



State of Idaho

DEPARTMENT OF WATER RESOURCES

900 North Skyline Drive, Suite A Idaho Falls Idaho 83402-1718

Phone: (208) 525-7161 FAX: (208) 525-7177 www.idwr.idaho.gov

C.L. "BUTCH" OTTER - Governor
Gary Spackman - IDWR Director

May 1, 2013

RE: Application for Transfer No. 77610 (Parkinson Farms)

Dear Parties:

Enclosed is a copy of the Staff Memorandum prepared by Dennis Owsley of the Hydrology Section in the Boise office. The memo addresses the seven specific questions raised by Gary Spackman, the IDWR Director, in the order remanding this contested case for augmentation of the administrative record.

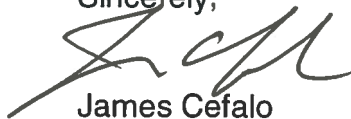
The staff memo prepared by Mr. Owsley includes information that was not part of the original administrative record for this contested case. Because the memo contains new information that may not have been available to the parties at the time of the hearing, the parties will now be given an opportunity to augment the administrative record with additional evidence relating to the topics addressed in the staff memo.

Additional evidence offered by the parties may be provided in various ways: historical documents, technical data, expert reports, written responses, or additional testimony. Please notify the hearing officer and other parties in writing on or before May 17, 2013 if you intend to offer additional evidence into the administrative record for this case. The written notice should identify the type of evidence to be provided. Please also provide notice on or before May 17, 2013 if you intend to depose Mr. Owsley prior to the potential administrative hearing.

After May 17th, I will issue an order setting deadlines for the disclosure of the additional evidence. If an additional hearing will be required, the order will also include a provision setting the hearing date. I will contact the parties prior to issuing the order to find a day during the summer to conduct the hearing.

I appreciate your patience as this contested case has taken a lengthy procedural path. Please contact me with any procedural questions you may have. As the hearing officer, I am still not free to discuss the facts or substance of the contested case.

Sincerely,



James Cefalo

Encl: April 30, 2013 Memo

CERTIFICATE OF MAILING

I hereby certify that on the 1st day of May 2013, I mailed a true and correct copy of the foregoing letter to the person(s) listed below:



Judea Jones
Administrative Assistant

US MAIL

RE: Letter with Staff Memorandum (Transfer No. 77610)

**Parkinson Farms
2253 North 3100 West
Arco, ID 83213**

**Kirby A. Jensen
2781 North 3375 West
Moore, ID 83255**

**James P. Speck
Speck & Aanestad
PO Box 987
Ketchum, ID 83340**

**Darrell L. McDonald
PO Box 246
Arco, ID 83213**

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: April 30, 2013
To: James Cefalo, Hearing Officer
From: Dennis Owsley, Hydrology Section, State Office
cc: Sean Vincent
Subject: Application for Transfer No. 77610 in the Name of Parkinson Farms

Overview

On February 14, 2013, the Hearing Officer for the subject transfer requested a staff memorandum to augment the record through a technical memorandum. The following questions were posed in the request:

1. What is the hydrogeology of the Big Lost River aquifer and any aquifer subunits from approximately Moore, Idaho, downstream to a location south of Arco, Idaho, where the gradient of the aquifer suddenly steepens, and becomes part of the larger Snake River Plain Aquifer?
2. Is the water in sub-aquifers of the Big Lost River aquifer the source of the "rising waters" in the Arco area, and, if not, what is the source of the rising waters?
3. Is the water in the various sub-aquifer units commingling in the deepened Parkinson well because of the decreasing gradient with depth?
4. What is the impact of pumping from the proposed point of diversion on each of the sub-aquifer units?
5. What is the impact of pumping from the proposed point of diversion on rising water in the Big Lost River?
6. What would be the impact on rising waters of pumping Parkinson's water right from the existing points of diversion?
7. Over the last 20 years, what are the quantities of water diverted by Water District 34 and delivered for ground water recharge?

The following sections address each question sequentially.

1. What is the hydrogeology of the Big Lost River aquifer and any aquifer subunits from approximately Moore, Idaho, downstream to a location south of Arco, Idaho, where the gradient of the aquifer suddenly steepens, and becomes part of the larger Snake River Plain Aquifer?

Hydrogeologic Framework

The hydrogeology of the Big Lost River Aquifer in the area of interest consists of an alluvial aquifer bound by carbonate bedrock formations that form the ridges along the east and west sides of the valley. Basalt flows are observed near the mouth of the valley (Figure 1). The valley fill is comprised of alternating layers of sand, gravel, silt, clay, and boulders. The majority of wells drilled in the area are completed in the valley fill.

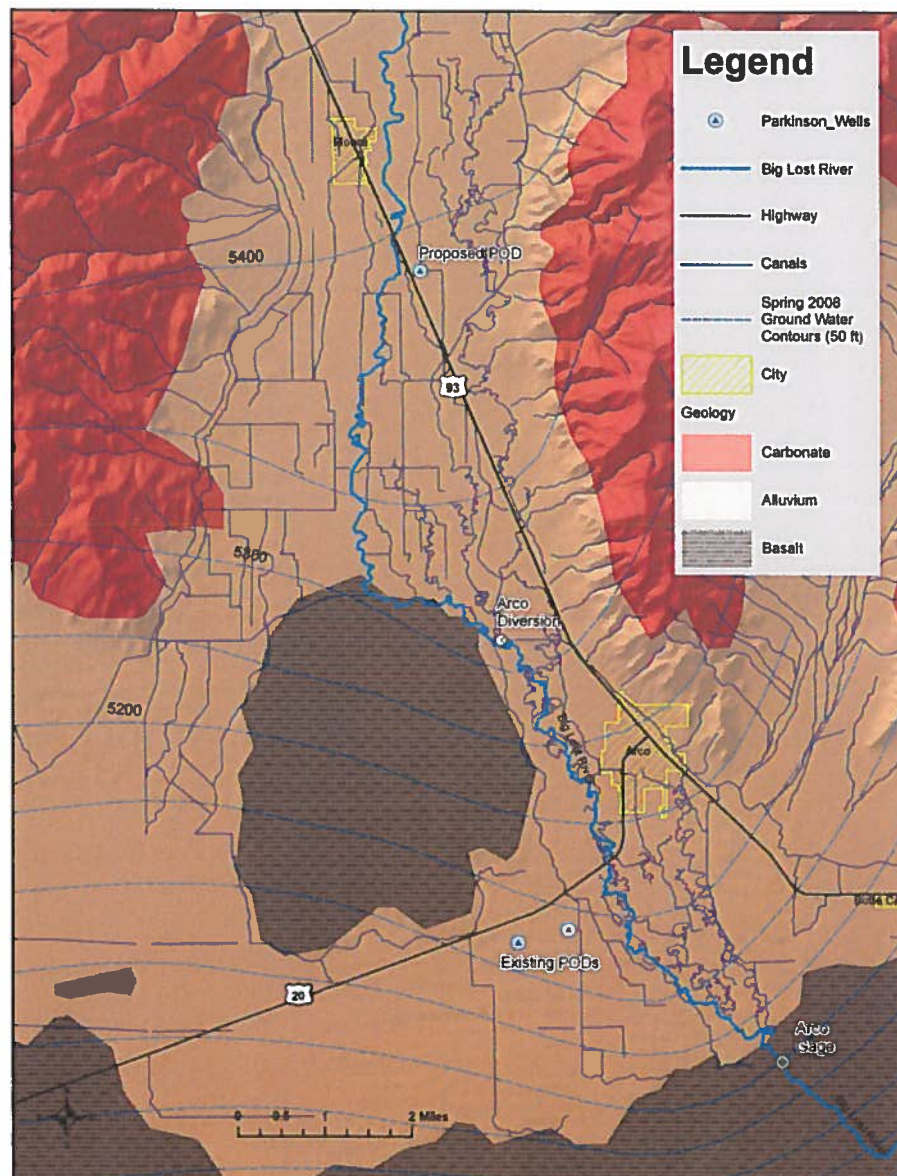


Figure 1. Generalized geologic map of the Big Lost River Valley from approximately Moore, Idaho south to the Eastern Snake River Plain.

