 within the WRV1.1 model boundary

Table 1. Predicted responses to curtailment starting July 1 within the WRV1.1 model boundary

Month	Curtailed consumptive use	Silver Creek		Big Wood above Dry Bed		Big Wood below Dry Bed		Groundwater underflow to ESPA		Increase in aquifer storage	Model convergence error
	AF	cfs	AF	cfs	AF	cfs	AF	cfs	AF	AF	AF
May	0	0	0	0	0	0	0	0	0	0	0
June	0	0	0	0	0	0	0	0	0	0	0
July	10,144	22.8	1,403	10.5	644	1.9	116	1.6	98	7,883	1
Aug	9,613	28.3	1,738	15.8	973	5.3	323	2.8	174	6,405	0
Sep	5,221	27.1	1,611	14.0	836	7.2	425	3.1	184	2,164	1
Sum	24,978		4,752		2,452		864		456	16,452	2
	100%		19%		10%		3%		2%	66%	0%

The second area for which curtailment was simulated comprised most of the model area south of Glendale Bridge (Figure 15, Figure 17). The second area excludes areas where groundwater pumping has minimal impact on streamflow in Silver Creek. Glendale Bridge crosses the Big Wood River at the north end of the Dry Bed. Aquifer water levels deepen at the northern margin of the triangle between Bellevue and Glendale Bridge. Between Glendale Bridge and the south end of the Dry Bed, interaction between the Big Wood River and the aquifer is generally limited to perched seepage from the Big Wood River during spring runoff, particularly during years with low water supply. North of Glendale Bridge, groundwater pumping primarily impacts streamflow in the Big Wood River above the Dry Bed. South of Glendale Bridge, groundwater pumping primarily impacts streamflow in Silver Creek, the Big Wood River below the Dry Bed, and/or underflow to the Eastern Snake Plain Aquifer (ESPA). Areas where pumping primarily impacts underflow to the ESPA or the Big Wood River below the Dry Bed where excluded from the curtailment simulation area south of Glendale Bridge.

Silver Creek and its spring-fed tributaries interact with the aquifer upstream of the Sportsman Access gage. Between the gage and the model boundary, Silver Creek is generally perched above the aquifer and streamflow measurements made by the USGS and IDWR indicate gains or losses in this reach are less than the streamflow measurement error. Aquifer water levels deepen significantly in the vicinity of Picabo (Figure 17). Groundwater pumping near the southeastern model boundary primarily impacts underflow to the Eastern Snake Plain Aquifer and has minimal effect on streamflow in Silver Creek.[21] This area was excluded from the curtailment simulation area south of Glendale Bridge.

The location of the confining unit and confined aquifer affect the distribution of the impacts of groundwater pumping. WRV1.1 model simulations[21] show groundwater withdrawals from the confined aquifer have significant in-season impacts to streamflow in Silver Creek, even in the area underlying Willow Creek. Groundwater pumping in the unconfined aquifer in this area would primarily impact streamflow in Willow Creek, but review of available well logs (Attachment A) and the early priority dates of water rights in this area both suggest that wells supplying irrigation water in this area are developed in the confined aquifer. Areas outside of the modeled extent of the confined aquifer in the vicinity of the southwestern model boundary were excluded from the curtailment simulation area south of Glendale Bridge.

The simulation of curtailment indicates that 99% of the predicted in-season benefit to Silver Creek streamflow can be achieved by curtailing 70% of the consumptive groundwater use within the

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[21] In-season transient response functions were calculated for selected model cells to examine the effect of groundwater pumping in the unconfined and confined aquifers on streamflow. Model files and results are provided in the supporting files.

model domain by reducing the area of curtailment to the area south of Glendale Bridge (Figure 17). The predicted benefits to the Big Wood River and the ESPA are reduced significantly by excluding pumping in areas north of Glendale Bridge and along the southeastern and southwestern model boundaries (Figure 18). As with the full model boundary curtailment simulation, a significant portion (67%) of the curtailed water use remains in aquifer storage on October 1, but the predicted July through September increases in Silver Creek streamflow (23 to 28 cfs) are also significant (Table 2).

The simulated curtailment in the areas south of Glendale Road would affect the groundwater supply for approximately 23,000 acres of land, including approximately 4,000 acres where groundwater is the sole source of irrigation water, and approximately 19,000 acres where both groundwater and surface water are sources of irrigation water.

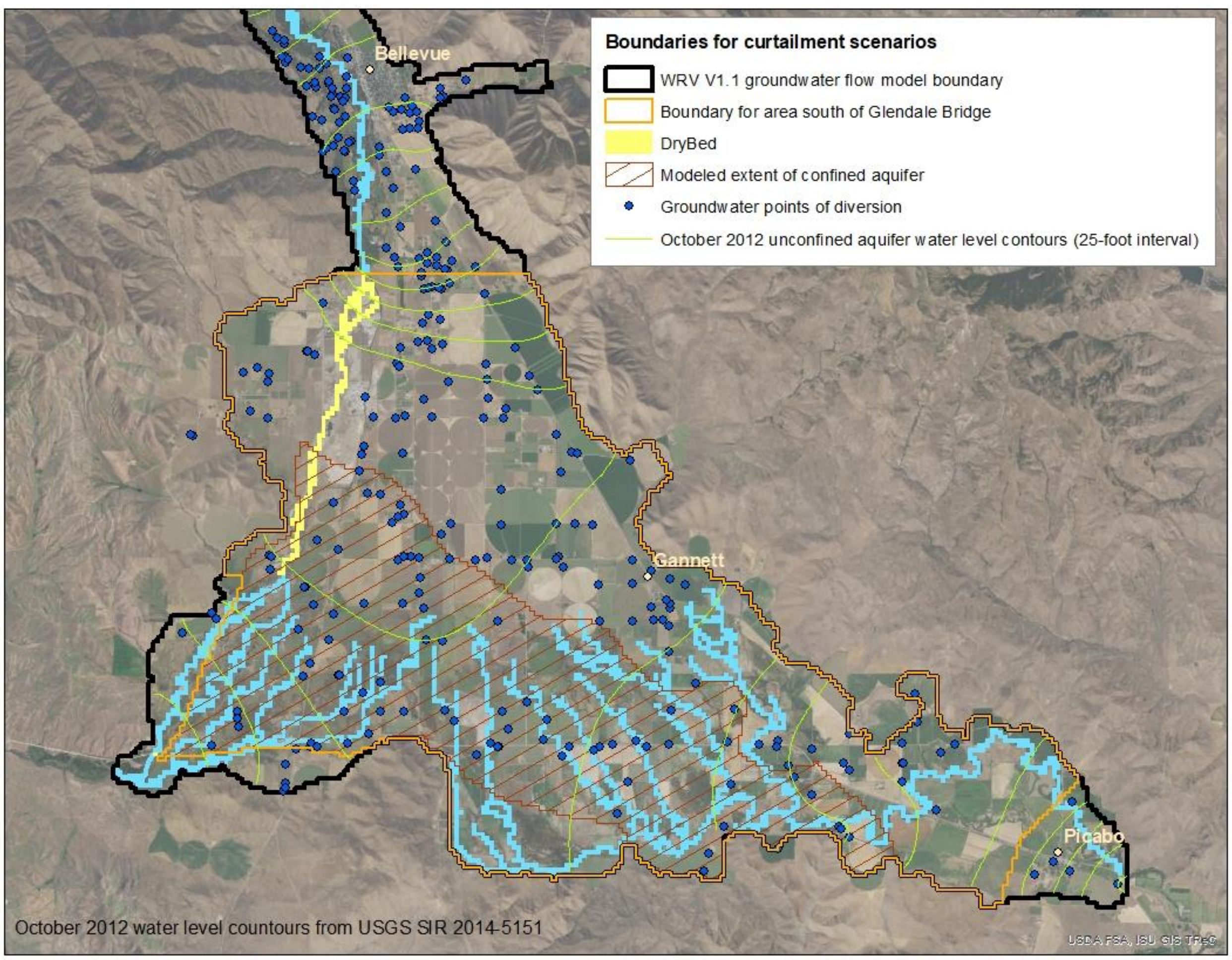

Figure 17. Simulated curtailment area south of Glendale Bridge

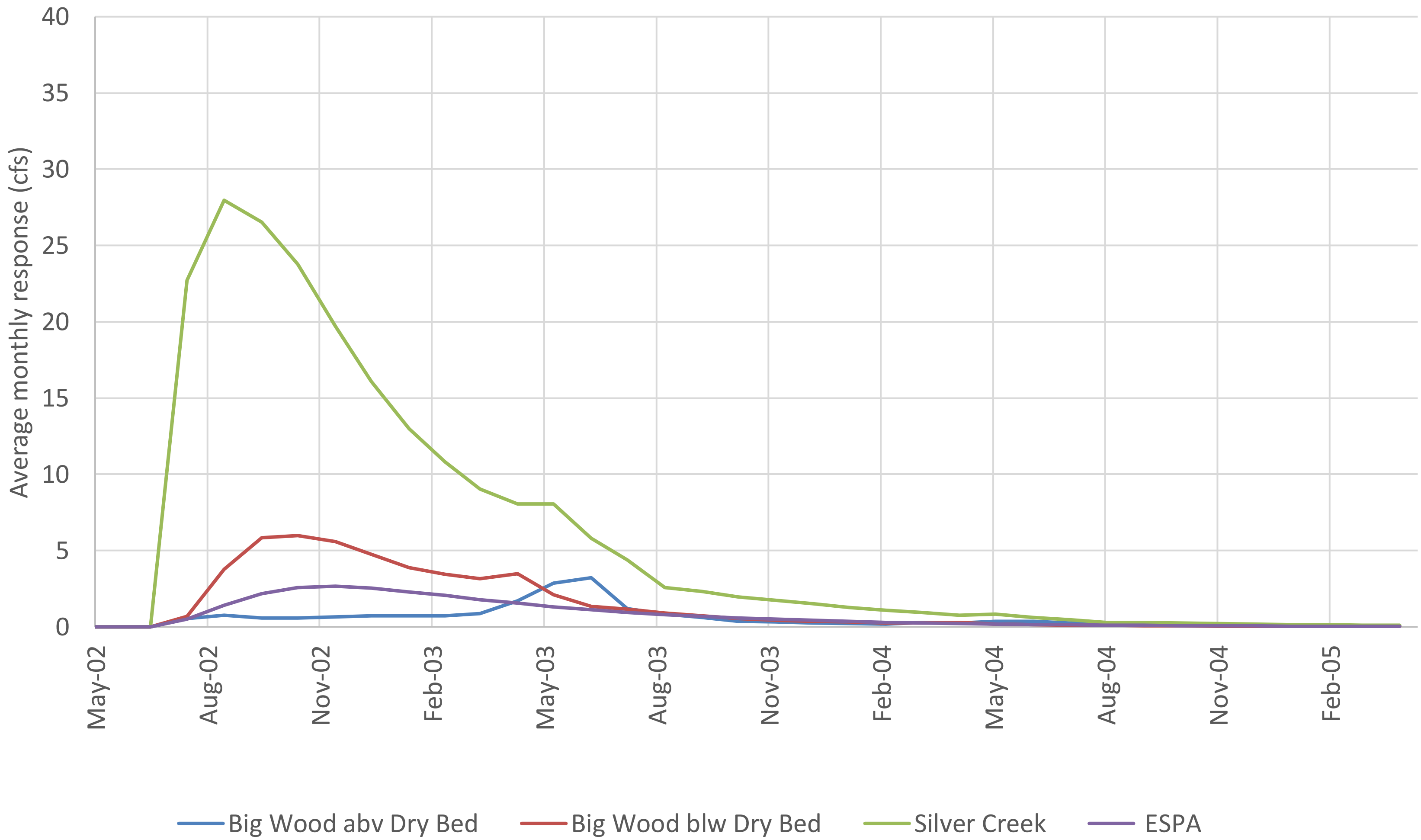

Figure 18. Predicted increase in aquifer discharge resulting from curtailment starting July 1 within the curtailment simulation area south of Glendale Bridge

Table 2. Predicted responses to curtailment starting July 1 within the area south of Glendale Bridge

Month	Curtailed consumptive use	Silver Creek		Big Wood above Dry Bed		Big Wood below Dry Bed		Groundwater underflow to ESPA		Increase in aquifer storage	Model convergence error
	AF	cfs	AF	cfs	AF	cfs	AF	cfs	AF	AF	AF
May	0	0	0	0	0	0	0	0	0	0	0
June	0	0	0	0	0	0	0	0	0	0	0
July	7,214	22.7	1,398	0.5	33	0.7	43	0.5	32	5,706	2
Aug	6,737	28.0	1,720	0.8	47	3.8	231	1.4	87	4,652	0
Sep	3,502	26.5	1,578	0.6	36	5.9	348	2.2	130	1,409	1
Sum	17,453		4,695		116		623		249	11,767	3
	100%		27%		1%		4%		1%	67%	0%

Additional streamflow in Silver Creek may benefit water users at different locations within the Silver Creek and Little Wood River system. As shown in Figure 1, Silver Creek and its tributaries gain water from the Wood River Valley aquifer system upstream of the Sportsman Access gage. Between the Sportsman Access gage and the North Picabo Road Bridge the creek becomes perched above the Wood River Valley aquifer system and periodic streamflow measurements indicate minimal interaction with the aquifer (Wylie, 2019c,[22] Fisher et al. 2016, Wylie, et al., 2019). The USGS also measured no significant seepage loss between the Sportsman Access gage and a location about 1.5 miles downstream of the Highway 20 Bridge in March 2013 (Bartolino, 2014).[23]

Between the WRV1.1 model boundary and Station 10 on the Little Wood River (Figure 19), both Silver Creek and the Little Wood River are perched above the Eastern Snake Plain aquifer system. The Little Wood River above Silver Creek flows intermittently and generally only contributes to the flow below Silver Creek during periods of high surface runoff (Sukow, 2015). During the irrigation season in relatively dry years, canals in the upper Little Wood River valley generally divert the entire flow of the upper Little Wood River. Silver Creek is expected be the only source of water for the Little Wood River at Station 10 during the 2021 irrigation season.

For the 2020 irrigation season, average monthly seepage losses between the Sportsman Access gage and Little Wood River Station 10 were calculated using the USGS recorded streamflow at the Sportsman Access gage and Water District 37 records of streamflow at Little Wood River Station 10, thirty diversions from Silver Creek, and two inflows to Silver Creek (Table 3). Estimated seepage losses range from 16 cfs to 46 cfs and from 20% to 37% of the inflow to the reach. Reliable evaluation of seepage losses is frustrated by measurement uncertainty at the gages, the large number of diversions, and lack of winter-season maintenance and calibration of the Station 10 gage. IDWR is currently working with Water District 37 to improve the future year-round operation and maintenance of the Station 10 gage.

[22] Wylie, A., 2019c, *Seven Silver Creek Flow Measurements Collected at North Picabo Bridge between October 2014 and November 2018*. Idaho Department of Water Resources, 10 p., https://idwr.idaho.gov/files/projects/wood-river-valley/20190627-SilverCreekNrModelBound0619.pdf.

[23] Bartolino, J., 2014, Stream Seepage and Groundwater Levels, Wood River Valley, South-Central Idaho, 2012-2013. U.S. Geological Survey, Scientific Investigations Report 2014-5151, 34 p., https://pubs.usgs.gov/sir/2014/5151/.

