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BEFORE THE IDAHO DEPARTMENT OF WATER RESOURCES

IN THE MATTER DESIGNATING THE EASTERN SNAKE PLAIN AQUIFER GROUND WATER MANAGEMENT AREA	)	Docket No. AA-GWMA-2016-001 **FREMONT MADISON IRRIGATION DISTRICT, MADISON GROUND WATER DISTRICT AND IDAHO IRRIGATION DISTRICT'S RESPONSE TO IDWR'S RESPONSE TO EXPERT REPORTS**

COMES NOW, Fremont Madison Irrigation District, Madison Ground Water District and Idaho Irrigation District (collectively hereinafter referred to as "UV"), acting for and on behalf of their members, by and through undersigned counsel, and pursuant to the Scheduling Order For Hearing contained in the Idaho Department of Water Resources' *Deadline for IDWR's Submittal of Materials; Order on Motion Practice; Notice of Hearing and Scheduling Order; Order*

Authorizing Discovery, dated September 25, 2019, UV hereby responds to IDWR's Response to Expert Reports:

1. Memo from Bryce A. Contor entitled *Reply to IDWR Response to Expert Report Regarding GWMA*, dated January 18, 2020.

Dated this 20th day of January, 2020.

RIGBY, ANDRUS & RIGBY LAW, PLLC

By: ______________________
Jerry R. Rigby, Esq.

CERTIFICATE OF SERVICE BY MAIL, HAND DELIVERY
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I hereby certify that a true and correct copy of the foregoing document was on this date served upon the persons named below, at the addresses set out below their name, either by mailing, hand delivery or by telecopying to them a true and correct copy of said document in a properly addressed envelope in the United States mail, postage prepaid; by hand delivery to them; or by facsimile transmission.

DATED this 20th day of January, 2020.

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MEMO

Date: January 18, 2020
To: Jerry Rigby, Hyrum Erickson
From: Bryce A. Contor
Re: Reply to IDWR Response to Expert Report Regarding GWMA

Bryce A. Contor

This document is Bryce Contor's reply to Jennifer Sukow's December 31, 2019 memo (Memo), regarding "Response to expert report in the matter of designating the Eastern Snake Plain Aquifer Ground Water Management Area, Docket No. AA-GWMA-2016-001" (Report). Excerpts quoted from the Memo will be in Times New Roman type, with italicization and indentation as in the original. Citations from the Report are in Tahoma type (the font of this paragraph) and underlined. Contor's replies to the Memo are in Tahoma type and indented.

Page 1-2

Contor does not explicitly delineate the boundaries.... For this memorandum, the extent of the Rexburg Bench delineated by Haskett (1972) was used in conjunction with the ESPA area of common ground water supply and ESPAM2.1 boundaries to identify the approximate extent of the Rexburg Bench.

> Sukow's delineation is acceptable.

Page 2-3

Rather than directly addressing the issue identified above, Contor reformulates the issue, stating his report addresses the question, "*Do the Rexburg Bench and the Eastern Snake Plain Aquifer (ESPA) comprise a single groundwater basin*?" and argues if not, "*then the Bench is sufficiently remote or disconnected to warrant exclusion....*" A technical evaluation of the degree of remoteness and hydrogeological disconnection can be presented without offering an opinion on sufficiency..."

"Sufficiency" is the meat of the admissible question, and to ignore it would have been a gross reformulation. My approach was an attempt to honor the intent of the admissible question by finding and addressing the technical content of its key component.

Page 3

Contor's reformulation of the issue and his conclusion… do not appear to rely on a technical evaluation of remoteness or hydrogeological disconnection….

On the contrary, all of my data and analyses speak directly to hydrogeological disconnection, distinctness, or remoteness.

Page 3

Contor cites portions of the definition of groundwater basins from several sources, but omits other portions…. The concept of defining areas of aquifer recharge and aquifer discharge, and the hydrogeological connectivity between these areas, is an important consideration for the delineation of a groundwater basin."