The sedimentary aquifer system in the Big Lost River valley north of Arco is over 2,000 feet thick (Crosthwaite et. al, 1970). Clay layers range from 5 to over 50 feet thick and act locally as confining beds separating saturated zones of sand and gravel as well as perching unconfined zones. The clay units were deposited during flood events when streams were dammed by the encroachment of basalt flows from the south (Crosthwaite et. al, 1970). The encroachment occurred during several episodes forming lakes which deposited clays. The clay deposits have since been eroded and reworked by the Big Lost River, resulting in a series of disconnected clay lenses. The areal extent of individual clay lenses is unknown, but in the Arco area, the clay and basalt sequences are laterally extensive and strongly influence lateral movement of ground water (Crosthwaite, et. al, 1970). Additionally, data from well logs suggest that the clay lenses confine or influence the vertical movement of water.

Although the clay horizons cannot be precisely mapped with confidence, a generalized conceptual geologic cross section was developed to illustrate the geologic variability encountered in the subsurface (Figure 2). As shown in Figure 2, nearly all of the wells examined in this area encounter at least one clay layer.

Quaternary basalts from the Eastern Snake River Plain are found at the mouth of the valley near Arco. A basalt outcrop can be observed just west of Arco, and has an impact on the surface water flow regime and possibly the ground water in the uppermost aquifer subunit. This basalt flow appears to have re-routed the channel of the Big Lost River as the river bends nearly 90 degrees as it approaches the northern edge of the outcrop (Figure 1). This indicates that the basalt is resistant to weathering and acts as a barrier to surface flow.

The outcrop is the northern-most surface exposure of basalt in the valley. The basalt flow appears to reduce the width of the alluvial aquifer from approximately four miles near Moore to less than two miles near Arco (Figure 1). The constriction reduces the cross sectional area of the uppermost portion of the aquifer, which in turn reduces the area that is available to store and transmit water.

The Big Lost River Aquifer merges with the larger Eastern Snake River Plain Aquifer (ESPA) a few miles south of Arco. In this transition area, the depth to water increases significantly, resulting in a relatively steeper hydraulic gradient as shown on Figure 1. The increase in hydraulic gradient is due to a reduction in aquifer transmissivity in the transition area from the Big Lost River Aquifer to the ESPA. The reduction in transmissivity is a result of the lacustrine clay deposits interbedded between relatively impermeable basalt which impede ground water flow and effectively reduce the thickness of the aquifer.

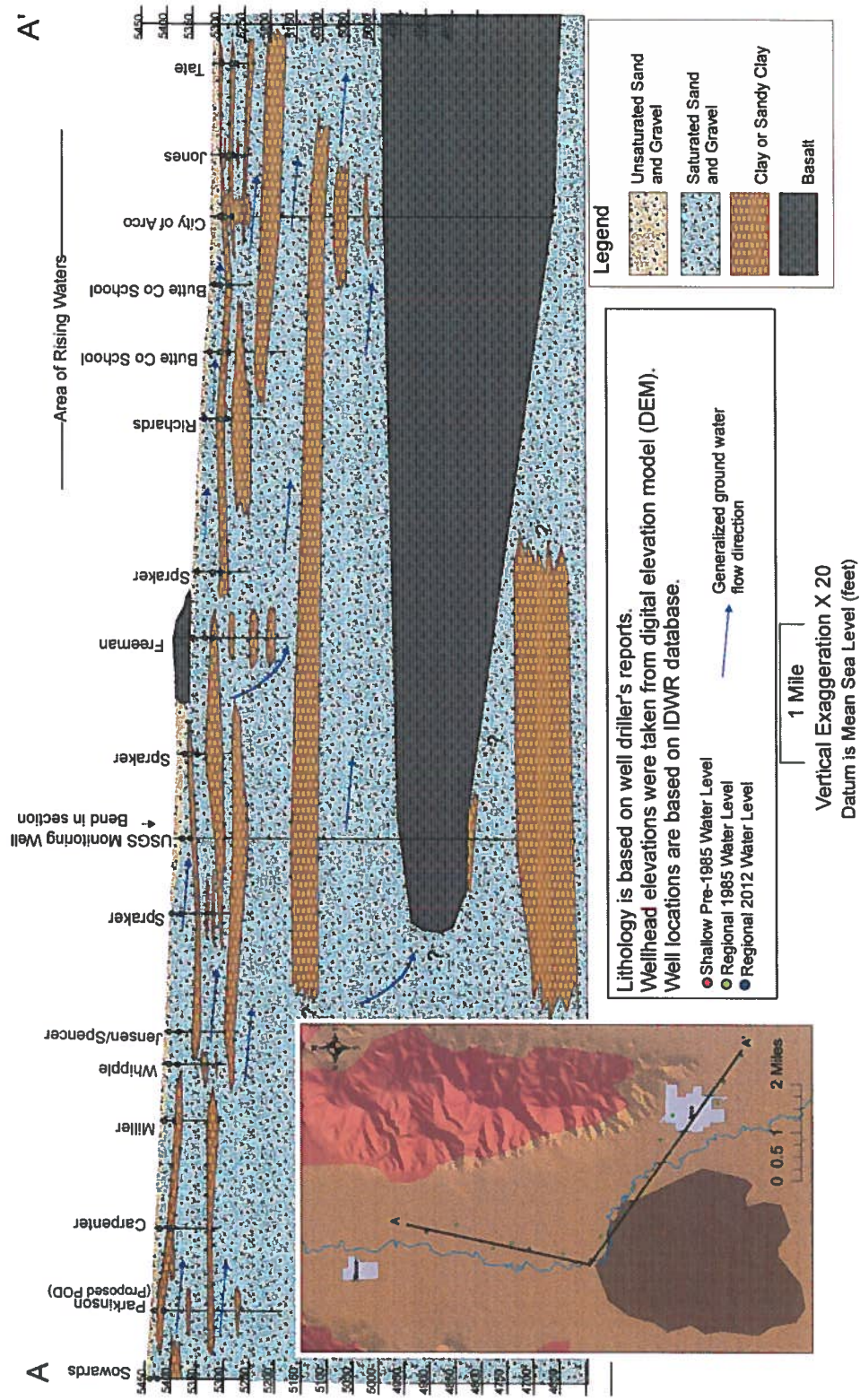


Figure 2. Generalized geologic cross section A-A'.

Aquifer Subunits

Individual aquifer subunits within the Big Lost River Aquifer system are difficult to identify on a basin-wide scale due to the heterogeneity of the alluvial deposits, the variability of the width of the aquifer, and the interconnection within wells completed at various depths. For discussion purposes, the uppermost and multiple deep aquifer subunits are described in this memo.

Available data indicate that the uppermost subunit is perched when water levels in the regional aquifer are low and comprises the top of the regional aquifer system if water levels in the regional aquifer system are high enough. Reviewing the driller's reports for the area that have construction dates included, only a few dozen domestic wells that have been drilled to 60 feet or less exist in the area. Of these wells, all but two of them were drilled prior to 1985. Many of these shallow wells have been deepened or replaced, due to declining aquifer levels. This suggests that the uppermost subunit is not a reliable source of water to domestic wells.

The multiple deep aquifer subunits contain sequences of clay layers interbedded with saturated sands and gravels. It is these subunits that are relied upon for majority of the domestic and irrigation wells in this area and are coincidental with the term "regional aquifer".