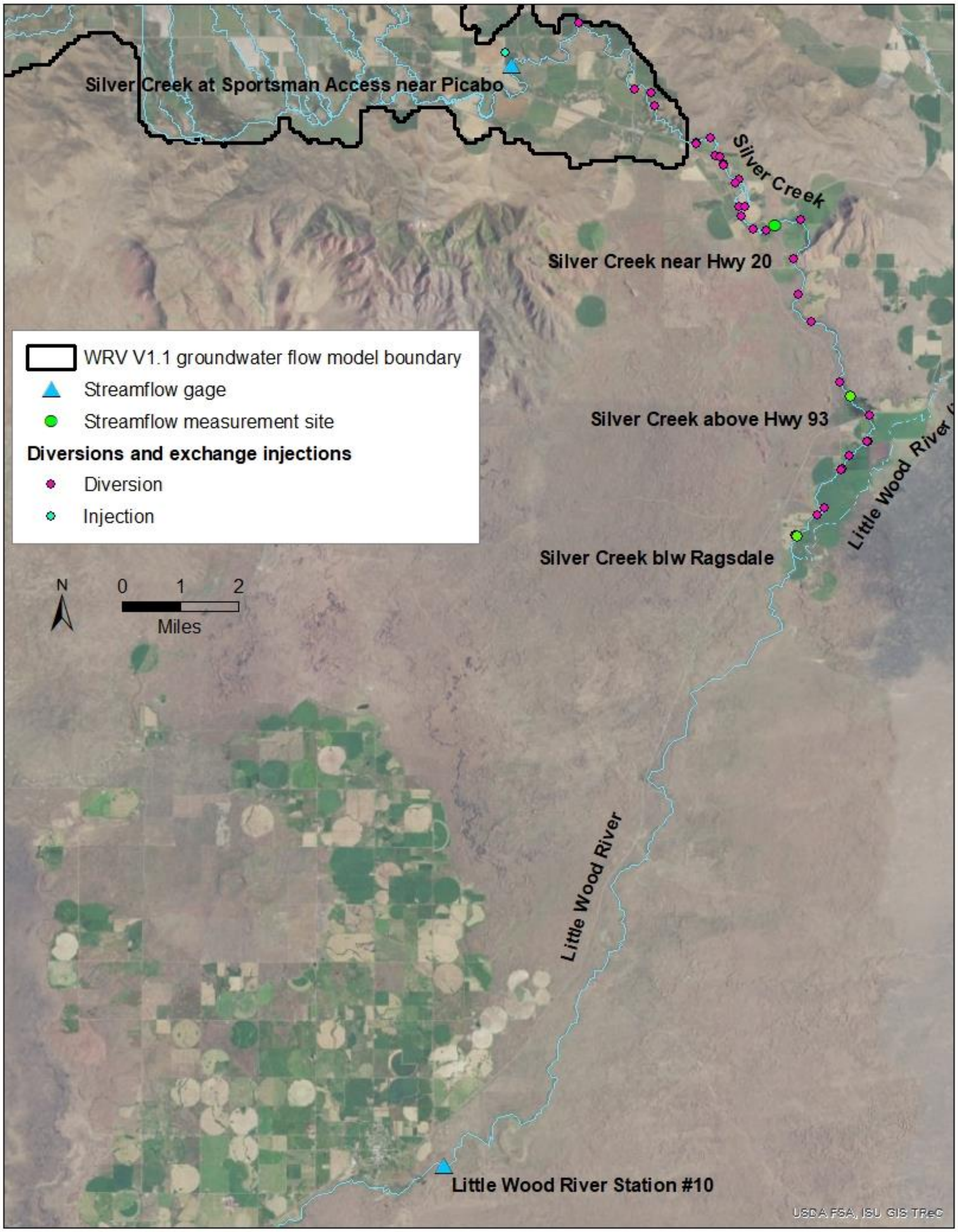

Figure 19. Silver Creek at Sportsman Access to Little Wood River Station 10

Table 3. Calculated seepage losses between Silver Creek at Sportsman Access and Little Wood River Station 10

Month	Inflows			Outflows		Calculated seepage loss (cfs)	% of inflow
	Silver Creek at Sportsman Access (cfs)	Exchange well 16P (cfs)	Little Wood River into Silver Creek 11C (cfs)	Diversions (cfs)	Little Wood River at Station 10 (cfs)		
May-20	118.3	4.9	5.3	31.5	51.2	45.8	36%
Jun-20	109.5	6.5	6.8	33.2	44.1	45.5	37%
Jul-20	83.2	6.4	6.8	35.3	29.5	31.7	33%
Aug-20	68.5	6.3	4.7	35.8	28.0	15.7	20%

As previously mentioned, seepage losses appear to be minimal between the Sportsman Access gage and where Highway 20 crosses Silver Creek. Seepage losses in the vicinity of the Highway 93 Bridge have been identified by water users as a concern, and losses in the range of 7 cfs to 15 cfs have reportedly been measured by Water District 37[24] between sites located approximately 0.5 mile upstream and 2.5 miles downstream of the bridge (Figure 19). IDWR has requested additional information regarding streamflow measurements at these sites, but has not received the data as of the date of this memorandum.

Conclusions

The Wood River Valley aquifer system is hydraulically connected to Silver Creek and its tributaries above the Sportsman Access gage, and consumptive use of groundwater within the Wood River Valley aquifer system has a significant impact on Silver Creek streamflow. Other aquifer systems in Basin 37 do not interact with Silver Creek or the Little Wood River. The WRV1.1 groundwater flow model is the best available tool for evaluating the interaction between groundwater and surface water in the Wood River Valley. The science underlying the development and calibration of WRV1.1 reflects the best knowledge of the aquifer system available at this time.

Curtailing groundwater use beginning July 1 within the WRV1.1 model boundary is predicted to result in increases in Silver Creek reach gain of approximately 23 cfs, 28 cfs, and 27 cfs during the months of July, August, and September (Table 1). Curtailing groundwater use within the reduced area south of Glendale Road delineated in Figure 15 and Figure 17 is predicted to result in similar increases, yielding approximately 99% of the benefit to Silver Creek reach gain while curtailing approximately 70% of the consumptive use within the WRV1.1 model boundary (Table 2, Attachment B).

Uncertainty is inherent in predictions made by all numerical and analytical models. Predictive uncertainty analyses of the WRV1.1 groundwater flow model performed by Wylie (2019b) found uncertainty of +/- 22% of the predicted response with a 95% confidence interval for predictions involving the impact of aquifer stress at selected locations in the Bellevue Triangle on reach gain in Silver Creek. The Wylie (2019b) predictive uncertainty analyses explored the predictive uncertainty associated with 10-month simulations. Because the simulations of curtailment beginning July 1 are shorter 3-month simulations, the predictive uncertainty associated with these predictions may be higher than +/- 22% at a 95% confidence interval.

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[24] BWRGWMAAC, 2020, *Meeting minutes of the Big Wood River Groundwater Management Area Advisory Committee*, December 15, 2020, 3 p., https://idwr.idaho.gov/files/groundwater-mgmt/big-wood-gwma-advisory-comm/20201215-Big-Wood-GWMA-Advisory-Committee-Meeting-Notes.pdf.

The simulated curtailment in the area south of Glendale Road would affect the groundwater supply for approximately 23,000 acres of land, including approximately 4,000 acres where groundwater is the sole source of irrigation water, and approximately 19,000 acres where both groundwater and surface water are sources of irrigation water.

Seepage losses would not be expected to affect delivery of water to senior users upstream of the Highway 20 Bridge. The reach between the Highway 20 crossing of Silver Creek and Little Wood River Station 10 loses water via seepage to the Eastern Snake Plain Aquifer, and seepage losses would be expected to reduce the amount of water that can be delivered to senior users on lower Silver Creek and the Little Wood River to some extent. Reliable estimation of seepage losses in this reach is frustrated by measurement uncertainty associated with the gages, particularly the Station 10 gage, and the large number of diversions from Silver Creek. Gage and diversion records from the 2020 irrigation season suggest seepage losses may be between 20% and 37% of the reach inflow, but there is high uncertainty in this estimate. Streamflow gains to Silver Creek resulting from curtailment of groundwater use can be expected to incur similar rates of seepage loss if conveyed between the Highway 20 Bridge and Station 10. Additional streamflow measurement data collected by Water District 37 or their contractor may help inform the estimation of seepage rates, but was not available to IDWR as of the date of this memorandum.

ATTACHMENT A. SUKOW (2015) STAFF MEMORANDUM

MEMO

State of Idaho
Department of Water Resources
322 E Front Street, P.O. Box 83720, Boise, Idaho 83720-0098
Phone: (208) 287-4800 Fax: (208) 287-6700

Date: August 28, 2015

To: Gary Spackman, P.E., Director

Cc: Sean Vincent, P.G., Hydrology Section Manager

From: Jennifer Sukow, P.E., P.G., Hydrology Section

Subject: Hydrology, hydrogeology, and hydrologic data, Big Wood & Little Wood Water Users Association delivery calls, CM-DC-2015-001 and CM-DC-2015-002

This memorandum responds to the Hydrology, Hydrogeology, and Hydrologic Data section of the Request for Staff Memoranda dated June 12, 2015. The Director requested Department staff review data and information in possession of the Department, and prepare a staff memorandum addressing the following:

1. Any hydrologic or hydrogeologic data or publications collected by or available to the Department that may assist the Director in understanding surface and ground water interactions in the Big and Little Wood River basins.

2. A conceptual description of the interaction between ground water and surface water in the Camas Creek drainage, the Big Wood River drainage, the Silver Creek drainage, the Little Wood River drainage, and any other hydrologic units that may be hydraulically connected to the ground water and surface water in the larger Big Wood River and Little Wood River basins.

3. Identification of diversion records for junior ground water pumping available to the Department.

4. Identification of methods and data available for analyzing consumptive use associated with junior ground water pumping.

5. Identification of any hydrologic or hydrogeologic methods or modeling tools that may be employed in analyzing the impacts of junior ground water pumping on calling senior-priority surface water right holders.

Section 1. Hydrologic or hydrogeologic data or publications

Hydrologic, geologic, and hydrogeologic reports

Hydrology and early irrigation development in the Big and Little Wood River drainages was described by Ross (1900). In 1902, Jay D. Stannard measured gains and losses in the Big Wood River, Silver Creek, and the Little Wood River (Ross, 1902). Between 1920 and 1922, S.H. Chapman discussed hydrology and the interaction of surface and groundwater in early watermaster reports pertaining to the Big Wood River, Silver Creek, and lower Little Wood River (Water Districts 7 & 11, 1920-1922). The Idaho Bureau of Mines and Geology published an early study of the hydrogeology of Camas Prairie (Piper, 1925). The geology of the Magic Reservoir area was described or mapped by Struhsacker et al. (1982), Leeman (1982), and Kauffman and Othberg (2007, 2008).

The U.S. Geological Survey (USGS) published several studies of the hydrology and hydrogeology of the Big Wood River, Little Wood River, Silver Creek, and Camas Creek basins. USGS studies of the Big Wood River basin include Stearns et al. (1938), Jones (1952), Smith (1959), Smith (1960), Schmidt (1962), Moreland (1977), Frenzel (1989), Skinner et al. (2007), Bartolino (2009), Bartolino and Adkins (2012), Hopkins and Bartolino (2013), and Bartolino (2014). USGS studies of the Little Wood River basin include Stearns et al. (1938), Jones (1952) and Smith (1960). The Silver Creek basin was investigated by Stearns et al. (1938), Jones (1952), Smith (1959), Smith (1960), Schmidt (1962), Moreland (1977), Skinner et al. (2007), Bartolino (2009), Bartolino and Adkins (2012), Hopkins and Bartolino (2013), and Bartolino (2014). The Camas Creek basin was investigated by Stearns et al. (1938), Jones (1952), Smith (1960), Walton (1962), Young (1978), and Young et al. (1978).

Publications by other organizations include Idaho Department of Water Resources (IDWR) studies of the Big Wood River area by Castelin and Chapman (1972) and Castelin and Winner (1975), reports describing a hydrologic and stream temperature model constructed for The Nature Conservancy (Loinaz, 2012a; Loinaz, 2012b), and reports describing a groundwater flow model constructed for The Nature Conservancy (Brockway and Kahlown, 1994; Wetzstein and others, 1999; Brown, 2000).

An excellent summary of previous work in the upper Big Wood River and Silver Creek basins is included in Bartolino and Adkins (2012). This report also provides an excellent description of the hydrogeologic framework of the Wood River Valley aquifer system. Bartolino and Vincent (2013) provide a short, concise summary of the hydrology and hydrogeology of the Wood River Valley aquifer system. Bartolino (2014) describes recent USGS investigations regarding groundwater levels and interaction between groundwater and surface water in the Wood River Valley.

The USGS, in collaboration with IDWR, is currently developing a MODFLOW numerical groundwater-flow model of the Wood River Valley aquifer system (Bartolino and Vincent, 2013). The USGS is scheduled to publish the model and supporting documentation in December 2015.

Hydrologic and hydrogeologic data

The USGS and Idaho Power Company (IPCO) collect, or have collected, continuous streamflow data at the sites listed in Table 1. Gage locations are shown in Figure 1. USGS data are available at http://waterdata.usgs.gov/nwis/sw. IPCO data are available at https://www.idahopower.com/OurEnvironment/WaterInformation/StreamFlow/stationList/basinstationList.cfm?selectS=3.

Site Number	Site Name	Dates	Agency
13135500	Big Wood River nr Ketchum	6/1948-9/1971; 4/2011-present	USGS
13135520	North Fork Big Wood River nr Sawtooth NRA HQ	4/2011-present	USGS
13137000	Warm Springs Creek nr Ketchum	1/2011-present	USGS
13137500	Trail Creek at Ketchum	11/2010-present	USGS
13138000	East Fork Big Wood River at Gimlet	10/2010-present	USGS
13139510	Big Wood River at Hailey, total flow	7/1915-present	USGS
13140800	Big Wood River at Stanton Crossing	9/1996-present	USGS
13140900	Willow Creek nr Spring Creek Ranch	6/2000-present	IPCO
13141000	Big Wood River nr Bellevue	7/1911-9/1996	USGS
13141500	Camas Creek nr Blaine	6/1912-present	USGS
13142000	Magic Reservoir nr Richfield (storage)	4/1909-present	USGS
13142500	Big Wood River bl Magic Dam nr Richfield	4/1911-present	USGS
13150430	Silver Creek at Sportsman Access	10/1974-9/2006; 10/2007-present	USGS
13150500	Silver Creek nr Hwy 20 nr Picabo	6/1920-12/1962	USGS
13151000	Little Wood River nr Richfield	1/1911-9/1972	USGS
13151500	Little Wood River at Shoshone	4/1922-12/1959	USGS
13152500	Malad River nr Gooding	3/1916-present	USGS

Table 1. Period of record for continuous recording gaging stations.

Figure 1. USGS and IPCO streamflow gaging stations.

Water District 37 and its predecessors monitor streamflow at additional sites on the Little Wood River and Big Wood River from April through September each year. Bound watermaster reports containing the additional streamflow data are available for inspection at the IDWR State Office (Water Districts 7 & 11, various years, 1920-1970; Water Districts 37 & 37M, various years, 1971-2013). In 2014, IDWR began gaging stage in the Little Wood River year-round at water district station 10 (formerly USGS station 13151000) and at water district station 54 (Figure 2). IDWR reestablished year-round gaging to obtain data on seepage from the Little Wood River to the Eastern Snake Plain Aquifer (ESPA) during the winter months. IDWR has not yet processed the data. Raw stage data are included in the supplemental files accompanying this memorandum.

Figure 2. Watermaster gaging stations with year-round gages installed by IDWR.

Surface water diversions from the Big Wood River, Silver Creek, and the lower Little Wood River have been recorded by water districts since 1920. Bound watermaster reports are available for inspection at the IDWR State Office (Water Districts 7 & 11, various years, 1920-1970; Water Districts 37 & 37M, various years, 1971-2013).

Groundwater level measurements collected by the USGS are available at http://nwis.waterdata.usgs.gov/id/nwis/gwlevels. Groundwater level measurements collected by both the USGS and IDWR are stored in IDWR's database and are available at http://idwr.idaho.gov/hydro.online/gwl/. Bartolino (2014) provides a recent evaluation of groundwater level measurements in the Wood River Valley aquifer system. Bartolino (2014) compared water level measurements collected in over 90 wells in October 2006 and October 2012. Bartolino (2014) also evaluated long term water level trends at five wells measured semi-annually. IDWR increased the frequency of water level monitoring at representative sites in the Wood River Valley between 2012 and 2014.

IDWR staff compiled selected groundwater level measurements in the Camas Prairie aquifer system for this memorandum. Sixteen Camas Prairie wells were measured at least 50 times by the USGS or IDWR between 1944 and 2013. Well locations and selected hydrographs are shown on Attachment A[1].

Well drillers' logs filed with IDWR are available for numerous wells in the Wood River Valley and Camas Prairie. A shapefile of approximate well locations is available at http://idwr.idaho.gov/GeographicInfo/GISdata/wells.htm. Drillers' logs are available at http://idwr.idaho.gov/WaterManagement/WellInformation/DrillerReports/dr_default.htm.