How much of a source to cite is always a judgment call. The Report focused on hydrogeological connectivity and remoteness. The Report and/or my follow-up work fit Sukow's framework in the following ways:

- The Bench and the plain have different areas and mechanisms of recharge. The primary recharge mechanism on the ESPA, documented in modeling reports, is incidental recharge from irrigation. This mechanism is virtually absent on the Bench except for a few pump stations from the South Fork on the south and limited diversions from Canyon Creek on the north. Primary Bench recharge is provided by precipitation (rainfall as well as snowmelt), underflow from the mountains to the east, and probably seepage from Canyon Creek and Moody Creek.
- The primary discharge mechanisms for the ESPA are discharges to the Snake River and springs, and pumping for irrigation. The discharge

mechanisms for the Bench are underflow to the plain and pumping for irrigation.

- The data indicate differing host materials for the productive portions of the aquifers.
- Rhyolites under the Bench differ in character from rhyolites beneath the plain.
- The Bench is structurally separate and distinct from the plain.
- There is no administratively-meaningful difference in technical ability to represent the effects upon the ESPA of pumping in the Rexburg Bench and pumping in excluded tributary groundwater basins.

Page 3-4

Contor also cites a portion of a groundwater basin definition from the California Department of Water Resources (2003), "*lateral boundaries can be 'features…such as rock or sediments with very low permeability or a geologic structure such as a fault'*." The full definition reads, "*A groundwater basin is defined as an alluvial aquifer or a stacked series of alluvial aquifers with reasonably-defined boundaries in a lateral direction and a definable bottom. Lateral boundaries are features that significantly impede groundwater flow such as rock or sediments with very low permeability or a geologic structure such as a fault. Bottom boundaries would include rock or sediments of very low permeability if no aquifers occur below those sediments within the basin. In some cases, such as in the San Joaquin and Sacramento Valleys, the base of fresh water is considered the bottom of the groundwater basin.*" Although aspects of this definition are specific to groundwater conditions in the State of California, the concept of lateral and vertical boundaries based on features that significantly impede groundwater flow is a general concept that can be applied in other areas.

The Memo is also abbreviated, omitting the citation that groundwater basins can be "open at one or more places to other [groundwater] basins."

Though abbreviating the citation, I did not abbreviate discussion of the important lateral boundaries. Nevertheless, my discussion of vertical boundaries (aquifer bottom) could have been more complete. Both groundwater basins are likely underlain at depth by similar geologic structures, but the productive aquifer in the ESPA groundwater basin near the Bench is hosted in alluvium overlying fractured basalt, with unproductive rhyolite at greater depth. The productive aquifer in the Bench tributary groundwater basin is hosted fractured rhyolites and overlying fractured basalts.

Page 4

Topography, Geology, and Hydrogeology

As mentioned by Contor, Haskett (1972) describes the topography, geology, and hydrogeology of the Rexburg Bench. Haskett described the Rexburg Bench as a broad apron extending northwest from the Big Hole Mountains to the margin of the Snake River Plain, with elevations ranging from approximately 6,500 feet at the base of the mountains to about 5,000 feet at the margin of the bench.

While the geology of the Rexburg Bench is complex, very productive wells have been developed in both the basalt and rhyolite underlying the Rexburg Bench. Haskett noted yields ranging from 925 to 3,500 gallons per minute (gpm) in wells developed in basalt and from 800 to 3,600 gpm in wells developed in rhyolite. High well yields are common in Quaternary basalt underlying the Eastern Snake Plain, but highly productive wells developed in rhyolite are less common. Haskett noted the rhyolite underlying the Rexburg Bench yields greater volumes of water than is usually obtained from rhyolite wells drilled "elsewhere about the Snake Plain." Haskett mentions jointing, the presence of fragmental tuffs, and faulting and associated fracturing as possible explanations for the relatively high permeability of rhyolite underlying the Rexburg Bench.