Water Levels

The direction of ground water flow is from north to south and generally parallels the course of the Big Lost River channel. Depth to water in most wells is generally less than 50 feet below land surface. The depth to water and hydraulic gradient through the valley are dependent on variations in the permeability of the alluvial material, the cross-sectional width of the valley, the depth below land surface, and the quantity of water moving through the aquifer (Crosthwaite et. al, 1970). It is important to note that aquifer head decreases with depth in this region. A review of well driller's reports of shallow wells (< 60' deep) indicates that the water levels in these wells are higher than the water levels in the deeper wells in the area.

Comparison of water levels to geologic information on well logs reveals that the aquifer system varies from unconfined near land surface to semi-confined at depth. Clay layers are commonly reported as not water yielding in the driller's logs and wells completed below these clay horizons often display semi-confined conditions., indicating the clay is relatively impermeable.

A review of hydrographs from wells routinely monitored in the area indicates that the seasonal and long term trends appear similar for most of the wells, regardless of the depth of completion (Figure 3). It is not known whether the apparent hydraulic connection throughout the aquifer subunits is due to clay layer discontinuities or to vertical communication provided by wells that lack annular well seals.

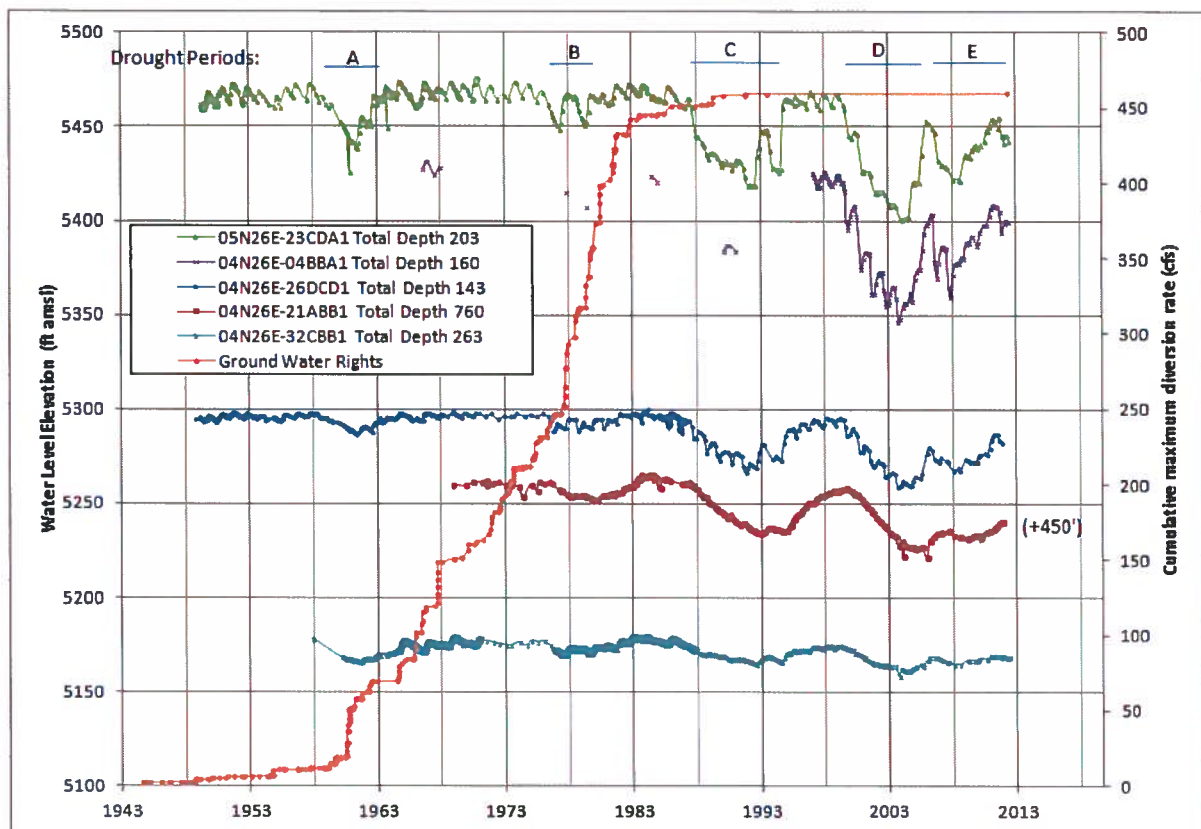


Figure 3. Hydrographs of five routinely monitored wells in the Moore to Arco area with cumulative maximum diversion rates for ground water rights superimposed. Note that 450' has been added to the water level elevation of well 04N26E-21ABB1 in order to plot on the same scale. Well locations can be seen in Appendix A.

On an annual basis, aquifer water levels respond to the water supply conditions in the valley. In water short years, aquifer levels decline in response to additional pumping and a reduction in incidental recharge from irrigation practices and leaking diversion networks. In water rich years, water levels increase in response to less ground water pumping and more incidental recharge from leaking canals, irrigation seepage, and leakage from flow in the Big Lost River (Figures 3 and 4). Although the individual dry years can be seen in the hydrographs (drought periods A through E), water levels were relatively stable until the mid 1980s. At this time, aquifer levels dropped significantly and have yet to return to "pre-1985" conditions. The overall reduction in the water table appears to coincide with the development of groundwater, expansion of irrigated lands in the area, and more efficient irrigation practices that result in less incidental recharge through excess surface water application. The cumulative maximum diversion rate for ground water rights in the Moore to Arco area increased beginning in about 1960 and steadily increased until the early 1980s. Since 1992, there has been a basin-wide moratorium on new ground water rights for consumptive use.

Although drought periods can be identified in the observation well hydrographs, the years of adequate and abundant water supply can also be seen. As seen in Figure 3, water levels respond rapidly to periods of high water supply. In the mid to late 1990s, water levels rose to near historic levels in response to five consecutive years of high water supply. Recent high water years (2007 and 2011) also

are represented in the hydrographs with rising ground water levels, but not to the extent that was observed in the mid to late 1990s.

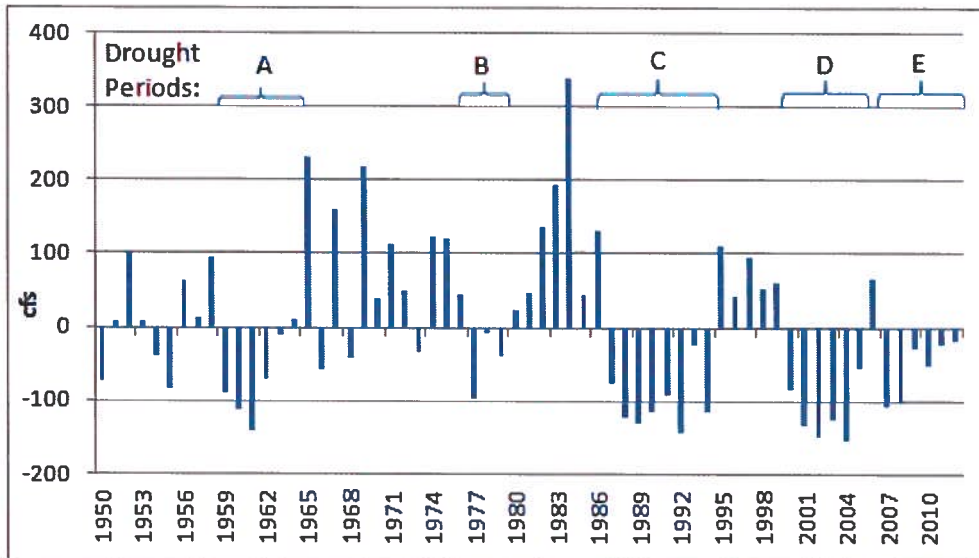


Figure 4. Departure from 1950-2012 average of Big Lost River flows below Mackay Reservoir.