Section 2. Conceptual description of interaction between groundwater and surface water

Overview

Aquifers underlying the Wood Rivers area include the Camas Prairie aquifer system, the Wood River Valley aquifer system, the ESPA, and small local aquifers in the upper Little Wood River valley. Figure 3 illustrates the general location of the primary aquifers and denotes stream reaches where gains from groundwater or losses to groundwater have been documented. Figure 3 also denotes perched reaches, where the rivers lose water to groundwater at a rate independent of groundwater elevation. The delineation of gaining, losing, and perched reaches is approximate. Transitions between gaining, losing, and perched reaches may move upstream or downstream seasonally and year to year with fluctuations in streamflow, aquifer recharge, and groundwater withdrawals. Figure 3 also shows intermittent reaches of the Big and Little Wood Rivers. These reaches generally lose water to the aquifer when water is flowing in the rivers, but are dry during low water periods because of diversions and/or seepage losses.

[1] Water level data used to generate hydrographs are provided in supplemental files accompanying this memorandum.

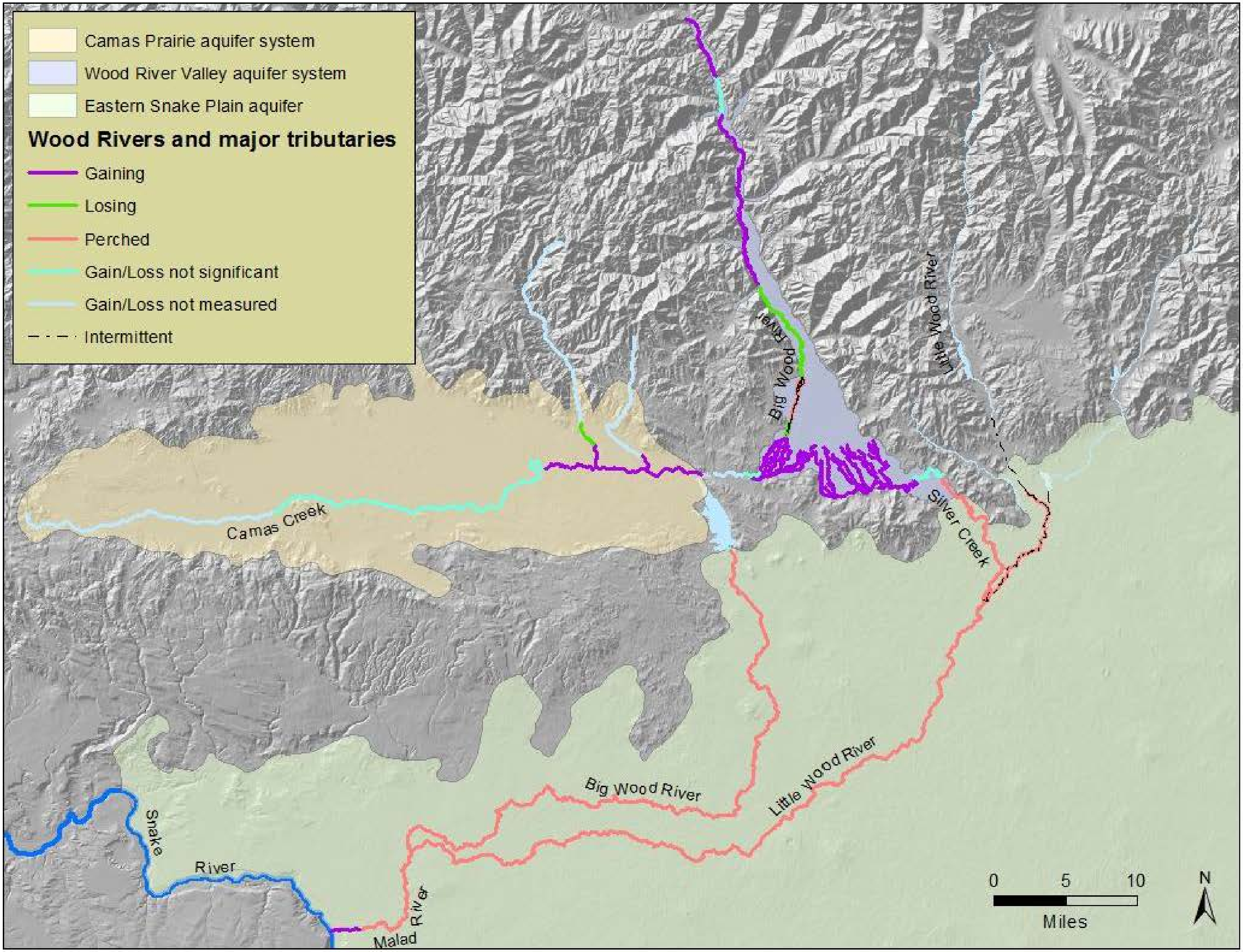

Figure 3. Generalized location of aquifers and interaction with surface water.

Interaction between Camas Prairie aquifer system, Camas Creek, and Magic Reservoir

USGS scientists investigated the hydrogeology of Camas Prairie in 1957 (Walton, 1962) and in 1977 (Young, et al., 1978; Young, 1978). The Camas Creek drainage basin is an eastward trending intermontane basin of approximately 730 square miles. The principal aquifers in the basin are located beneath the Camas Prairie in a structural depression approximately 40 miles long and 8 miles wide. The basin is bounded by mountains and uplands on the north, west, and south. Camas Creek flows eastward through the basin, joining the Big Wood River at Magic Reservoir (Figure 4).

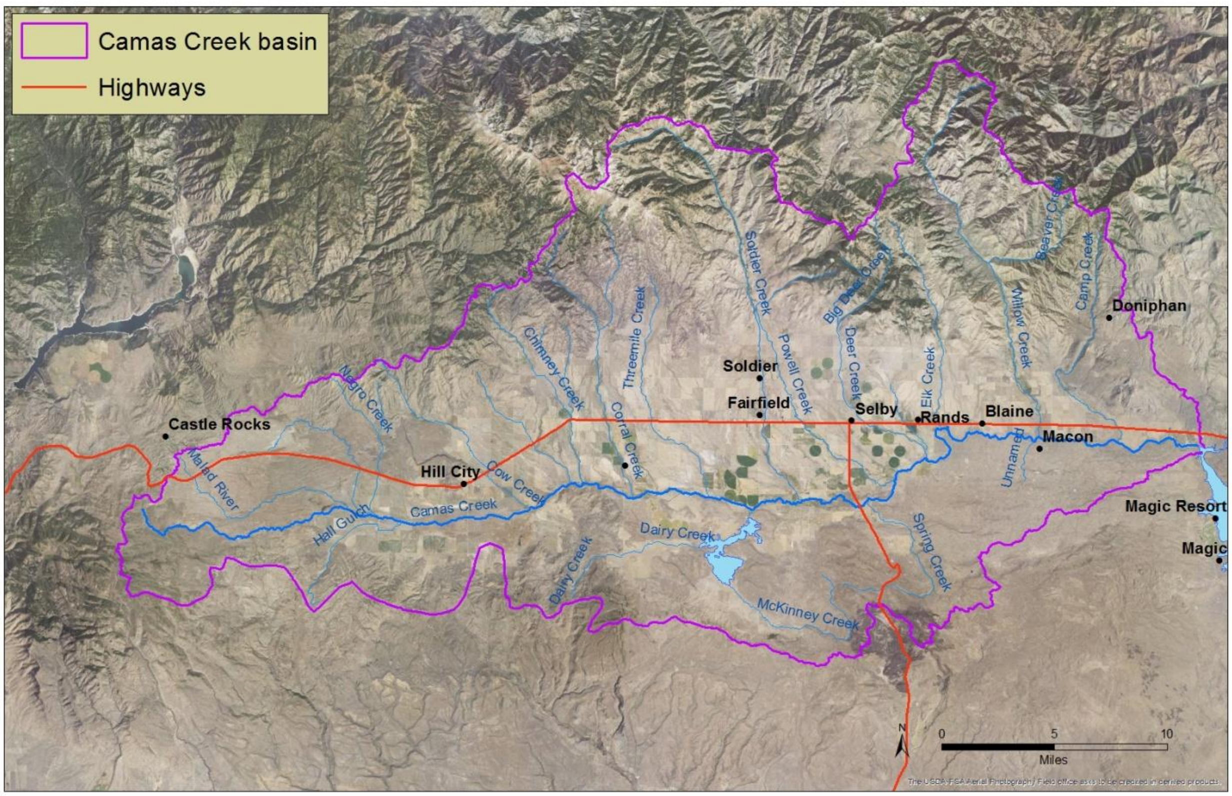

Figure 4. Camas Prairie hydrography

During the Pliocene and Pleistocene periods (between approximately 10,000 and 5 million years ago) lava flows intermittently blocked the basin's outlet to the east, resulting in deposition of valley fill sediments exceeding thicknesses of 500 feet in some locations. The valley fill includes alluvial (stream-deposited) and lacustrine (lake-bed) sediments. The alluvial sediments consist of interbedded clay, silt, sand, and gravel. The lacustrine deposits consist of silt and clay. Snake River Group basalt is exposed along the eastern, western, and southern margins of the

Camas Prairie. The basalt consists of a sequence of separate lava flows, and has permeable zones along contacts between lava flows, joints, and other crevices.

The principal aquifers in the Camas Creek basin are composed of sand and gravel within the valley fill sediments and Quaternary basalt of the Snake River Group. Walton (1962) and Young (1978) describe a moderately permeable shallow unconfined aquifer to depths of about 40 feet. Between depths of approximately 40 and 120 feet, silt and clay lenses within the alluvial valley fill result in locally confined conditions. Between depths of approximately 120 feet and 210 feet, low permeability lake-bed sediments form a significant confining unit with an average thickness of 90 feet. The confining unit is underlain by two zones of permeable sand and gravel. The upper zone, referred to by Walton (1962) as the "upper artesian aquifer" averages approximately 50 feet in thickness. The lower zone, referred to by Walton (1962) as the "lower artesian aquifer" occurs at the base of the valley fill and averages approximately 85 feet in thickness. Walton (1962) also noted confined conditions within the basalt. Most irrigation wells in the Camas Prairie withdraw water from the confined aquifers. In 1957, artesian pressure in confined aquifers beneath much of the Camas Prairie was sufficient to cause wells to flow at ground surface (Walton, 1962). By 1977, Young (1978) noted declines in pressure head in response to increased pumping for irrigation.

The Camas Prairie aquifer system is recharged primarily by direct infiltration of precipitation and seepage from streams. Groundwater beneath the Camas Prairie generally flows from recharge areas along the foot of the Soldier Mountains and Mount Bennett Hills toward Camas Creek, then eastward toward the basin outlet (Walton, 1962; Young, 1978). The confining units are leaky and allow upward flow of water from the deeper confined aquifers to the shallow unconfined aquifer. At the east end of the Camas Prairie, where Willow Creek and Camas Creek are incised into the basalt, groundwater discharges to the creeks and possibly the Camas Creek arm of Magic Reservoir (Figure 5). The elevation of Camas Creek drops from approximately 4,974 feet above mean sea level at the Elk Creek confluence to approximately 4,800 feet at the location of Young's Station 14. Walton (1962) noted, "*Water-level data for wells at Magic show that most of the underflow from the prairie discharges into Camas Creek or Magic Reservoir. Little, if any, of the underflow reaches the Snake River Plain*."

Geologic mapping in the vicinity of Magic Reservoir (Kauffman and Othberg, 2007; 2008) and the relatively small to negligible underflow from the Wood River Valley aquifer system to Magic Reservoir (Smith, 1959; Brockway and Kahlown, 1994; Bartolino and Adkins, 2012) suggest there is not a significant hydraulic connection between the Camas Prairie and Wood River Valley aquifer systems. While both aquifer systems contribute to the inflow of Magic Reservoir, groundwater levels in the Camas Prairie aquifer system are not expected to affect groundwater levels in the Wood River Valley aquifer system and vice versa.

Figure 5. Camas Creek measurement sites on the east end of Camas Prairie.

Both Walton (1962) and Young (1978) performed seepage studies to evaluate the interaction between groundwater and streamflow in the Camas Prairie. In November 1957, Walton (1962) measured a 1.3 cfs gain from groundwater to Camas Creek between the Soldier Creek confluence and Willow Creek confluence. A gain of 4 cfs from groundwater was measured in the vicinity of lower Willow Creek. Walton (1962) did not attempt to measure gains in Camas Creek between the confluence with Willow Creek and Magic Reservoir.

In May 1977, Young (1978) measured small reach losses to groundwater from Camas Creek between Cow Creek and Elk Creek. Corral Creek, Soldier Creek, Deer Creek, and upper Willow Creek also lost water to the aquifer. Between the confluence with Elk Creek and Magic Reservoir, where Camas Creek is incised into basalt, the creek gained approximately 5 cfs from groundwater. Total groundwater discharge to lower Camas, Willow, and Camp Creeks at the east end of the Camas Prairie was slightly more than 10 cfs. Young (1978) did not measure downstream of Station 14 (Figure 5), which was located near the upper extent of Magic Reservoir backwater. Additional groundwater discharge may occur directly to Magic Reservoir.

The USGS has one active stream gaging station on Camas Creek. Discharge measurements at Station 13141500, Camas Creek near Blaine (Figure 5) began in June of 1912. Between 1912 and 1944, data were not collected during the winter months. Year-round operation of the gaging station began in 1945. The gaging station is located downstream of the confluence with Willow Creek and measured streamflow includes surface runoff and groundwater discharge to lower Willow Creek and part of Camas Creek. Flow may be affected by upstream diversions of surface water during the irrigation season. During periods with little or no surface runoff, discharge from the Camas Prairie aquifers maintains the streamflow at the gage site (Young, 1978). Monthly average discharge measured at the gage site between 1945 and 2014 ranged from 1.3 cfs in June 1992 to 3,300 cfs in April 1952. Between July and February, flow at the gage site is commonly between 2 and 50 cfs. Additional groundwater discharge to Camp Creek and Camas Creek occurs downstream of the gage site. In May 1977, Young, et al. (1978) measured a reach gain of 5 cfs from groundwater to Camas Creek between the gage site and Magic Reservoir, and an inflow of 1 cfs from Camp Creek. Approximately half of the groundwater reach gains measured in May 1977 occurred downstream of the Camas Creek gage. Additional groundwater discharge may occur directly to Magic Reservoir downstream of the location measured by Young et al. (1978).

Water District 37 currently determines inflow from Camas Creek to Magic Reservoir using the flow measured at the Camas Creek gage. Aquifer discharge to the creek or reservoir downstream of the gage is not included in this measurement. In 1922, the watermaster S.H. Chapman reported adding 20 cfs to the calculation of Magic Reservoir inflow to account for "*normal gain in the reservoir section as found from past investigation*." This practice apparently continued for decades (Lakey, 2015), but was abandoned prior to the tenure of the current watermaster (Kevin Lakey, personal communication).

USGS studies performed by Walton (1962), Young (1978), and Young et al. (1978) document the interconnection between the Camas Prairie aquifer system and streamflow in lower Camas Creek. The seepage survey described in Young (1978) and Young et al. (1978) found a significant portion of the aquifer discharge to Camas Creek occurs downstream of the USGS gage on Camas Creek. This portion of the aquifer discharge is not measured and is not included in Water District 37's calculation of inflow to Magic Reservoir.

Interaction between Wood River Valley aquifer system and surface water

The hydrogeologic framework of the Wood River Valley aquifer system is described in detail by Bartolino and Adkins (2012). The primary aquifer system is composed of alluvial sediments and basalt. The aquifer system includes an unconfined aquifer underlying the entire valley and a deeper confined aquifer present only in the southwestern portion of the valley. Sediment thicknesses range from less than a foot at the margins of tributary valleys to about 350 feet in the central Bellevue fan. Bartolino and Vincent (2013) provide a summary of the hydrogeologic framework and observed hydrologic trends.

The Wood River Valley aquifer system interacts with the Big Wood River, Silver Creek, and tributary streams (Figure 3). Between the confluence with the North Fork of the Big Wood River and Hailey, the Big Wood River generally gains water from the aquifer (Bartolino and Adkins, 2012; Bartolino, 2014). Between Hailey and Black Slough, the Big Wood River loses water to the aquifer. Between Glendale Road and Black Slough, the river is perched above the aquifer and is typically dry part of the summer. Between Black Slough and Willow Creek, the river gains water from the aquifer via seeps and tributary springs. Willow Creek, which enters the Big Wood River below the Stanton Crossing gage station, is fed primarily by the aquifer though seeps and tributary springs. Figure 6 shows the location of springs identified on USGS topographic maps.