I do not understand the purpose of this recitation. Nevertheless, the presence of productive wells in two locations does not require that the two be hydraulically connected.

This passage does document difference in character between the Bench rhyolites and the ESPA rhyolites, supporting my assertion of different aquifer hydraulic characteristics.

Page 5

A second possibility is suggested by the anamolous [spelling in Memo] *north and northwest directed gradient....*

The anomalous gradient is a hydrogeologic distinction between the Bench and the ESPA.

Page 6

Considerable groundwater development has occurred on the Rexburg Bench since Haskett's study. Records of groundwater rights developed for irrigation use on the Rexburg Bench show that groundwater development for irrigation has almost doubled since the end of the 1970 irrigation season. On the Rexburg Bench, licensed and decreed water rights developed solely for irrigation with priority dates of 1970 or earlier have a total authorized diversion rate of approximately 418 cfs, while those with priority dates of 1971 or later have a total authorized diversion rate of approximately 384 cfs. Groundwater irrigation water rights on the Rexburg Bench have a mean authorized diversion rate per well of approximately 540 gpm and a maximum authorized diversion rate per well of 3,870 gpm. These values are consistent with the well yields reported by Haskett and support the conclusion that groundwater beneath the Rexburg Bench has a strong hydrogeological connection with the regional Eastern Snake Plain aquifer system. While not all of the geologic materials beneath the Rexburg Bench have high permeability, substantial portions of the basalt and rhyolite rocks have very high permeability,...

The existence of highly-productive wells on the Bench is factually correct. However:

- Well productivity on the Bench is irrelevant to the question of remoteness and hydrogeologic disconnection. It does not follow that productive wells in two locations require communication between them.
- It is not part of the admissible question.
- The only information in this passage related to the admissible question is the indication that rhyolites beneath the Bench differ from those beneath the ESPA.

Page 5

… and the highly permeable deposits are well-connected with each other and with highly permeable sediment and basalt deposits outside of the Rexburg Bench.

> Total isolation is not required between adjacent groundwater basins.

Page 7

Static Water Levels in Wells

Contor's analysis of static water levels relied on data obtained from well drillers' logs. Well drillers' logs can be a valuable source of information, but determining groundwater elevations based on a large number of well drillers' logs may be unreliable without substantial effort to verify each well location and the corresponding ground surface elevation. Well drillers' log data sets also include a large number of single-residence domestic wells, which only need very small yields and may or may not be connected to the regional aquifer system in which the irrigation wells are developed.

> The vagaries of drillers' data are well known. However, the primary effect of these is to introduce variability into analysis, not bias. A strong advantage to drillers' data is a more robust spatial distribution.
>
> Questions relating to domestic wells apply equally to the Bench and to the ESPA.
>
> It is correct that some irrigation wells on the Bench are developed in the deeper rhyolite materials. It is also true that some irrigation wells on the plain are developed in deeper basalt materials. These facts of themselves do not inform whether the rhyolite wells are indeed in the regional aquifer system. Further, the term "regional aquifer system" could be inclusive of multiple groundwater basins, so this assertion does not require that the two groundwater basins be one. The statute

did not use the term "regional aquifer system" but the singular term "ground water basin."

Page 7

Water level measurements collected by the U.S. Geological Survey, Bureau of Reclamation, or other water management agencies are generally better sources of data for evaluating groundwater levels.

These sources tend to produce data of higher quality and lower quantity than the IDWR database that the Report used.

Page 7

Haskett presented water level data collected from wells on the Rexburg Bench by the U.S. Geological Survey, Bureau of Reclamation, pump contractors, and well drillers. Contor's static water level analysis is inconsistent with water level information presented by Haskett.

I do not perceive inconsistencies between the Report's analysis and Haskett's water-level data. Other than asserting contradiction with Haskett, the Memo does not respond to the static water level analysis in the Report. The essence of the analysis is that if the ESPA groundwater basin continued uninterrupted beneath the Rexburg Bench; if the Rexburg Bench were just an unrelated topographic feature overlaid upon a continuous extensive groundwater basin; then the behavior of wells would be consistent with what the surface of the groundwater basin would have been absent the unrelated topographic feature laid upon it.