As previously mentioned, there is a downward hydraulic gradient throughout the valley between Moore and Arco. Decreasing water levels with depth were documented during the drilling of the 760-foot deep monitoring well 04N 26E 21ABB1 in 1969. USGS personnel noted that several wells had cascading water during a study conducted in 1985, further supporting the idea of a decreasing potential with depth (Baker, 1989). The existence of a downward gradient makes it important to consider the depth of the well when evaluating water levels in this area. This is especially important when correlating surface water flows to aquifer levels, although, few water level data are available for shallow wells completed in this area.

Hydraulic Connection with the Big Lost River

The Big Lost River and the underlying aquifer system of the valley are managed as one water resource. In areas where aquifer levels are at or near the land surface, ground water discharges into the Big Lost River channel and contributes to the flow of the river. In areas where the aquifer levels are below the elevation of the bottom of the river channel, water seeps from the bottom of the river channel into the underlying aquifer. Historically, the Big Lost River was connected to the aquifer throughout most of the valley, with some historic areas of losing reaches (Figure 5).

Current conditions indicate that the river and aquifer are now disconnected throughout most of the valley below the Darlington Sinks due in part to ground water development that has lowered the water table. Most of the reach between Moore and Arco was hydraulically connected in 1968 and gaining from the aquifer. In 1998, it appears the area near Moore was the furthest hydraulically connected downstream location.

The width of the valley appears to control, in part, which reaches of the river are gaining (ground water contributing to the river) and which reaches of the river are losing (river water contributing to the aquifer). Areas of the valley that are constricted correlate with historically gaining reaches and areas where the valley widens correlates with losing reaches. In addition, the depiction of vegetation on the

1960s 1:24,000 USGS topographic maps correlates well with the historically connected reaches of the river with the aquifer. South of Arco, the regional water table of the Big Lost River Aquifer merges with the deeper regional water table of the ESPA. Available data indicate that the river and aquifer have never been hydraulically connected where the Big Lost River Aquifer flows into the ESPA.

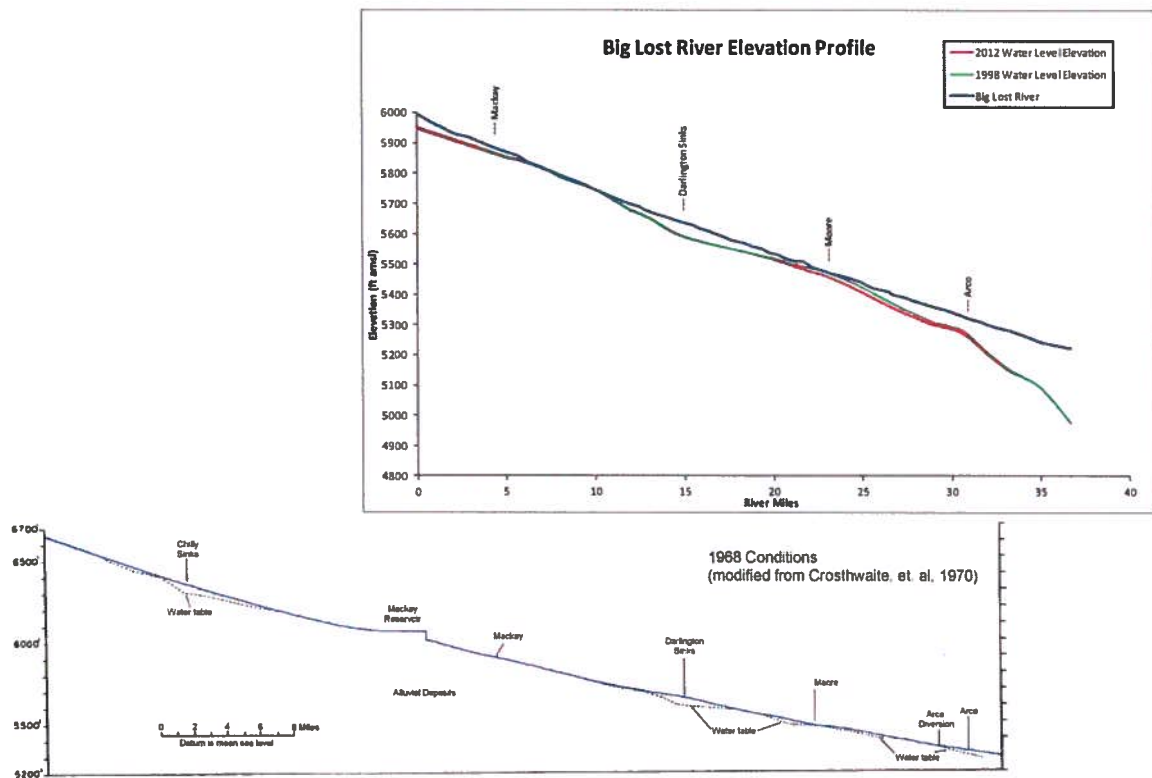


Figure 5. Big Lost River profiles comparing current conditions to 1998 and 1968 conditions.

2. Is the water in sub-aquifers of the Big Lost River aquifer the source of the “rising waters” in the Arco area, and, if not, what is the source of the rising waters?

For the purpose of this staff memo, the term “rising water” is used to refer to ground water that discharges from the aquifer system and emerges in the Big Lost River channel and in seeps and springs in the reach from approximately the Arco diversion to approximately the Arco gage (Figure 6). The water is described as “rising” because it provides a gain to the river and emerges as springs at the land surface. The source of the rising water is leakage from the Big Lost River and incidental recharge from irrigation in the area between Moore and Arco that causes the water table to intersect land surface.