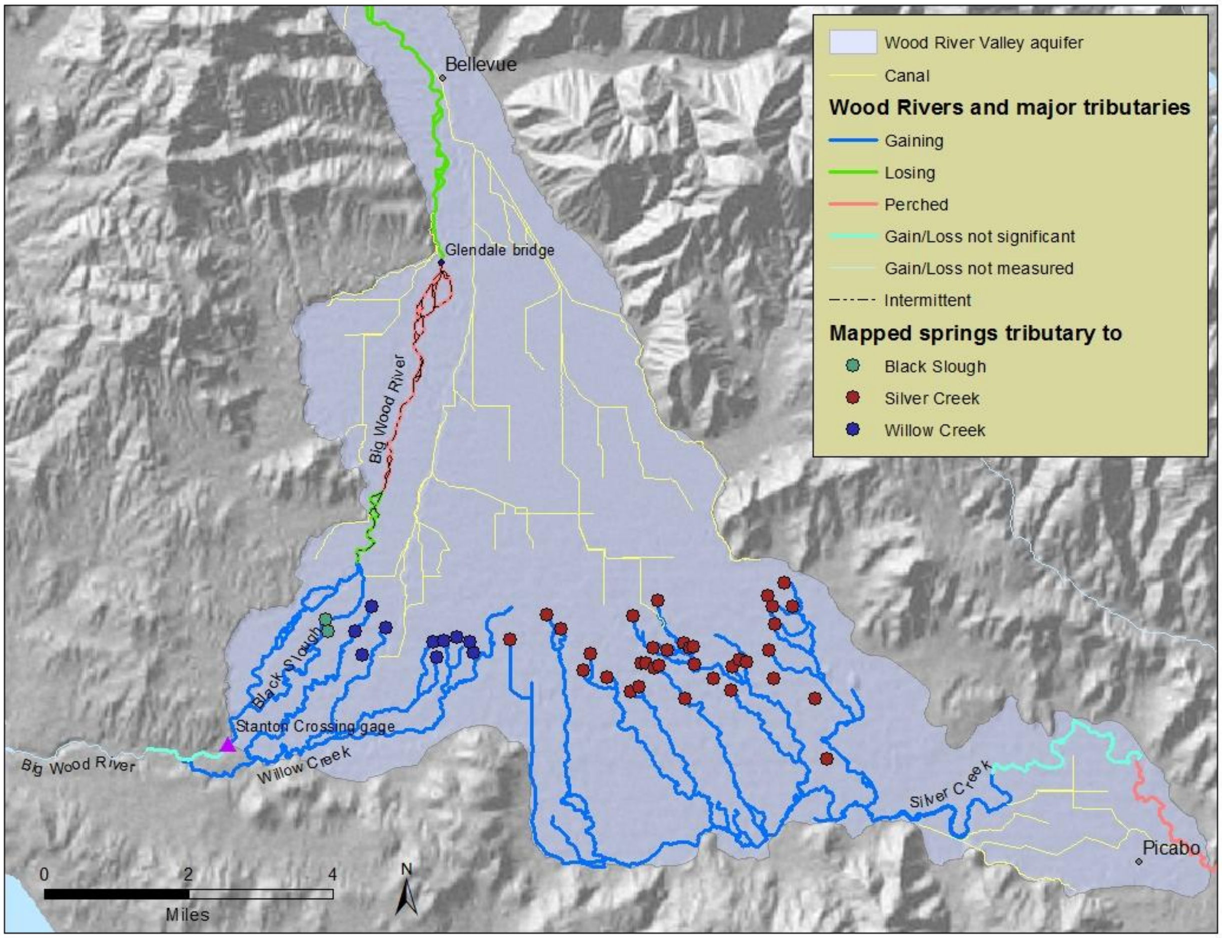

Figure 6. Mapped springs tributary to the Big Wood River and Silver Creek

Underflow beneath the Big Wood River between Stanton Crossing and Magic Reservoir appears to be negligible because of shallow, low-permeability bedrock (Bartolino and Adkins, 2012). Water District 37 determines inflow from the Big Wood River to Magic Reservoir by summing measured streamflow in the Big Wood River at Stanton Crossing and measured streamflow in Willow Creek (Kevin Lakey, personal communication). During high flow periods, both surface water flow and aquifer discharge contribute to the inflow. During low flow periods, Water District 37 diverts the entire flow of the Big Wood River into the Baseline Bypass Canal. While water can be returned from the Baseline Bypass Canal to the Big Wood River, the entire flow is typically diverted by senior water users until October. During low flow periods, aquifer discharge to springs and seeps is the primary source of the inflow from the Big Wood River to Magic Reservoir.

Discharge from the Wood River Valley aquifer system is the primary source of water for Silver Creek. Direct precipitation and snowmelt provide some additional water seasonally. Figure 6 shows the location of mapped springs emanating from the aquifer to form the tributaries of Silver Creek.

Throughout the year, groundwater elevation in the Wood River Valley aquifer affects discharge to seeps and springs feeding the Big Wood River below Black Slough, Willow Creek, and Silver Creek. Because the impacts of aquifer recharge and withdrawals propagate outward radially from the location of the applied stress, recharge or withdrawal at a single location within the aquifer affects discharge to springs tributary to both the Big Wood River and Silver Creek. Groundwater elevation and corresponding aquifer discharge to seeps and springs is influenced by a number of factors, including, but not limited to:

- volume of seepage from the Big Wood River recharging the aquifer between Hailey and Black Slough,
- volume of irrigation diversions from the Big Wood River and corresponding volume of aquifer recharge via canal seepage and incidental infiltration,
- volume of streamflow in the Big Wood River at Hailey available for riverbed seepage and diversions,
- volume of groundwater consumptively used for irrigation of agricultural fields and landscaping,
- volume of evapotranspiration from wetlands and riparian vegetation.

Groundwater elevation decreases rapidly where the Wood River Valley aquifer system discharges into the ESPA, and Silver Creek is perched above the ESPA (Figure 3). Several researchers have estimated the volume of underflow from the Wood River Valley aquifer system to the ESPA. Estimates range from 4,000 AF/yr (Bartolino and Adkins, 2012) to 53,000 AF/yr

(Garabedian, 1992). The Bartolino and Adkins (2012) estimate is based on more data than was available to prior researchers, and is likely the best estimate of underflow to the ESPA.

Interaction between the ESPA and Big and Little Wood Rivers

The Big and Little Wood Rivers and the upper Malad River are perched above the ESPA (IDWR, 2013). Depth to groundwater in the vicinity of these rivers generally exceeds 50 feet. The Big and Little Wood Rivers and the upper Malad River lose water to the ESPA via riverbed seepage, but the rate of seepage is independent of aquifer water level. The lower Malad River becomes hydraulically connected to the ESPA where the river enters an incised canyon approximately 2 miles before the confluence with the Snake River (Figure 3). The ESPA discharges large volumes of water to the lower Malad River (IDWR, 2013). Changes in water levels and groundwater use within the ESPA will affect flow in the lower Malad River and Snake River, but will not significantly affect streamflow in the Big and Little Wood Rivers.

Interaction between the Little Wood River and small local aquifers in the upper valley

Upstream of the confluence of Silver Creek with the Little Wood River, the Little Wood River is generally dry except during periods of high surface runoff (Water Districts 7 and 11, 1922; Jones, 1952; Claire, 2005; BOR 2010). East Canal and West Canal, below Little Wood River dam divert the entire flow of the Little Wood River during the irrigation season, and most non-irrigation season flow is stored in the reservoir. The entire flow of Fish Creek is similarly diverted or stored (Jones, 1952).

Small local aquifers in the upper Little Wood valley may interact with the upper Little Wood River and tributary creeks, but are not expected to affect streamflow in the Little Wood River downstream of the confluence with Silver Creek when the channel is dry between the East Canal diversion and Silver Creek. Because surface water supply shortages in the Little Wood River are not expected to occur during peak runoff, groundwater use in the upper Little Wood River valley does not appear to be relevant to the Little Wood Water Users Association delivery call. Water levels and groundwater use in upper Little Wood valley aquifers will affect groundwater underflow from the Little Wood basin into the ESPA and discharge from the ESPA to the Snake River and tributary springs, including the lower Malad River.

Section 3. Identification of diversion records for junior ground water pumping available to the Department

Groundwater use in the Wood River Valley

Prior to 2013, most groundwater diversions in the Wood River Valley were not measured or recorded. Water District 37 regulated and recorded a few groundwater diversions north of Bellevue. Water District 37M regulated and recorded exchange well diversions conveyed through Silver Creek. These data are included in the watermaster reports (Water Districts 7 & 11, various years, 1920-1970; Water Districts 37 & 37M, various years, 1971-2013). Larger municipal water providers in the Wood River Valley measure and record their diversions for their own use. Prior to 2013, municipal diversions were not reported to the water district, but municipal providers did submit monthly diversion data to the USGS to assist with development of the Wood River Valley Groundwater Flow Model. These data will be included in the model data sets when the USGS publishes the model.

In 2013, water users began installing flowmeters to comply with a measuring device order, and Water District 37 began recording annual groundwater diversions in the Wood River Valley. Data collected for 2013 and 2014 are stored in IDWR's Water Management Information System (WMIS) (https://www.idwr.idaho.gov/apps/wm/WMIS/). Many groundwater diversions in the Wood River Valley were still unmeasured in 2013 and 2014.

Unmeasured groundwater diversions from the Wood River Valley from 1995 through 2010 are being estimated for development of the Wood River Valley Groundwater Flow Model. Estimated monthly groundwater diversions are calculated using evapotranspiration (ET), precipitation, surface water diversion data, and estimated irrigation efficiency. ET and precipitation data are used to calculate irrigation water demand within subareas of the model boundary. In areas served only by groundwater, consumptive use of groundwater is assumed to be equal to the irrigation water demand and groundwater diversions are assumed to be equal to the irrigation water demand divided by irrigation efficiency. In areas served by both surface water and groundwater, the portion of the irrigation demand met by surface water is estimated by deducting canal seepage and irrigation inefficiency from recorded surface water diversions. The remaining irrigation demand not met by surface water is assumed to be met by groundwater. Because the irrigation efficiency is unknown, it is an adjustable parameter during calibration of the groundwater flow model. Estimated groundwater diversions used to calibrate the groundwater flow model will be included in the model data sets when the USGS publishes the model.

Groundwater use on the Camas Prairie

Prior to 1923, groundwater use on the Camas Prairie was limited to a few wells used for stockwater and domestic water supply. Early agriculture on the Camas Prairie consisted primarily of non-irrigated wheat (Piper, 1925; Walton, 1962). Between 1923 and 1924, about 50 deep wells were drilled into the upper artesian aquifer (Walton, 1962). Flowing wells developed during this time period yielded between 2 and 100 gallons per minute (gpm). Total groundwater diversions in 1924 were estimated to be approximately 600 acre-feet (AF). Groundwater development increased in the early 1950s. In 1957, Walton (1962) estimated groundwater withdrawals for irrigation and municipal use were approximately 1,350 AF. Walton (1962) also performed an inventory of flowing wells, and estimated the total discharge from flowing wells and springs was about 200 AF.

Another significant increase in groundwater withdrawals for irrigation occurred between 1974 and 1977 (Young, 1978). In 1977, Young (1978) quantified groundwater use using totalizing flowmeters, discharge measurements, power records, and estimates of municipal use. Groundwater withdrawals for irrigation and municipal use were approximately 9,500 AF in 1977, approximately seven times the estimated 1957 withdrawals.

In 2014, groundwater withdrawals reported in the Water District 37B Watermaster's Report (Kramer, 2015) total approximately 13,800 AF, an increase of approximately 45% over the 1977 withdrawals. In 2014, most of the wells were measured using totalizing flow meters. Some withdrawals were determined using power consumption coefficients. A few small diversions were estimated. The watermaster did not report the number of acres irrigated by groundwater in 2014.

Water right priority dates and cumulative maximum diversion rates shown in Figure 7 are generally consistent with the periods of groundwater development described by Walton (1962) and Young (1978). Water right records[2] suggest much of the groundwater development in the Camas Creek basin occurred between 1968 and 1979.

[2] Water right priority dates and diversion rates were extracted from IDWR's database on April 21, 2015. Data are provided in supplemental files accompanying this memorandum.

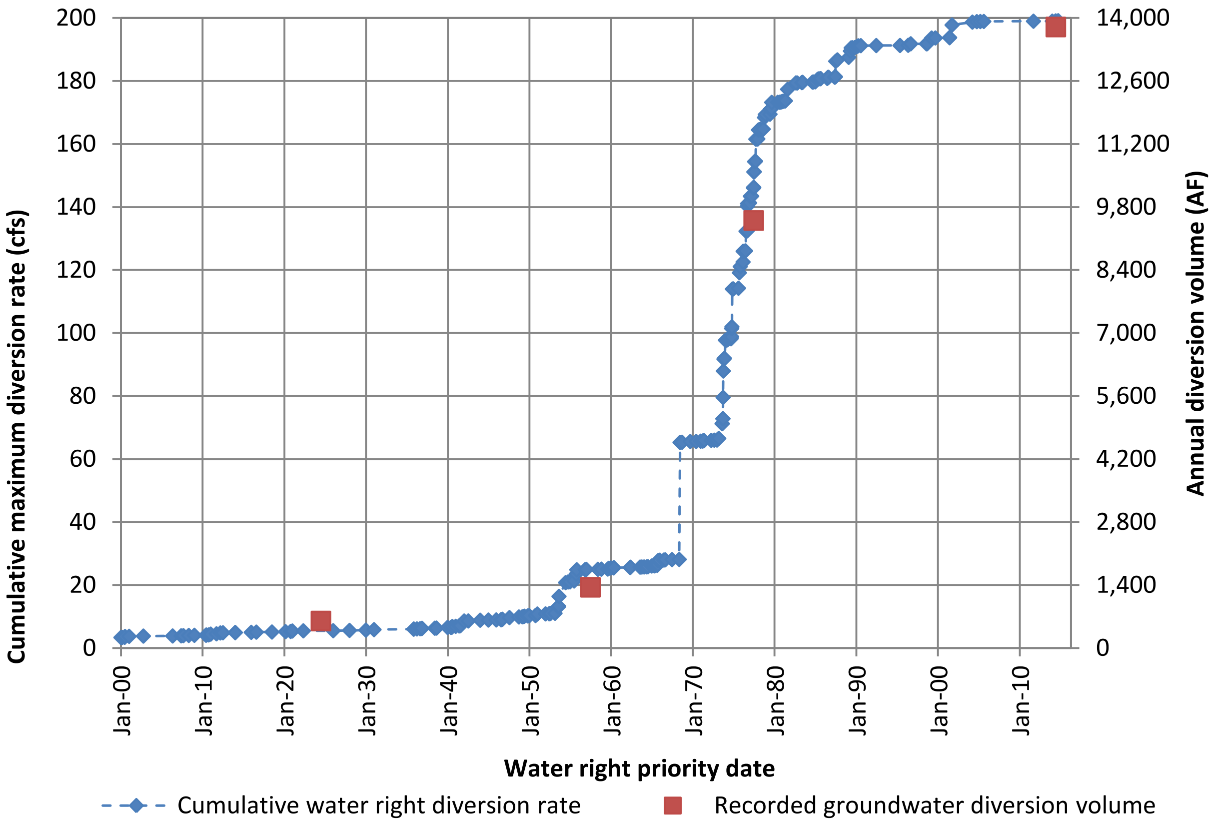

Figure 7. Cumulative maximum groundwater right diversion rate and recorded groundwater pumping in the Camas Creek basin.

Section 4. Identification of methods and data available for analyzing consumptive use associated with junior groundwater pumping

Wood River Valley

As discussed in the previous section, consumptive use associated with groundwater pumping in the Wood River Valley is being estimated for development of the Wood River Valley Groundwater Flow Model. Consumptive use is being calculated monthly for 1995 through 2010 using ET, precipitation, and surface water diversion data, and modeled irrigation efficiency. The data sets, programming code used to calculate groundwater demand, and estimated groundwater diversions will be included with the model when it is published by the USGS.