The analysis in the Report was done by using Geographic Information Systems (GIS) software to extend the surface of the plain to the east, by connecting elevation contours between points north and south of the bench and then interpolating those to a surface. On the plain, the projected surface is exactly equal to actual ground surface. The elevation of this surface was extracted at the location of each well, and subtracted from the recorded water-surface elevation. This yielded what the depth-to-water in the well would be, if the ground surface were at the surface of this projected plain. A positive result indicates the water surface is below land surface elevation, and is interpreted as depth to water, while a negative result indicates that the water-surface elevation is above where the surface of the plain would be if it extended uninterrupted into the space occupied by the Bench.

The Report presents the results as "Figure 3. Static Water Levels Relative to Projected Surface." This is perhaps mis-named, as the analysis was derived from water-surface elevations. The Report shows that static water elevations in wells on the plain tend to be relatively uniform relative to the surface of the plain itself, while on the Bench, those static water elevations are often either much deeper relative to the projected surface of the plain than in wells on the plain itself, or above the elevation of the projected surface. While the 2013 data were fewer in number than the data originally used in the Report, repeating the analysis on the same spatial extent using 2013 data produced a result qualitatively the same. Figure R-1 (attached) shows the results of the analysis with the smaller numbers of data available in the 2013 data set, with the same symbology as used in the Report. Consistent with the initial analysis, the following was found:

- The wells on the plain show water-surface elevations 10 to 83 feet below the projected surface.
- Between one-third and one-half the wells on the bench show water-surface elevations more than 83 feet below the projected surface.
- No wells on the plain show water-surface elevations above the projected surface.
- More than one-third of the wells on the Bench show water-surface elevations above the projected surface.
- Because the projected surface rises to the east, the water-surface elevations in those wells are even higher relative to the actual plain itself, than relative to the projected surface.

The 2013 data did not contradict the prior analysis that had been done using IDWR well-log data. Not all the 2013 data could be linked back to well-completion data, but a review of selected data suggests that for the most part, wells with water levels far above the projected surface are wells completed in shallower wells, probably in an upper aquifer with lower-permeability materials restricting downward movement of water. This confirms the geologic complexity of the Bench asserted by Haskett.

Other data support this complexity and difference between the Bench and the plain. Madison Groundwater District officers Bevan Jeppesen and Rhett Summers provided locations of wells they know personally to have disparate water levels and completion depths within relatively close proximity. While not an exhaustive search, the associated drillers' logs (attached) confirm these differences. I was able to use aerial photography to confirm the well locations mapped in IDWR's database.

Near the center of the Bench is the Dale Jeppesen irrigation well, drilled to 1340 feet in 1982, with a driller-reported static water level 550 feet below land surface and water temperature of 69 degrees F. Approximately 1350 feet to the east and 30 feet lower in elevation (to the precision of 20 foot contours on a USGS topographic map) is the Shawn Webster domestic well, drilled to 265 feet in 1993 with a driller-reported static water level of 175 feet and water temperature of 50 degrees F.

Near the north margin of the Bench is the Summerco irrigation well, drilled to 1215 feet in 2004, with a driller-reported static water level 324 feet below land surface. Approximately 490 feet to the northwest and ten feet higher in elevation (interpolated from 20-foot contours) is the Roy and Bart Summers irrigation well, drilled to 330 feet in 1960 with a driller-reported static water level of 270 feet. Neither log provides temperature information.

Page 7

Haskett's contour map shows groundwater flowing… from underneath the Rexburg Bench to underneath the Eastern Snake Plain along the western margin of the bench.

The hydrogeologic meaning of this fact is that the Rexburg Bench is tributary to the ESPA, as I assert.