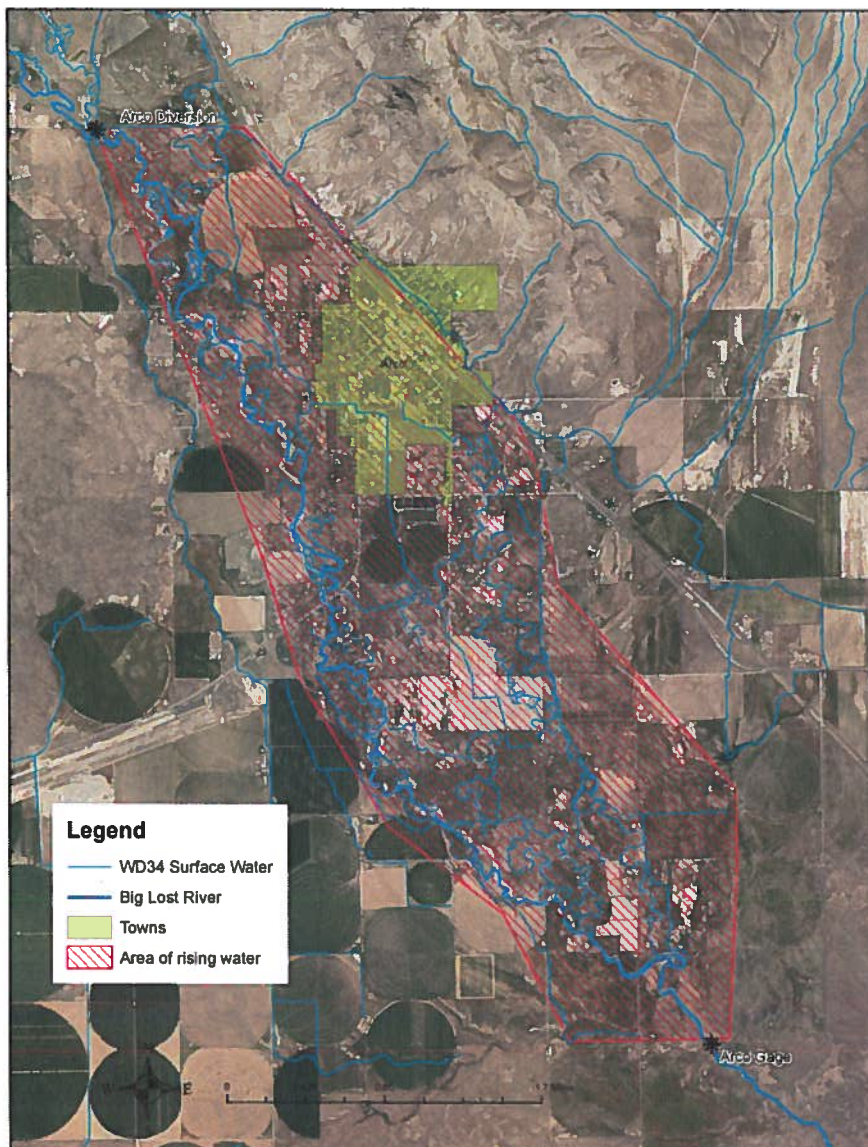


Figure 6. Area of occurrence and distribution of rising water.

Historically, rising water was observed in years of plentiful water supply when the river would flow beyond Moore and large amounts of water were used as irrigation in that area between Moore and Arco (Stearns, et. al, 1938). In such years, as much as 75 cfs would rise in the river channel and spring fed creeks just north of Arco (Stearns, et. al, 1938). In years of low water supply, the rising water is negligible. When aquifer levels are significantly lower than the elevation of the river, over 200 cfs must flow past the Moore Dam for any water to reach Arco (Stearns, et. al, 1938). According to the Water District 34 Annual Watermaster Report for 2011, the rising water has been low to non-existent for approximately the past 30 years:

"The water level is still increasing in the aquifer for example the static water level in June 2011 was 32 feet by December 2011 it had risen to 26 feet and for the first time in about 30 years there was rising water at the Arco Gage and in the ferris slough this fall."

There appear to be two different mechanisms that facilitate the occurrence of rising water: 1) the regional aquifer water levels are elevated to a point that the water table in the uppermost aquifer subunit intersects land surface, and 2) incidental recharge percolates until it encounters a clay layer that impedes downward flow, perching shallow water that eventually intersects the land surface in the area of the rising waters. Both mechanisms require the source water (either flow in the river or incidental recharge from irrigation) to be delivered to the southern portion of the basin. The lowering of the aquifer levels has moved the point of hydraulic connection up valley from Moore. As a consequence, the Big Lost River does not flow as far down valley as it had historically. This has reduced, if not eliminated, the source of the rising water.

The amount of water contributing to the rising water from the regional aquifer versus the uppermost perched aquifer cannot be quantified with currently available data. However, it appears that the perched component of the rising water is minimal in comparison to the contribution of the regional aquifer. For example, following several years of drought when the aquifer levels are low, a minor amount of rising water may appear from incidental leakage between Moore and Arco, but in quantities too low to divert to the local water users or to sustain river flows. In contrast, the pre-1985 aquifer levels were high enough to sustain rising water and flow in the Big Lost River in the Arco area. Contributions from the perched and regional systems are dependent on the amount of water that flows beyond Moore, as aquifer levels will rise if Big Lost River flows are sustained beyond Moore and more water is available to divert in the area between Moore and Arco. Observations support the existence of both uppermost and deep aquifer subunits contributions to the rising water.

The following observations support the deep aquifer subunits contributions:

- The area in which the rising waters have been observed is in a section of the Big Lost River valley that is restricted in width. The restriction of the cross-sectional area of the valley would facilitate higher water levels than in places where the valley is wider and water can spread out and flow through a greater volume of material.
- Although the data is anecdotal, it appears the reduction of the rising water is coincident with the lowering of the aquifer levels over the past few decades. It is apparent that, in the past, the rising waters were a significant source of water for local irrigators, as evidenced by the existence of multiple sloughs and irrigation diversions from the sloughs. Water right records indicate multiple rights exist on the rising waters, with priority dates as old as 1880.
- The hydrograph for well 03N27E-08BCB1 (Figure 7) shows a correlation between the winter water levels and the annual diversion volumes to the Arco canal. This well, located approximately 2.5 miles south of Arco, is 93 feet deep and it assumed to represent the deep aquifer subunits. Historically, depth to water in this well has been as shallow as 3 feet below land surface. The well driller's report is not available, so the depth to water when the well was drilled is unknown. Many wells in the area exhibit semi-confined conditions, and it is not apparent whether this shallow water level represents the uppermost saturated zone or semi-confined conditions.
- The depth to water across the valley from approximately Moore and extending down south of Arco was mapped as less than 10 feet in the fall of 1968 (Crosthwaite, et. al, 1970).
- Semi-confining to confining conditions are reported in many of the driller's reports in the area of rising water. These conditions may allow ground water from the deep aquifer subunits to flow upwards into the uppermost aquifer subunit through the annular spaces or screened interval of the wells drilled in the area.

- The cut and fill nature of alluvial deposits in the valley suggests that at least some of the clay units are discontinuous. Hydraulic communication between aquifer subunits would be facilitated by the absence of clay layers.

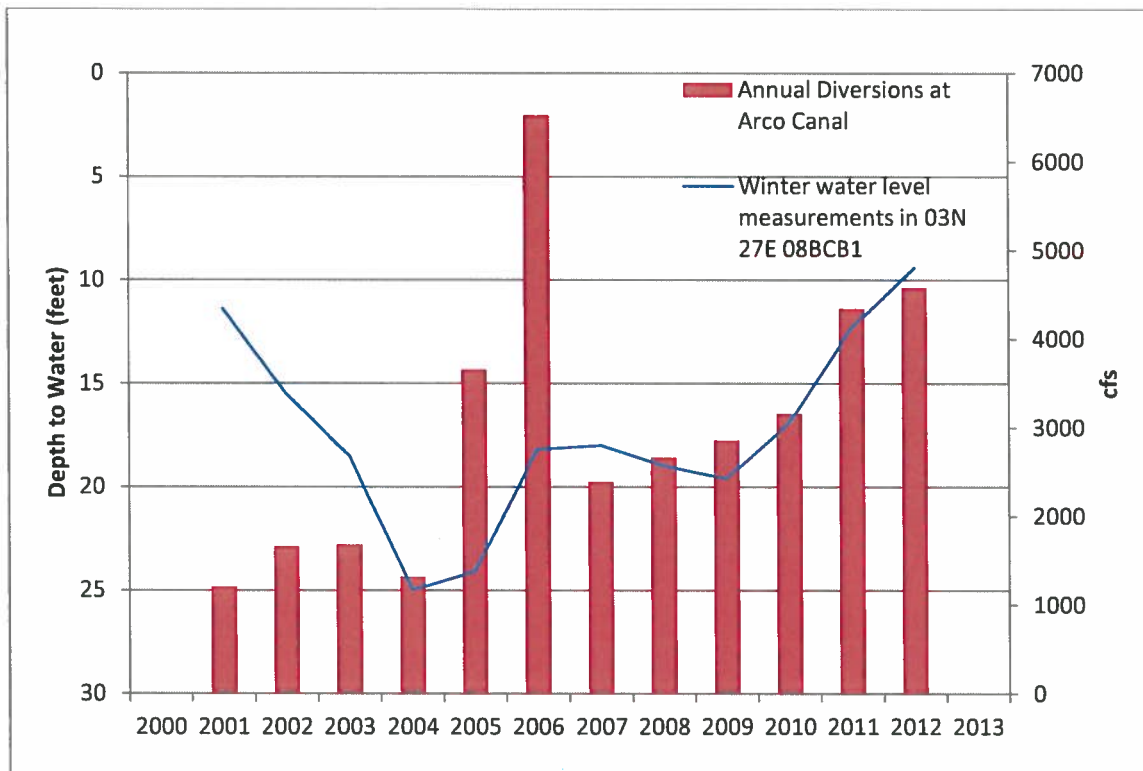


Figure 7. Comparison of winter water level measurements in observation well 03N 27E 08BCB1 and the annual diversions into the Arco canal.