Camas Prairie

Consumptive use associated with groundwater pumping from the Camas Prairie aquifer system can be estimated from ET, precipitation, and water right place of use. ET rasters generated using

Mapping EvapoTranspiration at High Resolution and Internalized Calibration (METRIC) are available for the irrigation seasons of 1996, 2000, 2002, 2006, 2008, 2009, 2010, and 2011. Raster files are available at http://idwr.idaho.gov/ftp/gisdata/Spatial/Projects/METRIC/. Because METRIC ET does not assume ideal growing conditions nor require knowledge of crop type and management, use of METRIC ET to quantify irrigation season ET is generally preferable to use of other ET data sources such as ET Idaho. Winter ET varies less with crop type. Winter ET data are available from ET Idaho for the Fairfield Agrimet station, Fairfield National Weather Service (NWS) station, and Hill City NWS station (http://data.kimberly.uidaho.edu/ETIdaho/). Annual and monthly precipitation rasters are available from the PRISM Climate Group at Oregon State University (http://www.prism.oregonstate.edu/). Precipitation data for the Fairfield Agrimet station, Fairfield NWS station, and Hill City NWS station are available from ET Idaho (http://data.kimberly.uidaho.edu/ETIdaho/). Water right place of use data are available from IDWR at http://idwr.idaho.gov/GeographicInfo/GISdata/water_rights.htm.

Consumptive use associated with groundwater pumping from the Camas Prairie aquifer system in 2014 can also be estimated from groundwater pumping records (Kramer, 2015) by assuming a reasonable value for irrigation efficiency. Some information on surface water availability for mixed source lands is also provided in the 2014 Watermaster's Report.

Section 5. Identification of any hydrologic or hydrogeologic methods or modeling tools that may be employed in analyzing the impacts of junior ground water pumping on calling senior-priority surface water right holders

Wood River Valley

IDWR staff anticipates the impact of changes in groundwater use in the Wood River Valley can be simulated with the Wood River Valley Groundwater Flow Model after the model is published by the USGS. The Wood River Valley Groundwater Flow Model is a mathematical approximation of the aquifer developed using the numerical model program MODFLOW-USG (Panday et al., 2013), which is freely available to the public at http://water.usgs.gov/ogw/mfusg/. Numerical models are recognized by the USGS as the most robust approach for analyzing the effects of groundwater pumping on streamflow (Barlow and Leake, 2012). The model is expected to predict impacts of changes in consumptive groundwater use on aquifer discharge to the Big Wood River, Willow Creek, Silver Creek, and the ESPA.

Camas Prairie

Because the recognized outlets for net groundwater discharge from the Camas Prairie are limited to ET and discharge to Camas Creek and Magic Reservoir, the impacts of changes in groundwater use on inflow to Magic Reservoir are equal to the change in consumptive use at steady state. Analytical or numerical modeling is not needed to quantify the impacts of consumptive groundwater use at steady state.

Analytical methods could be employed to estimate the seasonal timing of the impacts, but will require several simplifying assumptions regarding aquifer properties and geometry. Predictions of timing are highly dependent on hydraulic conductivity and the coefficient of storage. A wide range of predictions can be generated using the range of reasonable assumptions for hydraulic conductivity and coefficients of storage applicable to the Camas Prairie aquifer system.

Because seasonal measurements of aquifer discharge to lower Camas Creek and Magic Reservoir are not available to correlate changes in aquifer discharge with changes in groundwater use, there are not sufficient data available to calibrate a numerical model to predict the timing of impacts.

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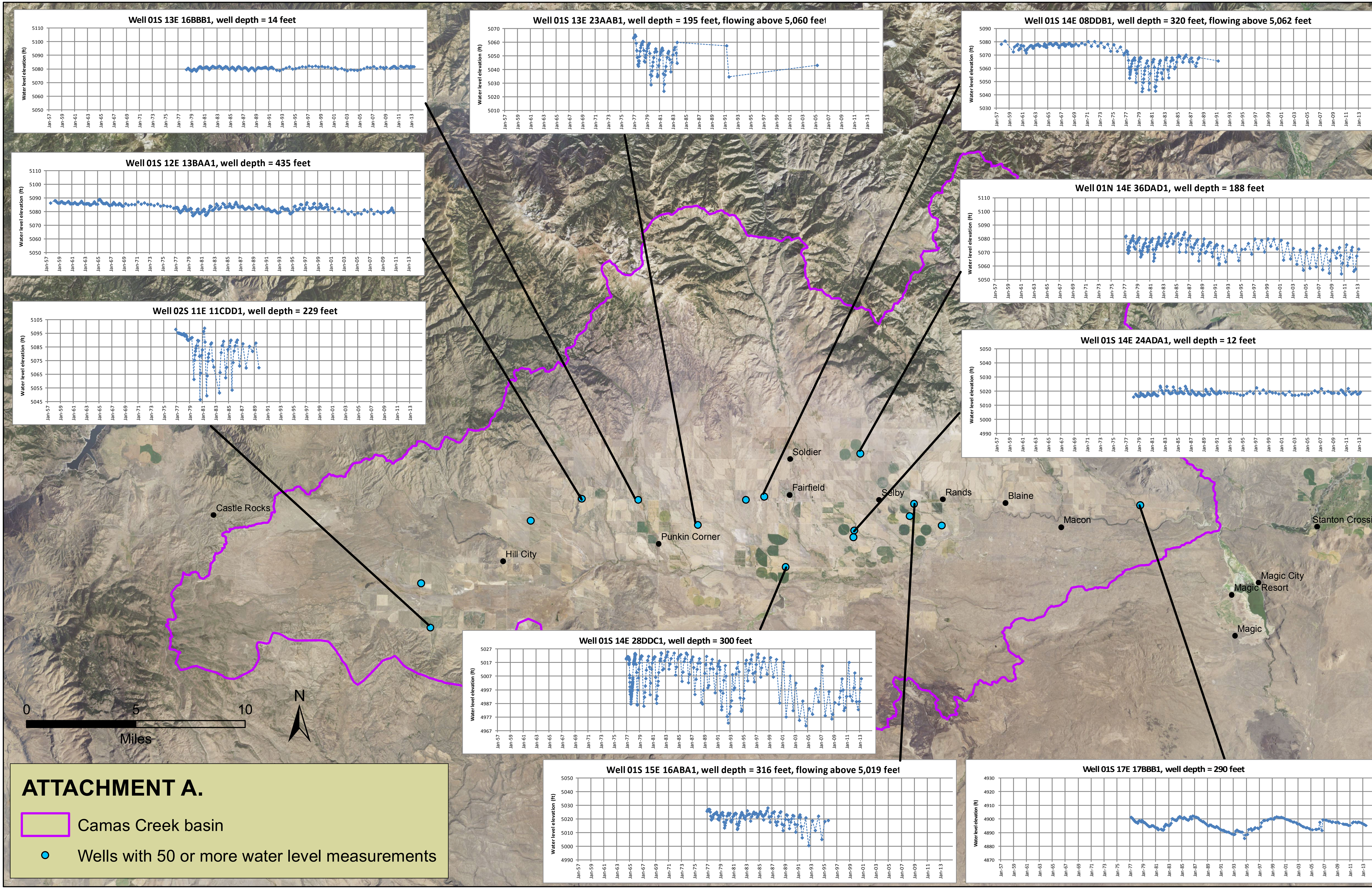


Well 01S 13E 16BBB1, well depth = 14 feet
Well 01S 13E 23AAB1, well depth = 195 feet, flowing above 5,060 feet
Well 01S 14E 08DDB1, well depth = 320 feet, flowing above 5,062 feet
Well 01S 12E 13BAA1, well depth = 435 feet
Well 01N 14E 36DAD1, well depth = 188 feet
Well 02S 11E 11CDD1, well depth = 229 feet
Well 01S 14E 24ADA1, well depth = 12 feet
Well 01S 14E 28DDC1, well depth = 300 feet
Well 01S 15E 16ABA1, well depth = 316 feet, flowing above 5,019 feet
Well 01S 17E 17BBB1, well depth = 290 feet
Water level elevation (ft)
Soldier
Fairfield
Selby
Rands
Blaine
Macon
Stanton Crossing
Castle Rocks
Punkin Corner
Hill City
Magic City
Magic Resort
Magic
N
0
5
10
Miles
ATTACHMENT A.
Camas Creek basin
Wells with 50 or more water level measurements

ATTACHMENT B. RESULTS OF MAY 1, JUNE 1, JULY 1, AND AUGUST 1 CURTAILMENT SIMULATIONS FOR BOTH SIMULATION AREAS

Predicted responses to curtailment starting May 1 within the WRV1.1 model boundary

Month	Curtailed consumptive use	Silver Creek		Big Wood above Dry Bed		Big Wood below Dry Bed		Groundwater underflow to ESPA		Increase in aquifer storage	Model convergence error
	AF	cfs	AF	cfs	AF	cfs	AF	cfs	AF	AF	AF
May	3,206	5.6	347	6.3	384	0.9	54	0.4	26	2,393	2
June	5,224	17.4	1,038	11.1	661	1.5	92	1.0	60	3,373	0
July	10,144	32.7	2,012	15.2	937	3.8	231	2.6	159	6,805	0
Aug	9,613	35.1	2,157	19.1	1,177	6.9	426	3.8	233	5,620	0
Sep	5,221	32.1	1,911	16.6	985	8.5	505	4.0	238	1,581	1
Sum	33,407		7,464		4,145		1,308		715	19,772	3
	100%		22%		12%		4%		2%	59%	0%

Predicted responses to curtailment starting May 1 within the area south of Glendale Bridge

Month	Curtailed consumptive use	Silver Creek		Big Wood above Dry Bed		Big Wood below Dry Bed		Groundwater underflow to ESPA		Increase in aquifer storage	Model convergence error
	AF	cfs	AF	cfs	AF	cfs	AF	cfs	AF	AF	AF
May	1,846	5.6	346	0.2	14	0.1	4	0.2	11	1,470	1
June	3,311	17.4	1,033	1.5	89	0.0	-1	0.6	34	2,156	0
July	7,214	32.5	1,996	0.9	57	2.0	124	1.3	80	4,955	2
Aug	6,737	34.6	2,126	1.1	65	5.1	314	2.3	139	4,094	0
Sep	3,502	31.3	1,865	0.8	46	7.0	416	3.0	179	996	1
Sum	22,611		7,366		271		857		442	13,670	5
	100%		33%		1%		4%		2%	60%	0%

Predicted responses to curtailment starting June 1 within the WRV1.1 model boundary

Month	Curtailed consumptive use	Silver Creek		Big Wood above Dry Bed		Big Wood below Dry Bed		Groundwater underflow to ESPA		Increase in aquifer storage	Model convergence error
	AF	cfs	AF	cfs	AF	cfs	AF	cfs	AF	AF	AF
May	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0
June	5,224	13.2	786	8.3	493	0.8	49	0.6	36	3,859	1
July	10,144	30.0	1,843	13.6	839	3.1	189	2.2	135	7,138	0
Aug	9,613	33.1	2,034	18.0	1,106	6.4	392	3.4	211	5,870	0
Sep	5,221	30.6	1,819	15.7	933	8.1	480	3.7	218	1,771	1
Sum	30,202		6,482		3,370		1,110		600	18,638	2
	100%		21%		11%		4%		2%	62%	0%

Predicted responses to curtailment starting June 1 within the area south of Glendale Bridge

Month	Curtailed consumptive use	Silver Creek		Big Wood above Dry Bed		Big Wood below Dry Bed		Groundwater underflow to ESPA		Increase in aquifer storage	Model convergence error
	AF	cfs	AF	cfs	AF	cfs	AF	cfs	AF	AF	AF
May	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0
June	3,312	13.2	784	0.9	55	-0.4	-25	0.3	17	2,480	1
July	7,213	29.8	1,833	0.8	47	1.5	90	1.0	60	5,182	1
Aug	6,737	32.7	2,008	0.9	58	4.6	286	1.9	119	4,266	0
Sep	3,502	29.9	1,779	0.7	42	6.6	394	2.7	161	1,125	1
Sum	20,763		6,403		202		745		357	13,054	2
	100%		31%		1%		4%		2%	63%	0%

Predicted responses to curtailment starting July 1 within the WRV1.1 model boundary

Month	Curtailed consumptive use	Silver Creek		Big Wood above Dry Bed		Big Wood below Dry Bed		Groundwater underflow to ESPA		Increase in aquifer storage	Model convergence error
	AF	cfs	AF	cfs	AF	cfs	AF	cfs	AF	AF	AF
May	0	0	0	0	0	0	0	0	0	0	0
June	0	0	0	0	0	0	0	0	0	0	0
July	10,144	22.8	1,403	10.5	644	1.9	116	1.6	98	7,883	1
Aug	9,613	28.3	1,738	15.8	973	5.3	323	2.8	174	6,405	0
Sep	5,221	27.1	1,611	14.0	836	7.2	425	3.1	184	2,164	1
Sum	24,978		4,752		2,452		864		456	16,452	2
	100%		19%		10%		3%		2%	66%	0%

Predicted responses to curtailment starting July 1 within the area south of Glendale Bridge

Month	Curtailed consumptive use	Silver Creek		Big Wood above Dry Bed		Big Wood below Dry Bed		Groundwater underflow to ESPA		Increase in aquifer storage	Model convergence error
	AF	cfs	AF	cfs	AF	cfs	AF	cfs	AF	AF	AF
May	0	0	0	0	0	0	0	0	0	0	0
June	0	0	0	0	0	0	0	0	0	0	0
July	7,214	22.7	1,398	0.5	33	0.7	43	0.5	32	5,706	2
Aug	6,737	28.0	1,720	0.8	47	3.8	231	1.4	87	4,652	0
Sep	3,502	26.5	1,578	0.6	36	5.9	348	2.2	130	1,409	1
Sum	17,453		4,695		116		623		249	11,767	3
	100%		27%		1%		4%		1%	67%	0%

Predicted responses to curtailment starting August 1 within the WRV1.1 model boundary

Month	Curtailed consumptive use	Silver Creek		Big Wood above Dry Bed		Big Wood below Dry Bed		Groundwater underflow to ESPA		Increase in aquifer storage	Model convergence error
	AF	cfs	AF	cfs	AF	cfs	AF	cfs	AF	AF	AF
May	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0
June	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0
July	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0
Aug	9,613	13.6	839	11.2	688	2.3	144	1.5	93	7,849	1
Sep	5,221	17.5	1,040	10.7	638	4.5	266	1.8	107	3,169	1
Sum	14,834		1,879		1,326		410		200	11,018	2
	100%		13%		9%		3%		1%	74%	0%

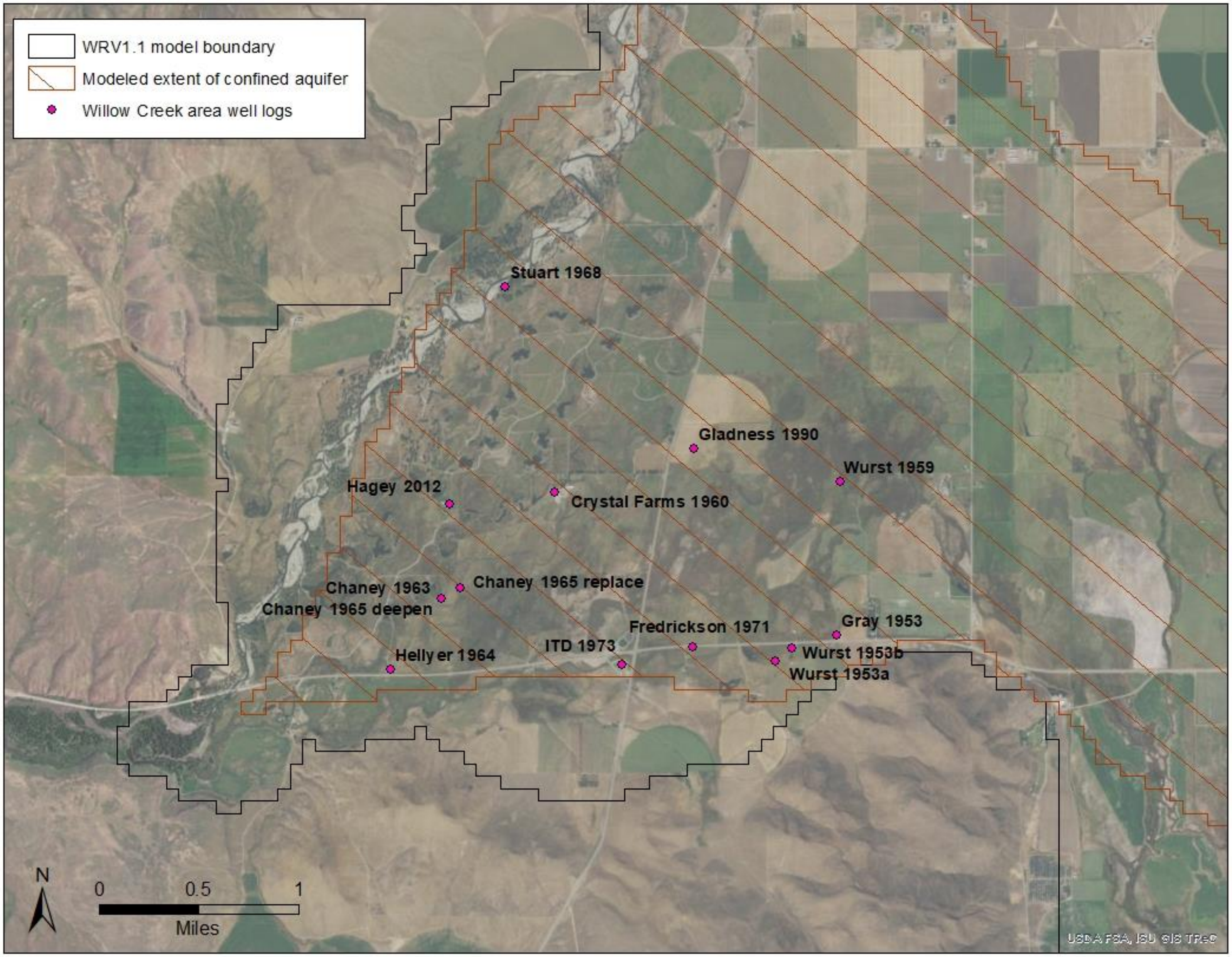
Predicted responses to curtailment starting August 1 within the area south of Glendale Bridge