Observations that support the occurrence of uppermost aquifer subunit contribution to the rising water are as follows:

- The timing of the appearance of the rising water coincides with the irrigation season. Based on discussions with the current Basin 34 Watermaster, in the past few years, the limited amount of rising water generally appears in late June to early July, approximately two weeks after the water disappears at its southernmost point in the river channel. (Totten, 2013).
- Although the flows were minimal, the existence of rising water in the past few years indicates that the source cannot be entirely ground water from the deep regional aquifer subunit, as water levels are currently well below the land surface elevation.
- Well driller's reports for the four wells closest to the head of the Ferris Slough (one of the main delivery systems of the rising water) were reviewed. All four wells indicate semi-confined to confined conditions as the static water levels are significantly higher than the first water zone encountered and/or the open interval of the well. The fact that the water levels in these wells are higher than the top of the uppermost water bearing zone indicates that there is a relatively impermeable confining layer. If the layer is impermeable enough to create semi-confined

conditions, it would seem reasonable that it would also impede the downward flow of seepage from localized irrigation and canals, creating a perched system.

- The driller's report for a Butte County School well, drilled in January of 1981, indicates that the first water was encountered at 21 feet, below a sandy clay horizon. The well is located up-gradient of the start of the Ferris Slough and was screened between depths of 30 and 75 feet, with a static water level 9 feet below ground surface. At the time the well was drilled, there was approximately 21 feet of unsaturated soil and clay separating the upper water bearing zone from the land surface. Therefore, it seems unlikely that the upper water bearing zone is the source of the rising water that is observed a few hundred yards south of this well.
- The hydrograph for well 04N26E-26DCD1 indicates that the water levels have historically been well below the elevation of the river (Figure 8). This well is routinely measured by IDWR and has water level data dating back to 1949. The well is 143 feet deep, and is located approximately ½ mile northwest of the town of Arco and is approximately 350 feet north of the Big Lost River channel. Depth to water in this well has ranged from 37 to over 75 feet below land surface and the bottom of the Big Lost River channel. Currently, the regional aquifer level is approximately 50 feet below the Big Lost River channel. The only plausible explanation for the occurrence of rising water at this location is contribution from a perched system.

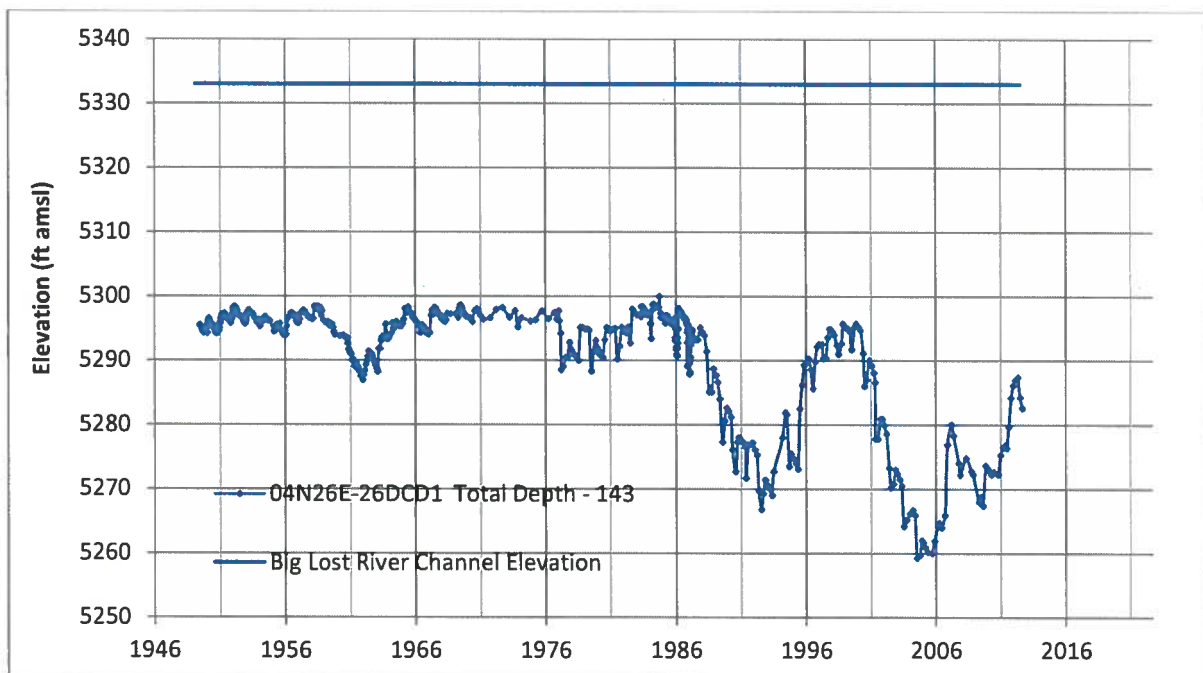


Figure 8. Comparison of water levels in 04N26E-26DCD1 to the elevation of the Big Lost River channel.

During low water years, the volume of rising water is expected to be reduced, if not zero. This is due to the fact that during low water years, the only source of rising water is incidental leakage from irrigation between Moore and Arco. During these low water years, the Big Lost River typically does not flow down to Arco as all of the river water is diverted into canals for irrigation. Therefore, the water that incidentally leaks into the subsurface encounters shallow clay horizons that perch the water and allow it to flow laterally, rather than seep into the deep aquifer subunit. If the volume of water is sufficient, seeps and springs flow where the clay horizons intersect the land surface or the bottom of the river channel.

During historic (pre-1985) years of high water supply, rising waters appeared due to a combination of two factors. First, if the regional aquifer levels were elevated to a point that the uppermost aquifer subunit became saturated, the water migrated laterally in the area of Arco and discharged as rising water. Second, and more importantly, if elevated regional aquifer levels increased to the point that the aquifer and river become reconnected near Moore, this reconnection provided additional flow in the Big Lost River, which in turn, increased the source of the rising water.

3. Is the water in the various sub-aquifer units commingling in the deepened Parkinson well because of the decreasing gradient with depth?

The water in the various aquifer subunits is commingling in the Parkinson well due to the design and construction of the well (Figure 9). There is a downward hydraulic gradient in the area (evidenced by decreasing static water levels with depth while drilling monitoring well 04N26E-21ABB1 approximately 3.5 miles south of the proposed POD), and the long screened interval within the well allows the aquifer subunits to commingle. The screened interval of the well extends from 30' to 244' below ground surface and penetrates four water bearing zones separated by clay formations. Therefore, water is allowed to migrate from the uppermost aquifer subunit to the deeper subunit through the large section of screen within the well. When this well is not pumping, water flows naturally from the uppermost aquifer subunit down into deep aquifer subunits via the screened portion of this well.

The water level in this well has declined since the well was drilled in May of 1977. The difference in water levels in the Parkinson well at the time of drilling and at the time of deepening (December 2009) was 26 feet (Figure 9). For comparison, the water level in observation well 04N26E-26DCD1 (approximately 5.5 miles southeast of the Parkinson well) was 41.3 feet below land surface in May 1977 and 62.3 feet below land surface in December 2009, a difference of 21 feet.