Month	Curtailed consumptive use	Silver Creek		Big Wood above Dry Bed		Big Wood below Dry Bed		Groundwater underflow to ESPA		Increase in aquifer storage	Model convergence error
	AF	cfs	AF	cfs	AF	cfs	AF	cfs	AF	AF	AF
May	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0
June	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0
July	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0
Aug	6,737	13.6	834	0.3	18	1.4	86	0.5	31	5,767	1
Sep	3,502	17.3	1,030	0.3	17	3.5	208	1.1	67	2,179	1
Sum	10,239		1,864		34		295		98	7,946	2
	100%		18%		0%		3%		1%	78%	0%

ATTACHMENT C. WILLOW CREEK AREA WELL LOGS

Well driller's logs available for Willow Creek area

Owner	Date	Well Use	Production (gpm)	Static water level (ft)	Casing Diam. (in)	Casing Depth (ft)	Total Depth (ft)
WINTON S GRAY	7/23/1953	Irrigation	685	-37	8	150	153
HENRY L WURST	8/11/1953	Irrigation	396	-37	6	139	144
HENRY L WURST	8/31/1953	Irrigation	396	-37	6	141	144
HENRY L WURST	6/22/1959	Irrigation	2,080	flowing (<0)	8	155	156
CRYSTAL FARMS INC	10/27/1960	Domestic	900	-33	6	105	105
JAMES CHANEY	12/26/1963	Irrigation	1,058	flowing (<0)	8	102	102
K F HELLYER	1/9/1964	Domestic		flowing (<0)	6	70	72
JAMES CHANEY	8/9/1965	Irrigation	150	flowing (<0)	8	118	128
CHANEY RANCH	8/18/1965	Irrigation	720	flowing (<0)	8	96	96
E HADLEY STUART JR	11/14/1968	Domestic	50	flowing (<0)	8	115	132
J F FREDRICKSON	3/13/1971	Domestic	1,600	flowing (<0)	6	126	140
STATE OF IDAHO	7/12/1973	Irrigation	1,330	flowing (<0)	6	112	118
SPRING OF GLADNESS RANCH INC	11/14/1990	Stock	850	flowing (<0)	6	121	124
HARRY HAGEY	5/1/2012	Heating	254	flowing (<0)	6	110	110


WRV1.1 model boundary
Modeled extent of confined aquifer
Willow Creek area well logs
Stuart 1968
Gladness 1990
Wurst 1959
Hagey 2012
Crystal Farms 1960
Chaney 1963
Chaney 1965 replace
Chaney 1965 deepen
Fredrickson 1971
Gray 1953
ITD 1973
Hellyer 1964
Wurst 1953b
Wurst 1953a
N
0
0.5
1
Miles
USDA FSA, ISU GIS TReC

WELL LOG AND REPORT TO THE STATE RECLAMATION ENGINEER OF IDAHO

Log No. 034520
Rec. ...., 19......
Well No. ....
Permit No. S-24503 V
(DO NOT FILL IN)

Owner WINTON GRAY Driller EUGENE W. WALKER

Address SUN VALLEY Address TWIN FALLS Lic. No. 15

Location of Well SE ¼ SE ¼ Sec. 13, T 15 N/S, R. 18 E/W BLAINE County.

and 250 feet N/S, and 500 feet E/W from NW corner of SE ¼ SE ¼ Sec. 13

Water will be used for DOMESTIC - IRRIGATION Total depth of well 153

Size of drilled hole 8 inch Weight of casing per linear foot 25 lb

Thickness of casing .277 Casing material BLACK PIPE
e.g., pipe, concrete, wood.

Diameter, length and location of casing 150 ft 8 inch - Surface to Water
(Casing 12" in diameter and under give inside diameter; casing over 12" in diameter give outside diameter.)

Number and size of perforations None located .... feet to .... feet from surface of ground.

Other perforations:

If flowing well, give flow in c.f.s. .... or g.p.m. 685 and shut in pressure 16 -

If non-flowing well, give depth of standing water from surface

If flowing well, describe control works 6" FLANGE VALVE
(Type and size of valve, etc.)

On pumping test delivery was .... g.p.m. or .... c.f.s. Drawdown was .... feet

Length of time pumped during check was .... hr. .... min. Water temp. 49 ° Fahrenheit.

Date of commencement of well July 15, 1953 Date of completion of well July 23, 1953

Type of well rig CHURN

CASING RECORD

Diam. Casing	From Feet	To Feet	Length	"Remarks" — Seals, Grouting, Etc.
8"	0	150	150	Set in Clay

GENERAL INFORMATION — Pumping Test, Quality of Water, Etc.

Well has not been measured; GPM are Based on a Mathematical formula
Water Started flowing 12 AM July 23
Well was Capped 25 July 1953

SESE 13 15 18E

WELL LOG

From Feet	To Feet	Type of Material	Drilling Time Hrs.	Drilling Time Min.	Water-bearing Formation Ans. Yes or No	Casing Perforated Ans. Yes or No
0	5	Surface - top soil		30	no	no
5	17	River gravel	3		yes	none
17	29	Sandy Brown Clay	2	30	no	no
29	37	Brown Running Sand - fine	3		yes	no
37	49	" " Sand - fine	3		"	no
49	60	Blue " " "	2	30	yes	no
60	79	Blue Clay	2	30	yes	no
79	89	Blue Clay	2	30	no	no
89	99	" "	2		no	no
99	125	Blue Clay	4		no	no
125	138	Heavy Blue Clay	3		no	no
138	148	" " "	3		no	no
148	150	Brown Clay - Sticky	3		no	no
150	152	Gravel - -	8		yes	no
152	153	Blue Clay	4		—	
		If more space is required use Sheet No. 2				

WELL DRILLERS STATEMENT

This well was drilled under my jurisdiction and the above information is true and correct to the best of my knowledge and belief.

Signed Eugene W. Walker

By

License No. 15

Dated ______, 19____

Subscribed and sworn before me this ______ day of ______, 19____.

NOTARIZATION NOT NECESSARY UNDER NEW LAW.

______
Notary Public

My commission expires ______

______
Residing at

RECEIVED SEP 5

Department of Reclamation

WELL LOG AND REPORT TO THE STATE RECLAMATION ENGINEER OF IDAHO

Log No. ....

Rec. ...., 19....

Well No. 034537

Permit No. 4-25056

(DO NOT FILL IN)

Owner HENRY L. WURST Driller EUGENE W WALKER

Address Ga ... Address TWIN FALLS Lic. No. 15

Location of Well SW ¼ SE ¼ Sec. 13, T. 1 S, R. 18 E BLAINE County.

and ~~250~~ 500 feet N, and ~~500~~ 225 feet E from SW corner of SW ¼ SE ¼ Sec. 13

Water will be used for DOMESTIC - IRRIGATION Total depth of well 144

Size of drilled hole 6 inch Weight of casing per linear foot 19

Thickness of casing .280 Casing material BLACK PIPE
e.g., pipe, concrete, wood.

Diameter, length and location of casing 6" ~~140~~ 139-4" ft — Surface to Water
(Casing 12" in diameter and under give inside diameter; casing over 12" in diameter give outside diameter.)

Number and size of perforations NONE located .... feet to .... feet from surface of ground.

Other perforations: none

If flowing well, give flow in c.f.s. .... or g.p.m. 396 and shut in pressure 16+

If non-flowing well, give depth of standing water from surface ....

If flowing well, describe control works 6" Screw Valve - gate
(Type and size of valve, etc.)

On pumping test delivery was .... g.p.m. or .... c.f.s. Drawdown was .... feet

Length of time pumped during check was .... hr. .... min. Water temp. 49 ° Fahrenheit.

Date of commencement of well Aug. 3 1953 Date of completion of well Aug 11 1953

Type of well rig CHURN

CASING RECORD

Diam. Casing	From Feet	To Feet	Length	"Remarks" — Seals, Grouting, Etc.
6	0	139-4	139-4"	Set in Clay

GENERAL INFORMATION — Pumping Test, Quality of Water, Etc.

Well has not been measured; G.P.M are Based on a Mathematical formula

SWSE 8.13 1S 18E

WELL LOG

From Feet	To Feet	Type of Material	Drilling Time Hrs.	Drilling Time Min.	Water-bearing Formation Ans. Yes or No	Casing Perforated Ans. Yes or No
0	3	Surface		30		
3	15	River gravel	5		yes	no
15	20	Brown Clay	7		no	no
20	30	Brown Running Sand	4	30	yes	no
30	45	" " "	4	30	yes	no
45	60	BLUE " "	4		yes	no
60	70	Blue Clay - light	3		no	no
70	105	" " "	5		no	"
105	125	Heavy Blue Clay	5	30	no	"
125	138	" " "	3		no	"
138	141	Brown Sticky Clay		30	no	"
141	144	Gravel	3	30	yes	"
144		Blue Clay				
			40			
		If more space is required use Sheet No. 2				

WELL DRILLERS STATEMENT

This well was drilled under my jurisdiction and the above information is true and correct to the best of my knowledge and belief.

Signed Eugene W. Walker

By ______

NOTARIZATION NOT NECESSARY
UNDER NEW LAW

License No. ______

Dated ______, 19____

Subscribed and sworn before me this ______ day of ______, 19____

______
Notary Public

My commission expires ______

______
Residing at

Well Log Form 1
4M - 5/62

RECEIVED
JUL 16 1964
Department of Reclamation

WELL LOG AND REPORT OF THE STATE RECLAMATION ENGINEER OF IDAHO

034519

Permit No. G 37968 Well No. ______ County Blaine

Owner Henry L Wurst

Address Gannett

Driller EUGENE W. WALKER 624 Pierce St. Twin Falls, Idaho

EUGENE W. WALKER 624 Pierce St. Twin Falls, Idaho

Address ______

Well location SW 1/4 SE 1/4 Sec. 13, T. 1 ~~N~~/S, R. 18 E/~~W~~

Size of drilled hole 6 in

Total depth of well 144

Locate well in section

NW¼	NE¼
SW¼	SE¼

Give depth to standing water from the ground ______ Water temp. 46 °Fahr.

On "Pumping Test" delivery was 396 g.p.m. or — c.f.s. ~~Drawdown was~~ — feet.

Size of pump and motor used to make test ______

Length of time of test ______ hours ______ minutes.

If flowing well, give flow ______ c.f.s. or ______ g.p.m. and of shut off pressure 16 - lb

If flowing well, described control works Gate Valve
(TYPE AND SIZE OF VALVE, ETC.)

Water will be used for Supplementary Irrigation Weight of casing per lineal foot 19 lb

Thickness of casing .280 Casing material Steel
(STEEL, CONCRETE, WOOD, ETC.)

Diameter, length and location of casing 6 in 144 ft
(CASING 12" IN DIAMETER OR LESS, GIVE INSIDE DIAMETER; CASING OVER 12" IN DIAMETER, GIVE OUTSIDE DIAMETER)

CASING RECORD

Diam. Casing	From Feet	To Feet	Length	Remarks—seals, grouting, etc.
6	0	144	144	

WHS

Number and size of perforations None located ______ feet to ______ feet from ground

Date of commencement of well Last July 1953 Date of completion of well Early Aug 1953

SWSE S. 13 1S18E

WELL LOG

From Feet	To Feet	Type of Material	Water-bearing Formation Ans. Yes or No	Casing Perforated Ans. Yes or No
0	3	Surface	no	no
3	15	River Gravel	yes	no
15	20	Brown Clay	no	no
20	45	Brown Running Sand		
		under Pressure	yes	no
45	60	Blue Running Sand	yes	no
60	138	Blue Clay	no	no
138	141	Brown Sticky Clay		
141	144	Gravel Artesian Water	yes	no
144		Blue Clay	no	no
		If more space is required use Sheet No. 2		

WELL DRILLER'S STATEMENT

This well was drilled under my supervision and the above information is complete, true and correct to the best of my knowledge and belief.

Signed Eugene W Walker

By

License No. 15

Dated 11 July, 1966

WELL LOG AND REPORT TO THE STATE RECLAMATION ENGINEER OF IDAHO

Log No. ______
Rec. Department ______ 19 ______
Well No. ______
Permit No. S 27968
034536
(DO NOT FILL IN)

Owner Henry Wurst Address Gannett

Driller Eugene W Walker Address Twin Falls Lic. No. 15

Location of Well: NE ¼ NE ¼ Sec. 13, T. 1 S, R 18 E, BLAINE County,

and ______ feet N/S, and ______ feet E/W from ______ Corner of ______ ¼ ______ ¼ Sec. ______

Size of Drilled Hole 8 in Total depth of Well 156

Give depth of standing water from surface ______ Water Temp. 49 °Farenheit

On pumping test delivery was ______ g.p.m. or ______ c.f.s. Drawdown was ______ feet.

Size of pump and motor used to make the test ______

Length of time pumped during check was ______ hr., ______ minutes.

If flowing well, give flow in c.f.s. 4.4 or g.p.m. 2086 and shut in pressure unknown

If flowing well, describe control works Gate Valve
(TYPE AND SIZE OF VALVE, ETC.)

Water will be used for Irrigation Weight of casing per linear foot 25 lb

Thickness of casing .277 Casing material Steel
E.G., PIPE, CONCRETE, WOOD.

Diameter, length and location of casing 8 in - 155
(CASING 12" IN DIAMETER AND UNDER GIVE INSIDE DIAMETER; CASING OVER 12" IN DIAMETER GIVE OUTSIDE DIAMETER.)

Number and size of perforations none located ______ feet to ______ feet from surface of ground.

Other perforations none

Date of commencement of well 15 June Date of completion of well 22 June 59

Type of well rig Churn

CASING RECORD

DIAM. CASING	FROM FEET	TO FEET	LENGTH	"REMARKS" -- SEALS, GROUTING, ETC.
8	0	155	155	

GENERAL INFORMATION—Pumping Test, Quality of Water, Etc.

NENE S.13 1S 18E

WELL LOG

From Feet	To Feet	Type of Material	Drilling Time Hrs.	Drilling Time Min.	Water-bearing Formation Ans. Yes or No	Casing Perforated Ans. Yes or No
0	4 1/2	Surface	1		no	no
	4 1/2	Water			yes	
4 1/2	40	Layers of River gravel				
		& Clay - Lots of Water	11		yes	no
40	70	Brown Running Sand	6		yes	no
70	121	Blue Running Sand	12		yes	no
121	143	Light Sandy Blue Clay	4		no	no
143	155	Sticky Brown Clay	2		no	no
155	155 1/2	Artesian Water				
155 1/2	156	~~Sa~~ Clay & gravel	1		?	no
156	?	Second Strata Artesian Water				
		If more space is required use Sheet No. 2				

WELL DRILLER'S STATEMENT

This well was drilled under my jurisdiction and the above information is true and correct to the best of my knowledge and belief.