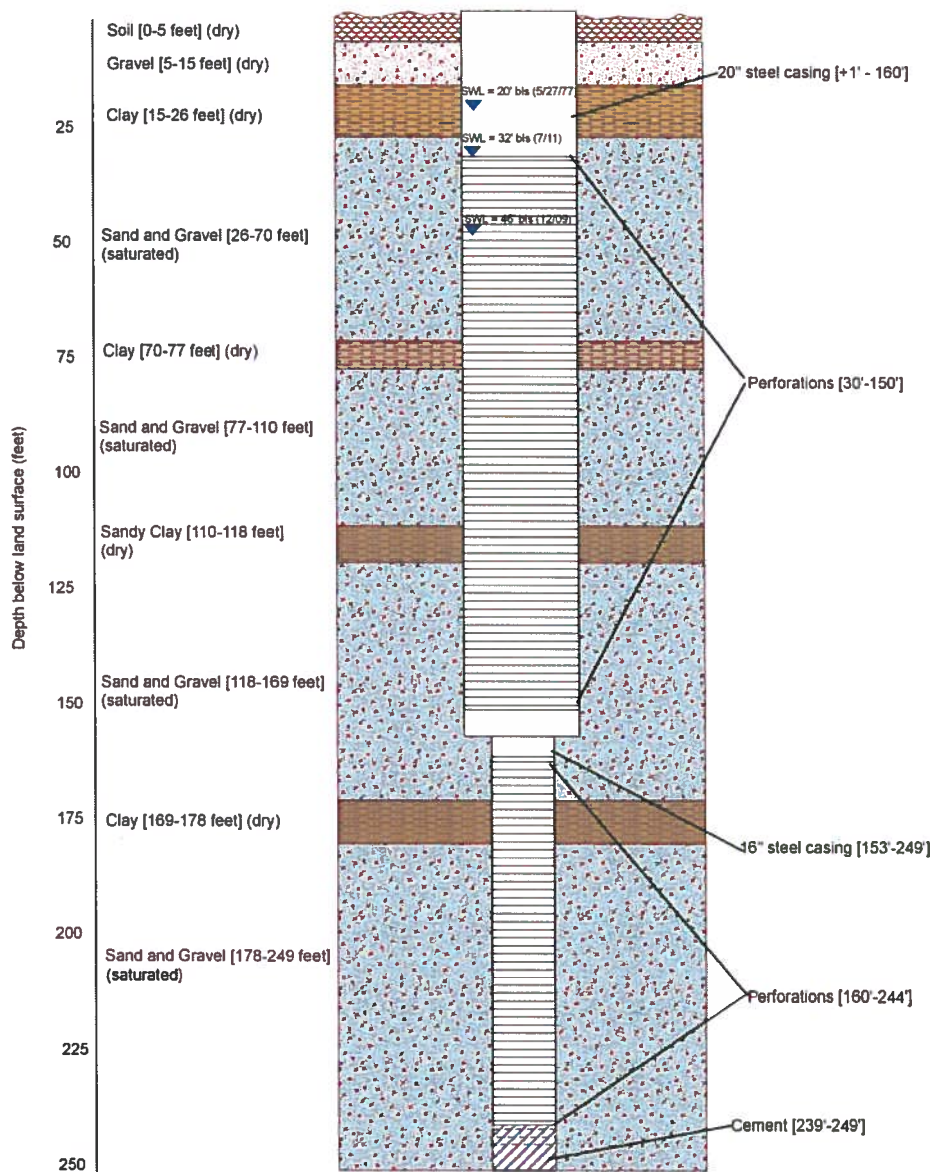


Figure 9. Schematic diagram of the proposed point of diversion.

4. What is the impact of pumping from the proposed point of diversion on each of the sub-aquifer units?

It can reasonably be assumed that there is hydraulic communication between the aquifer subunits that are accessed by the proposed point of diversion since the clay units are discontinuous and the screened section of the well spans across three confining units. However, information for quantifying the impacts to each individual aquifer subunit is lacking.

Although hydraulic property estimates for each of the aquifer subunits is lacking, an aquifer test was conducted by Clearwater Geosciences using the proposed point of diversion as the pumping well on July 28, 2011 (Clearwater Geosciences, 2011). The well was pumped at a rate of 5,117 gpm for four days. The test results were used to estimate aquifer properties in the area and to predict drawdown from pumping the proposed point of diversion at the rate applied for in the transfer application (4 cfs). The simulation of the pumping of this well at 1,800 gallons per minute for 6 months resulted in an estimated drawdown of 14 feet at the pumping well and 4 feet at a distance of ¼ mile from the pumping well (Clearwater Geosciences, 2011).

5. What is the impact of pumping from the proposed point of diversion on rising water in the Big Lost River?

The impact of pumping from the proposed point of diversion on the rising water in the Big Lost River is indirect, but important. The pumping at the proposed point of diversion will lower the aquifer level in the area of the well. Historically, lowering of aquifer water levels has caused the hydraulic connection between the river and the aquifer to migrate up-valley and reduce the volume of water flowing in the Big Lost River. Available data indicate that seepage from the Big Lost River and diversion infrastructure is the source of the rising water. Therefore, moving the separation line between the aquifer and the river up-valley will tend to reduce the volume of rising water near Arco.

As described above, the predicted impacts at the pumping well from the approval of this transfer would be approximately 14 feet at the pumping well and approximately 4 feet at a distance of ¼ mile from the well. Moving the point of diversion up-valley will cause greater impacts to the currently connected reach of the river which will move the connection point between the river and the aquifer further up the valley.

6. What would be the impact on rising waters of pumping Parkinson's water right from the existing points of diversion?

The impact on rising water from pumping at the existing points of diversion are likely not significant since the existing points of diversion are located southwest of the area of rising water. In addition, in one of the existing points of diversion, the first water encountered was approximately 50 feet below land surface, below a significant sequence of clay (Figure 10). It appears the water being pumped at the existing point of diversion has already infiltrated below the depth of the perching clay layers near Arco.

Any impacts to rising water from pumping at this location will be due to lowering of the aquifer levels in the area west of Arco and allowing the uppermost aquifer subunit water (rising water) to drain into lower deep subunit through non-continuous clay units or through the un-sealed annular space in the numerous wells completed in the area. It can reasonably be assumed that pumping from wells completed in the uppermost aquifer subunit would have a more significant and direct impact on the rising water than the pumping of a deeper well (such as the existing PODs) due to the existence of numerous clay layers that separate the aquifer subunits in this area.

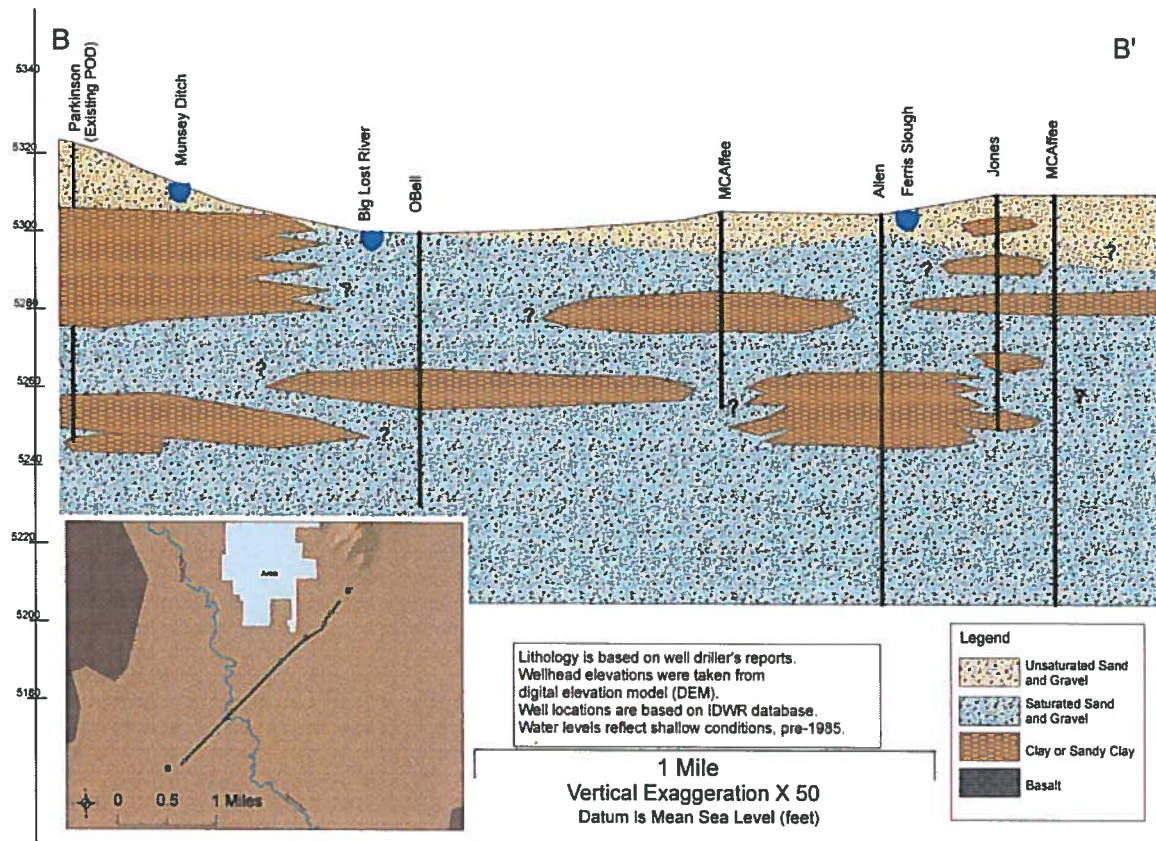


Figure 10. Generalized geologic cross section B-B'.

7. Over the last 20 years, what are the quantities of water diverted by Water District 34 and delivered for ground water recharge?

The aquifer has been recharged by river seepage for as long as water has flowed in the valley, hence the name Big Lost River. Aquifer recharge increased with the development of canals and water delivery systems that have been shown to have high seepage rates. In the 1990s, a managed recharge program was developed with the creation of a recharge committee and the approval of recharge water right permits 34-07571 and 34-07537. Initially, approximately 12 sites, both below and above Mackay Reservoir, were selected as suitable recharge locations. Currently, Water District 34 is diverting water for managed recharge at more than 20 sites in the basin.

Recharge records for Water District 34 are incomplete for the last 20 years. Some annual reports do not contain recharge volumes because of multiple years of low water supply, eliminating any recharge activities. It is unclear as to whether the reported recharge amounts reported for some years include water that incidentally recharged or if all of the reported values were managed recharge volumes.

Figure 11 shows the quantities of water diverted for ground water recharge in Water District 34 according to the watermaster's annual reports. It appears there may have been differences in what is considered recharge by the watermasters. For example, much of the water reported as recharge in the late 1990s was likely incidental recharge that occurred through the normal operations of the irrigation system. Allowing for natural variations in the available supply, the values reported by the current

watermaster do not match historic values (Totten, 2013). The values reported in the past four years appear to represent actual managed recharge volumes exclusive of incidental recharge.

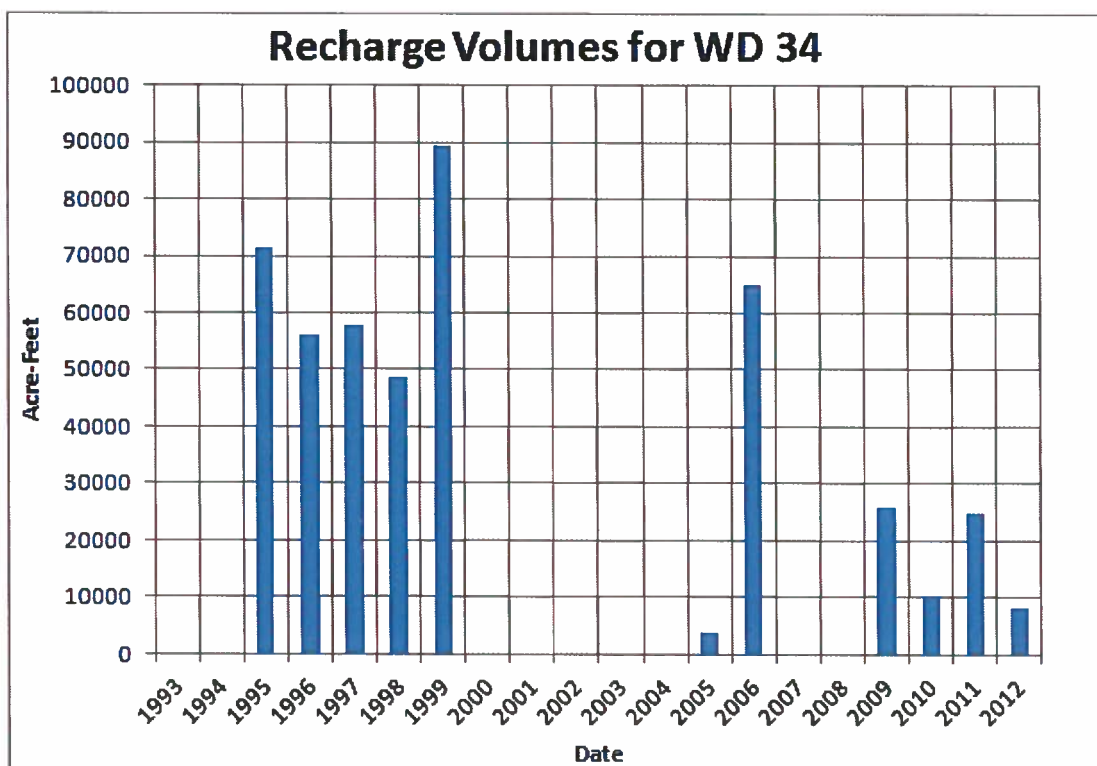


Figure 11. Historic recharge volumes for Water District 34.

Conclusions

Historically, ground water levels were high enough to sustain a hydraulic connection between the Big Lost River and the underlying aquifer system. This connection resulted in the Big Lost River flowing for a longer duration and further down the valley than what is observed today. Aquifer water level declines over the past few decades have reduced the length of river that is hydraulically connected and reduced the volume of the rising water.

Specific conclusions are as follows:

- Flow in the Big Lost River below Moore increases the likelihood that rising water will appear.
- Approval of the proposed transfer will result in a further separation of the Big Lost River and the aquifer near Moore. Since water in the river below this point is considered the source of the rising water near Arco, approval of this transfer will further reduce the likelihood that rising water will appear.
- The incidental leakage through the delivery of the 4 cfs proposed in this transfer will not overcome the impacts from lowering the water table at the current hydraulic connection point. At the point where the river and the aquifer are connected, there is a constant and significant supply of ground water from the deep aquifer subunits entering the river and the uppermost aquifer subunit. The leakage back to the aquifer from the diversion of the proposed transfer will be a volume less than the total 4 cfs pumped from the aquifer.

- If aquifer levels were to return to “pre-1985” conditions, the rising water would be more likely to appear, even during low water years.
- Based on the hydrographs of the observation wells in the area, aquifer water levels may return to “pre-1985” conditions following several good water supply years that would help facilitate rising water.
- Due to the rising waters being virtually absent for the past few decades, many of the diversion structures have been buried or filled in. If the rising waters were to return at a substantial amount of flow, maintenance work will be required to facilitate diversion and delivery of the water.

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Appendix A -- Regional Well Hydrographs