Signed Eugene W Walker

By

License No. 15

Dated 1 Oct, 1959

Well Log Form 1
4/59 2 M

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DEC 6 1960
Department of Reclamation

WELL LOG AND REPORT OF THE STATE RECLAMATION ENGINEER OF IDAHO

034521

Permit No. ________ Well No. ________ County Blaine

Owner Crystal Farms Inc - Harry Betts

Address Gannett Idaho

Driller Eugene W Walker

Address

Well location NE ¼ NW ¼ Sec. 14, T. 1 N/S, R. 18 E/W

Size of drilled hole 6 in

Total depth of well 105

Locate well in section

NW¼	NE¼
SW¼	SE¼

Give depth to standing water from the ground ________ Water temp. 50 °Fahr.

On "Pumping Test" delivery was — g.p.m. or — c.f.s. Drawdown was — feet.

Size of pump and motor used to make test — —

Length of time of test ________ hours ________ minutes.

If flowing well, give flow ________ c.f.s. or appx 900 g.p.m. and of shut off pressure 14½

If flowing well, described control works Gate Valve
(TYPE AND SIZE OF VALVE, ETC.)

Water will be used for Domestic Weight of casing per lineal foot 19 lb

Thickness of casing .288 Casing material Steel
(STEEL, CONCRETE, WOOD, ETC.)

Diameter, length and location of casing 6 in — 105
(CASING 12" IN DIAMETER OR LESS, GIVE INSIDE DIAMETER; CASING OVER 12" IN DIAMETER, GIVE OUTSIDE DIAMETER)

CASING RECORD

Diam. Casing	From Feet	To Feet	Length	Remarks—seals, grouting, etc.
6	0	105	105	

Number and size of perforations None located ________ feet to ________ feet from ground

Date of commencement of well 2 Oct Date of completion of well 27 Oct

NENW S.14 1S 18E

WELL LOG

From Feet	To Feet	Type of Material	Water-bearing Formation Ans. Yes or No	Casing Perforated Ans. Yes or No
0	10	Surface - Some Gravel.	Yes	No
10	17	Gravel	Yes	No
17	26	gravel & Clay	?	No
26	35	gravel Sand & Clay	Yes	No
35	45	Sandy Clay	Yes	No
45	65	Brown Running Sand, turning	Yes	No
~~65~~		to Blue Sand	Yes	No
65	95	Blue Clay Sticky	No	No
95	105	Brown Clay Sticky	No	No
	105	Artesian Water	Yes	No
		If more space is required use Sheet No. 2		

WELL DRILLER'S STATEMENT

This well was drilled under my supervision and the above information is true and correct to the best of my knowledge and belief.

Signed Eugene W Walker

By

License No. 15

Dated 1 Dec, 1960.

Well Log Form 1
4/59 2 M

RECEIVED
JUN 15 1964
Department of Reclamation

WELL LOG AND REPORT OF THE STATE RECLAMATION ENGINEER OF IDAHO

G-26994

034523

Permit No. 31541 Well No. ____ County Blaine

Owner James Chaney

Address Box 535

Driller ____

Address ____

Well location NE ¼ SE ¼ Sec. 15, T. 1 N/S, R. 18 E/W

Size of drilled hole 8 inch

Total depth of well 102

Locate well in section

NW¼	NE¼
SW¼	SE¼

Give depth to standing water from the ground ____ Water temp. 46 °Fahr.

On "Pumping Test" delivery was ____ g.p.m. or ____ c.f.s. Drawdown was ____ feet.

Size of pump and motor used to make test ____

Length of time of test ____ hours ____ minutes.

If flowing well, give flow ____ c.f.s. or 1058 g.p.m. and of shut off pressure Unknown

If flowing well, described control works Gate Valve (TYPE AND SIZE OF VALVE, ETC.)

Water will be used for Domestic & Irrigation Weight of casing per lineal foot 24 lb

Thickness of casing .277 + .250 Casing material Steel (STEEL, CONCRETE, WOOD, ETC.)

Diameter, length and location of casing 8 in (CASING 12" IN DIAMETER OR LESS, GIVE INSIDE DIAMETER; CASING OVER 12" IN DIAMETER, GIVE OUTSIDE DIAMETER)

CASING RECORD

Diam. Casing	From Feet	To Feet	Length	Remarks—seals, grouting, etc.
8	0	102	102	
				USHS

Number and size of perforations None located ____ feet to ____ feet from ground

Date of commencement of well 7 Dec 63 Date of completion of well 12/26/63

NESE S.15 1S 18E

WELL LOG

From Feet	To Feet	Type of Material	Water-bearing Formation Ans. Yes or No	Casing Perforated Ans. Yes or No
0	4	Surface		
4	26	Gravel & Sand Clay	yes	No
26	50	Light Blue Clay	No	No
50	65	Blue Running Sand	yes	No
65	88	Blue Clay		
88	93	Decomposed Granite - Running		
		Sand	yes	no
93	98	Brown Clay - (Tough)	No	No
98	102	Artesian Water - Gravel	yes	No
		If more space is required use Sheet No. 2		

WELL DRILLER'S STATEMENT

This well was drilled under my supervision and the above information is true and correct to the best of my knowledge and belief.

Signed Eugene W Walker

By

License No. 15

Dated 11 Jan, 1964

Well Log Form 1
4M - 5/62

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JUN 15 1964
Department of Reclamation

WELL LOG AND REPORT OF THE STATE RECLAMATION ENGINEER OF IDAHO

034525

Permit No. ______ Well No. ______ County Blaine

Owner R F Hellyer

Address Gannett

Driller ______

Address ______

Well location ___ ¼ SE ¼ Sec. 15, T. 1 N/S, R 18 E/W

Size of drilled hole 6 in

Total depth of well 72

Locate well in section

NW¼	NE¼
SW¼	SE¼

Give depth to standing water from the ground ______ Water temp. 46 °Fahr.

On "Pumping Test" delivery was ______ g.p.m. or ______ c.f.s. Drawdown was ______ feet.

Size of pump and motor used to make test ______

Length of time of test ______ hours ______ minutes.

If flowing well, give flow unknown c.f.s. or ______ g.p.m. and of shut off pressure unknown

If flowing well, described control works Gate Valve
(TYPE AND SIZE OF VALVE, ETC.)

Water will be used for Domestic Weight of casing per lineal foot 19 lb.

Thickness of casing .280 Casing material Steel
(STEEL, CONCRETE, WOOD, ETC.)

Diameter, length and location of casing 6 in 0 to 70 ft
(CASING 12" IN DIAMETER OR LESS, GIVE INSIDE DIAMETER; CASING OVER 12" IN DIAMETER, GIVE OUTSIDE DIAMETER)

CASING RECORD

Diam. Casing	From Feet	To Feet	Length	Remarks—seals, grouting, etc.
6	0	70	70	

Number and size of perforations None located ______ feet to ______ feet from ground

Date of commencement of well 12-27-63 Date of completion of well 1-9-64

SE 5.15 / 1 S 18E

USGS

WELL LOG

From Feet	To Feet	Type of Material	Water-bearing Formation Ans. Yes or No	Casing Perforated Ans. Yes or No
0	7	Surface	no	no
7	15	Gravel & Clay	yes	no
15	52	Layers of Sandy Clay	yes	no
52	61	Sticky Blue Clay		
61	62	Decomposed Granite Fine Sand		
		under pressure	yes	no
62	72	Brown Sticky Clay	no	no
	72	Artesian Water	yes	no
		If more space is required use Sheet No. 2		

WELL DRILLER'S STATEMENT

This well was drilled under my supervision and the above information is complete, true and correct to the best of my knowledge and belief.

Signed Eugene W Walker

By

License No. 15

Dated 11 June, 1964.

Well Log Form 1
4M - 5/62

E 2 SE 15
NENE 22

102 A
68 "

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NOV 30 1965
Department of Reclamation

WELL LOG AND REPORT OF THE STATE RECLAMATION ENGINEER OF IDAHO

034522

~~Permit No.~~ License G-26994 Well No. Old Well County Blaine

Owner James Chaney

Address Ketchum

Driller EUGENE W. WALKER
624 Pierce St.
Twin Falls, Idaho

Address

Well location NE ¼ SE ¼ Sec. 15, T. 1S N/S, R. 18 E/W

Locate well in section

NW¼	NE¼
SW¼	SE¼

Size of drilled hole 8 in

Total depth of well 128

Give depth to standing water from the ground — Water temp. 46 °Fahr.

On "Pumping Test" delivery was ____ g.p.m. or ____ c.f.s. Drawdown was ____ feet.

Size of pump and motor used to make test —

Length of time of test — hours — minutes.

If flowing well, give flow ~~150~~ c.f.s. or 150 g.p.m. and of shut off pressure

If flowing well, described control works 6 in Gate Valve
(TYPE AND SIZE OF VALVE, ETC.)

Water will be used for ____ Weight of casing per lineal foot 23

Thickness of casing 250 Casing material Steel
(STEEL, CONCRETE, WOOD, ETC.)

Diameter, length and location of casing 8 in - 99 to 118 New Hole
(CASING 12" IN DIAMETER OR LESS, GIVE INSIDE DIAMETER; CASING OVER 12" IN DIAMETER, GIVE OUTSIDE DIAMETER)

CASING RECORD

Diam. Casing	From Feet	To Feet	Length	Remarks—seals, grouting, etc.
8	0	118	115	

uWH

Number and size of perforations None located ____ feet to ____ feet from ground

Date of commencement of well 26 July Date of completion of well 9 Aug 65

NESE S.15 1S 18E disposed

WELL LOG

From Feet	To Feet	Type of Material	Water-bearing Formation Ans. Yes or No	Casing Perforated Ans. Yes or No
0	102	Old Well		No
102	105	Clay & Sand	no	No
105	118	Layers of Gravel, Sand & Clay, Flowed some Water from each Layer of gravel - Would not flow the orignal amount		No
		Well Flowed Sand & Lumps of Clay for 1½ days then quit flowing.		
		W. Formations appeared to Have Broken down away from lower end of Casing.		
118	125	Sand + Clay	yes	No
		If more space is required use Sheet No. 2		

WELL DRILLER'S STATEMENT

This well was drilled under my supervision and the above information is complete, true and correct to the best of my knowledge and belief.

Signed Eugene W. Walker

By ________

License No. ________

Dated 20 Aug, 1965.

Well Log Form 1
4M - 5/62

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NOV 30 1965
Department of Reclamation

WELL LOG AND REPORT OF THE STATE RECLAMATION ENGINEER OF IDAHO

034524

Permit No. 23541 Well No. ____ County Blaine

Owner Chaney Ranch - James Chaney

Address Ketchum Idaho

Driller EUGENE W. WALKER 624 Pierce St. Twin Falls, Idaho

Address ____

Well location NE ¼ SE ¼ Sec. 15, T. 1 N/S, R. 18 E/W

Size of drilled hole 8 in Replacement Well

Total depth of well 96

Locate well in section

NW¼	NE¼
SW¼	SE¼

Give depth to standing water from the ground ____ Water temp. 46 °Fahr.

On "Pumping Test" delivery was ____ g.p.m. or ____ c.f.s. Drawdown was ____ feet.

Size of pump and motor used to make test ____

Length of time of test ____ hours ____ minutes.

If flowing well, give flow 720 c.f.s. or ____ g.p.m. and of shut off pressure ____

If flowing well, described control works Gate Valve - 8 in
(TYPE AND SIZE OF VALVE, ETC.)

Water will be used for Irrigation Weight of casing per lineal foot 23

Thickness of casing 250 Casing material Steel
(STEEL, CONCRETE, WOOD, ETC.)

Diameter, length and location of casing 8 in 96 ft - Complete
(CASING 12" IN DIAMETER OR LESS, GIVE INSIDE DIAMETER; CASING OVER 12" IN DIAMETER, GIVE OUTSIDE DIAMETER)

CASING RECORD

Diam. Casing	From Feet	To Feet	Length	Remarks—seals, grouting, etc.
8	0	96	96	Stopped in Clay

used

Number and size of perforations None located ____ feet to ____ feet from ground

Date of commencement of well 10 Aug 65 Date of completion of well 18 Aug 65

NESE S.15 1S 18E

WELL LOG

From Feet	To Feet	Type of Material	Water-bearing Formation Ans. Yes or No	Casing Perforated Ans. Yes or No
0	4	Surface	no	
4	25	Gravel Sand Clay	yes	no
26	50	Light blue Sandy Clay	no	no
50	58	Blue Running Sand	yes	no
58	88	Blue Clay — Sticky	no	no
88	96	Sticky Brown Clay	no	no
	96	Gravel - Artesian		
		Water	yes	no
		If more space is required use Sheet No. 2		

WELL DRILLER'S STATEMENT

This well was drilled under my supervision and the above information is complete, true and correct to the best of my knowledge and belief.

Signed Eugene W Walker

By

License No.

Dated 20 Aug, 1965.

✓ 709

RECEIVED
DEC 24 1968
Department of Reclamation

REPORT OF WELL DRILLER
State of Idaho

State law requires that this report shall be filed with the State Reclamation Engineer within 30 days after completion or abandonment of the well.

WELL OWNER:
Name E Haddley Stuart
Address Gannett Idaho
Owner's Permit No.
NATURE OF WORK (check): Replacement well ☐
New well ☑ Deepened ☐ Abandoned ☐
Water is to be used for: domestic
METHOD OF CONSTRUCTION: Rotary ☐ Cable ☒
Dug ☐ Other (explain)
CASING SCHEDULE: Threaded __ Welded __
8 "Diam. from 0 ft. to 115 ft.
"Diam. from ft. to ft.
"Diam. from ft. to ft.
"Diam. from ft. to ft.
Thickness of casing: 1/4 Material:
Steel ☑ concrete ☐ wood ☐ other ☐
(explain)
PERFORATED? Yes ☒ No ☐ Type of perforator used: Mills Knife
Size of perforations: " by "
40 perforations from 97 ft. to 110 ft.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.
WAS SCREEN INSTALLED? Yes ☐ No ☒
Manufacturer's name
Type Model No.
Diam. Slot size Set from ft. to ft.
Diam. Slot size Set from ft. to ft.
CONSTRUCTION: Well gravel packed? Yes ☐
No. ☒ size of gravel Gravel placed from ft. to ft. Surface seal provided? Yes ☐ No ☐ To what depth? ft. Material used in seal:

Did any strata contain unusable water? Yes ☐
No. ☒ Type of water:
Depth of strata ft. Method of sealing strata off:

Surface casing used? Yes ☐ No. ☐
Cemented in place? Yes ☒ No ☐

Locate well in section

X

Sec.

LOCATION OF WELL: County Blaine
NW¼ NW¼ Sec. 11 T. 1 N/S R. 18 E/W

Size of drilled hole: 8 Total depth of well: 132 Standing water level below ground: Flow Temp. Fahr. 50 ° Test delivery: 50 gpm or cfs Pump? ☐ Bail ☐
Size of pump and motor used to make test:

Length of time of test: Hrs. Min.
Drawdown: ft. Artesian pressure: ft. above land surface Give flow cfs or 50 gpm. Shutoff pressure: 14
Controlled by: Valve ☒ Cap ☒ Plug ☐
No control ☐ Does well leak around casing?
Yes ☐ No ☒

39516

DEPTH FROM FEET	DEPTH TO FEET	MATERIAL	WATER YES OR NO
0	4	Surface	
4	10	Gravel Sand Water	10 ft
10	26	Gravel - Sand & Clay	Yes
26	40	Light tan Clay	
40	60	Sandy Clay	
60	95	Sand with Some Clay Layers	yes
95	96½	Brown Clay	
96½	107	Clay & decomposed Granite	Yes
107	115	Sand & Clay	No
115	132	" "	No

Work started: 9 Oct 1968
Work finished: 14 Nov 1968
Well Driller's Statement: This well was drilled under my supervision and this report is true to the best of my knowledge.
Name: Eugene W Walker
Address: 1624 Pierce St
Signed by: Twin Falls Idaho
License No. 15 Date: 13 Dec 1968

Use other side for additional remarks

USGS

37

USE TYPEWRITER OR BALL POINT PEN

State of Idaho
Department of Water Administration

WELL DRILLER'S REPORT

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Department of ...

State law requires that this report be filed with the State Reclamation Engineer within 30 days after completion or abandonment of the well.

1. WELL OWNER

Name J. E. Fredrickson

Address Bellevue Ida

Owner's Permit No. ______

2. NATURE OF WORK

☒ New well ☐ Deepened ☐ Replacement

☐ Abandoned (describe method of abandoning)

3. PROPOSED USE

☒ Domestic ☐ Irrigation ☐ Test

☐ Municipal ☐ Industrial ☐ Stock

4. METHOD DRILLED

☒ Cable ☐ Rotory ☐ Dug ☐ Other

5. WELL CONSTRUCTION

Diameter of hole 6 inches Total depth 140 feet

Casing schedule: ☒ Steel ☐ Concrete

Thickness	Diameter	From	To
281 inches	6 inches	+1 feet	126 feet
inches	inches	feet	feet
inches	inches	feet	feet
inches	inches	feet	feet
inches	inches	feet	feet

Was a packer or seal used? ☒ Yes ☐ No

Perforated? ☐ Yes ☒ No

How perforated? ☐ Factory ☐ Knife ☐ Torch

Size of perforation ______ inches by ______ inches

Number	From	To
perforations	feet	feet
perforations	feet	feet
perforations	feet	feet

Well screen installed? ☐ Yes ☒ No

Manufacturer's name ______

Type ______ Model No. ______

Diameter ___ Slot size ___ Set from ______ feet to ______ feet

Diameter ___ Slot size ___ Set from ______ feet to ______ feet

Gravel packed? ☐ Yes ☒ No Size of gravel ______

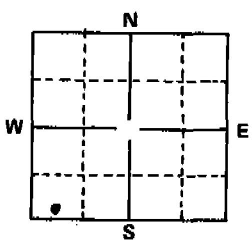
Placed from ______ feet to ______ feet

Surface seal? ☒ Yes ☐ No To what depth 18 feet

Material used in seal ☐ Cement grout ☒ Puddling clay

6. LOCATION OF WELL

Sketch map location must agree with written location.



County Blaine

SW ¼ SW ¼ Sec. 13, T. 1 N/S, R. 18 E/W

7. WATER LEVEL

Static water level 0 feet below land surface

Flowing? ☒ Yes ☐ No G.P.M. flow 1600

Temperature ______ °F. Quality Clear

Artesian closed-in pressure 14 p.s.i.

Controlled by ☒ Valve ☐ Cap ☐ Plug

8. WELL TEST DATA

☐ Pump ☐ Bailer ☐ Other

Discharge G.P.M.	Draw Down	Hours Pumped

9. LITHOLOGIC LOG

39708

Hole Diam.	Depth From	Depth To	Material	Water Yes	Water No
9⅝	0	15	Topsoil & Small Gravel	X	
9⅝	15	18	Quicksand	X	
6"	18	45	"	X	
6"	45	125	Sandy Blue Clay		X
6"	125	130	Blue Clay		X
6"	130	135	Sandy Blue Clay		X
6"	135	140	Brown Gravel & Sand	X	
			Drive Shoe set in Blue Clay		

10.

Work started 3-9-71 finished 3-13-71

11. DRILLER'S CERTIFICATION

This well was drilled under my supervision and this report is true to the best of my knowledge.

Roesske Well Drilling — Driller's or Firm's Name — Number 19

303 N Rail Shoshone — Address

Signed By: Norman A. Acker — Date 4-18-71

USE ADDITIONAL SHEETS IF NECESSARY

FORWARD THE WHITE, BLUE, AND PINK COPIES TO THE DEPARTMENT

USE TYPEWRITER OR BALL POINT PEN

State of Idaho
Department of Water Administration

WELL DRILLER'S REPORT

State law requires that this report be filed with the Director, Department of Water Ad[ministration within 30] days after the completion or abandonment of the well.

Location Corrected by IDWR To:
T01S R18E Sec. 14 SWSESE
By: mciscell 2012-09-06

1. WELL OWNER

Name State Of Ida Dept Of Highways

Address Boise Ida

Owner's Permit No. 37-7004

2. NATURE OF WORK

☒ New well ☐ Deepened ☐ Replacement

☐ Abandoned (describe method of abandoning)

3. PROPOSED USE

☒ Domestic ☒ Irrigation ☐ Test

☐ Municipal ☐ Industrial ☐ Stock

4. METHOD DRILLED

☒ Cable ☐ Rotory ☐ Dug ☐ Other

5. WELL CONSTRUCTION

Diameter of hole 8" inches Total depth 118' feet

Casing schedule: ☒ Steel ☐ Concrete

Thickness		Diameter		From		To	
.250	inches	10"ID	inches	+1½'	feet	20½'	feet
.322	inches	06"ID	inches	1' 10"	feet	100'8"	feet
	inches		inches		feet		feet
	inches		inches		feet		feet
	inches		inches		feet		feet

Was a packer or seal used? ☐ Yes ☒ No

Perforated? ☐ Yes ☒ No

How perforated? ☐ Factory ☐ Knife ☐ Torch

Size of perforation ____ inches by ____ inches

Number		From		To	
	perforations		feet		feet
	perforations		feet		feet
	perforations		feet		feet

Well screen installed? ☐ Yes ☒ No

Manufacturer's name

Type ____ Model No. ____

Diameter ____ Slot size ____ Set from ____ feet to ____ feet

Diameter ____ Slot size ____ Set from ____ feet to ____ feet

Gravel packed? ☐ Yes ☒ No Size of gravel ____

Placed from ____ feet to ____ feet

Surface seal? ☒ Yes ☐ No To what depth 22 feet

Material used in seal ☒ Cement grout ☐ Puddling clay

23½ sacks cement

6. LOCATION OF WELL

Sketch map location must agree with written location.

37

N / W / E / S

County Blaine

NE ¼ NE ¼ Sec. 26, T. 1S N/S, R. 18 E/W

7. WATER LEVEL

Static water level ____ feet below land surface

Flowing? ☒ Yes ☐ No G.P.M. flow Approx. 1330

Temperature ____ °F. Quality clear & pure

Artesian closed-in pressure 16 p.s.i.

Controlled by ☒ Valve ☐ Cap ☐ Plug

8. WELL TEST DATA

☐ Pump ☐ Bailer ☐ Other

Discharge G.P.M.	Draw Down	Hours Pumped

033534

9. LITHOLOGIC LOG

Hole Diam.	Depth From	Depth To	Material	Water Yes	Water No
14"	0	20½'	with seal		
14"	0	6'	top soil (black)		X
14"	6'	16'	1-4" gravel bldrs & Black soil		X
14"	16'	22'	Black sandy quick sand with (non-potable) clay	X	
~~XX~~ 8"	22'	92'	Bluish-gray clay, fine black (non-potable) sand	X	
8"	92'	103'	Black sand & clay		X
8"	103'	112'	Bluish-black clay		X
8"	112'	115'	Brown, sticky clay		X
8"	115'	118'	Brown sand, med gravel	X	
8"					

10.

Work started 6-28-1973 finished 7-12-73

USGS

11. DRILLER'S CERTIFICATION

This well was drilled under my supervision and this report is true to the best of my knowledge.

Roessler Well Drilling — Driller's or Firm's Name; I9 — Number

Box 537 Shoshne, Ida — Address

Geo Roessler — Signed By; 7-27-73 — Date

USE ADDITIONAL SHEETS IF NECESSARY

FORWARD THE WHITE, BLUE, AND PINK COPIES TO THE DEPARTMENT

Form 238-7
6/89

STATE OF IDAHO
DEPARTMENT OF WATER RESOURCES

WELL DRILLER'S REPORT

USE TYPEWRITER OR BALLPOINT PEN

State law requires that this report be filed with the Director, Department of Water Resources within 30 days after the completion or abandonment of the well.

Klg

1. WELL OWNER

Name SPRING OF GLADNESS RANCH, INC.

Address P. O. Box 102, Jerome, Idaho 83338

Owner's Permit No. 37-90-S-124 ok

2. NATURE OF WORK

[✓ New well] ☐ Deepened ☐ Replacement
☐ Well diameter increase
☐ Abandoned (describe abandonment procedures such as materials, plug depths, etc. in lithologic log)

3. PROPOSED USE

☐ Domestic ☐ Irrigation ☐ Test ☐ Municipal
☐ Industrial [✓ Stock] ☐ Waste Disposal or Injection
☐ Other ______ (specify type)

4. METHOD DRILLED

[✓ Rotary] ☐ Air ☐ Hydraulic ☐ Reverse rotary
☐ Cable ☐ Dug ☐ Other

5. WELL CONSTRUCTION

Casing schedule: [✓ Steel] ☐ Concrete ☐ Other

Thickness		Diameter		From		To	
~~.250~~	inches	~~.375~~	inches	~~+1~~	feet	~~19~~	feet
.375	inches	6 5/80	inches	+1	feet	-19	feet
.250	inches	6 5/80	inches	-19	feet	-121	feet
	inches		inches		feet		feet

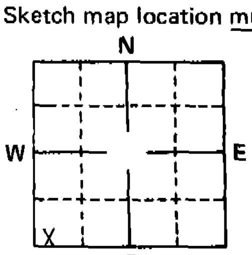
Was casing drive shoe used? [✓ Yes] ☐ No
Was a packer or seal used? ☐ Yes [✓ No]
Perforated? ☐ Yes [✓ No]
How perforated? ☐ Factory ☐ Knife ☐ Torch ☐ Gun
Size of perforation ______ inches by ______ inches

Number		From		To	
	perforations		feet		feet
	perforations		feet		feet
	perforations		feet		feet

Well screen installed? ☐ Yes [✓ No]
Manufacturer's name
Type ______ Model No.
Diameter ____ Slot size ____ Set from ____ feet to ____ feet
Diameter ____ Slot size ____ Set from ____ feet to ____ feet
Gravel packed? ☐ Yes [✓ No] ☐ Size of gravel
Placed from ______ feet to ______ feet
Surface seal depth 18 Material used in seal: ☐ Cement grout ☐ Bentonite [✓ Puddling clay] ☐
Sealing procedure used: ☐ Slurry pit ☐ Temp. surface casing ☐ Overbore to seal depth
Method of joining casing: ☐ Threaded ☐ Welded ☐ Solvent Weld ☐ Cemented between strata
Describe access port

6. LOCATION OF WELL

Sketch map location must agree with written location.



Subdivision Name

MICROFILMED
AUG 29 1991

Lot No. ______ Block No. ______

County Blaine

SW ¼ SW ¼ Sec. 12, T. 1S N☐ S☐ R. 18E E☐ W☐

7. WATER LEVEL

Static water level 0 feet below land surface.
Flowing? [✓ Yes] ☐ No G.P.M. flow ~~APPROX 850~~
Artesian closed-in pressure 8lbs p.s.i.
Controlled by: [✓ Valve] ☐ Cap ☐ Plug
Temperature 48 °F. Quality
Describe artesian or temperature zones below.

8. WELL TEST DATA NOne

☐ Pump ☐ Bailer ☐ Air ☐ Other

Discharge G.P.M.	Pumping Level	Hours Pumped

9. LITHOLOGIC LOG 78533

Bore Diam.	Depth From	Depth To	Material	Water Yes	Water No
	0	2	Top Soil		X
	2	14	Clay and Gravel		X
	14	17	Gravel & clay trace		
	17	27	~~XXX~~ Clay and Gravel		
	27	35	Gravel and sand	X	
	35	47	Tan CLay		X
	47	69	sand & clay trace		
	69	100	~~XXXXXX~~ Blue gray clay		X
	100	117	Blue clay		X
	117	121	Brown clay		X
	121	124	Gravel & Sand	X	

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Department of Water Resources
Southern Region Office

RECEIVED
DEC - 4 1990
Department of Water Resources
Southern Region Office

10.

Work started 9/13/90 finished 10/14/90

11. DRILLERS CERTIFICATION

I/We certify that all minimum well construction standards were complied with at the time the rig was removed.

Firm Name SMITH DRILLING & PUMP CO., INC. Firm No. 11

Address Jerome Date 10/14/90

Signed by (Firm Official) [illegible]

and

(Operator) [illegible]

USE ADDITIONAL SHEETS IF NECESSARY — FORWARD THE WHITE COPY TO THE DEPARTMENT

Form 238-7
6/07

IDAHO DEPARTMENT OF WATER RESOURCES
WELL DRILLER'S REPORT

AD

1. WELL TAG NO. D 0060729

Drilling Permit No. 863174

Water right or injection well # 37-22685

2. OWNER: Harry Hagey

Name

Address P.O.Box 3742

City Hailey State Id Zip 83333

3. WELL LOCATION:

Twp. 1 North ☐ or South ☒ Rge. 18 East ☒ or West ☐

Sec. 15 ____ 1/4 (10 acres) NE 1/4 (40 acres) NE 1/4 (160 acres)

Gov't Lot ____ County ____

Lat. 43 ° 20.559 (Deg. and Decimal minutes)

Long. 114 ° 17.848 (Deg. and Decimal minutes)

Address of Well Site 100 Heart Rock Road (10302 Hwy 75)

(Give at least name of road + Distance to Road or Landmark) City Bellevue

Lot. ____ Blk. ____ Sub. Name ____

4. USE:

☒ Domestic ☐ Municipal ☐ Monitor ☐ Irrigation ☐ Thermal ☐ Injection

☒ Other Heating & Cooling / Fire Protection

5. TYPE OF WORK:

☒ New well ☐ Replacement well ☐ Modify existing well

☐ Abandonment ☐ Other ____

6. DRILL METHOD:

☒ Air Rotary ☐ Mud Rotary ☐ Cable ☐ Other ____

7. SEALING PROCEDURES:

Seal material	From (ft)	To (ft)	Quantity (lbs or ft³)	Placement method/procedure
Bentonite Grout	42ft	10ft	400lbs	Pumped Tremie Pipe
Bentonite Chips	10ft	0ft	1000lbs	Dry Pour

8. CASING/LINER:

Diameter (nominal)	From (ft)	To (ft)	Gauge/ Schedule	Material	Casing	Liner	Threaded	Welded
6"	110ft	+6ft	250	Steel	☒	☐	☐	☒
					☐	☐	☐	☐
					☐	☐	☐	☐
					☐	☐	☐	☐

Was drive shoe used? ☒ Y ☐ N Shoe Depth(s) 110ft

9. PERFORATIONS/SCREENS:

Perforations ☐ Y ☒ N Method ____

Manufactured screen ☐ Y ☒ N Type ____

Method of installation ____

From (ft)	To (ft)	Slot size	Number/ft	Diameter (nominal)	Material	Gauge or Schedule

Length of Headpipe ____ Length of Tailpipe ____

Packer ☐ Y ☒ N Type ____

10. FILTER PACK:

Filter Material	From (ft)	To (ft)	Quantity (lbs or ft³)	Placement method

11. FLOWING ARTESIAN:

Flowing Artesian? ☒ Y ☐ N Artesian Pressure (PSIG) 8 psi

Describe control device Flanged Plate with Valves

12. STATIC WATER LEVEL and WELL TESTS:

Depth first water encountered (ft) 10ft Static water level (ft) Flowing

Water temp. (°F) cold Bottom hole temp. (°F) cold

Describe access port Ball Valves

Well test:

Drawdown (feet)	Discharge or yield (gpm)	Test duration (minutes)
0	254	3 days

Test method:

Pump	Bailer	Air	Flowing artesian
☐	☐	☐	☒
☐	☐	☐	☐

Water quality test or comments: Goood

13. LITHOLOGIC LOG and/or repairs or abandonment:

Bore Dia. (in)	From (ft)	To (ft)	Remarks, lithology or description of repairs or abandonment, water temp.	Water Y	Water N
10	0	6	Fill Dirt		X
10	6	15	Gravel & Clay		X
10	15	23	Gravel & Sand	X	
10	23	27	Sand		X
10	27	42	Sticky Blue Clay		X
6	42	46	Sticky Blue Clay		X
6	46	50	Sand		X
6	50	52	Blue Clay		X
6	52	77	Granite Sand	X	
6	77	78	Blue Clay		X
6	78	93	Granite Sand		X
6	93	96	Decomposed Granite	X	
6	96	100	Decomposed Granite		X
6	100	107	Decomposed Granite	X	
6	107	108	Brown Clay		X
6	108	110	Cemented Slate & Shale & Gravel	X	

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MAY 10 2012
DEPT. OF WATER RESOURCES
SOUTHERN REGION

Completed Depth (Measurable): 110ft

Date Started: 4/18/2012 Date Completed: 5/01/2012

14. DRILLER'S CERTIFICATION:

I/We certify that all minimum well construction standards were complied with at the time the rig was removed.

Company Name Dirt Works Co. No. 652

*Principal Driller Bill McNamee Date 5/02/2012

*Driller ____ Date ____

*Operator II ____ Date ____

Operator I ____ Date ____

* Signature of Principal Driller and rig operator are required.

60717