Page 8

Representation of the EPSA in Numerical Groundwater Flow Models

The locations of the Rexburg Bench, the ESPA area of common ground water supply, and the ESPA GWMA are shown in Figure 1. The ESPA area of common ground water supply was defined by CM Rule 50 in 1994 as "*the aquifer underlying the Eastern Snake River Plain as the aquifer is defined in the report, Hydrology and Digital Simulation of the Regional Aquifer System, Eastern Snake River Plain, Idaho, USGS Professional Paper 1408-F, 1992 excluding areas south of the Snake River and west of the line separating Sections 34 and 35, Township 10 South, Range 20 East, Boise Meridian.*" This report was one of a series of seven reports published by the USGS on the Snake River Plain Regional Aquifer-System Analysis (RASA) and the boundary is commonly referred to as the RASA boundary.

> The whole point of a Regional Aquifer System Analysis is to evaluate a *regional* aquifer system. While the authors never explicitly state that their evaluation comprises the groundwater basin, they take great pains to justify separation of the eastern and western aquifer. Given this careful justification and lack of similar discussion of other boundaries, it is a stretch of the imagination to assert that this study explicitly represented as a *regional aquifer system analysis* was an analysis of only part of one groundwater basin.

Page 9

The RASA boundary delineated in Garabedian (1992) and other reports in the RASA series is referred to as the "boundary of Eastern Snake River Plain" and is not referred to as a "basin" boundary. Multiple figures in these reports show the delineation of the Eastern Snake River Plain boundary within the larger Snake River Basin boundary, Figure 5 is an example from Garabedian (1992).

> In the nearly 20 years I have been involved in discussions referring to this figure, it has always been implicitly assumed that "Boundary of Snake River Basin" refers to the *surface* water basin, and that the two regional aquifers described (eastern and western) comprise the groundwater basins. Nowhere in the RASA documentation is it indicated that the intent of the broader boundary was to

describe a single groundwater. It is my experience that unless explicitly identified as a *groundwater* basin, at least initially, the word "basin" refers to surface topography.

Page 10

I found no indication in the RASA reports that the delineation of the RASA boundary was intended to delineate the entirety of a groundwater basin.

The notion of entirety is implicit in the plain-language meaning of the title "Regional Aquifer System Analysis," the pains taken to justify separation of the eastern and western aquifers, and the lack of justification for any other omission. The words "regional" and "system" point to a notion of inclusivity and not exclusivity.

Nowhere in the documentation is it stated that (except for the east/west separation) the RASA model did *not* comprise an entire groundwater basin.

Page 10

Lindholm (1994) describes the predevelopment water supply in the Eastern Snake Plain aquifer system as follows:

> *"Before large areas were irrigated, total average annual recharge to and discharge from the ground-water system in the main part of the eastern plain was about 3.9 million acre-feet. About 60 percent of the total recharge was from tributary drainage basins, 25 percent was from Snake River losses, and 15 percent was from precipitation on the plain."*

This designation of areas outside the plain as *tributary* is consistent with my assertion regarding the Bench.

Page 11

Goodell (1988) describes the impact of agricultural development in tributary drainage basins on water supply in the Eastern Snake Plain aquifer system as follows:

> *"In some tributary basins, agricultural development and consequent crop evapotranspiration of surface and ground water have reduced available water flowing to the plain. Most water available to the Snake River Plain originates as surface-water inflow and ground-water underflow from tributary basins. Kjelstrom (1984) estimated available water flowing from tributary basins to the eastern and western plain on the basis of (1) present irrigation development and (2) no development or reservoir storage in tributary basins. According to his figures, on the average, agricultural development in tributary basins has reduced annual available water flowing to the eastern plain by about 7 percent (10.972 MAF to 10.215 MAF)...for water years 1934-1980."*

This is simply a fact of the nature of tributary groundwater basins, and does not inform the admissible question.

Further, this citation does not distinguish the Bench from excluded groundwater basins.

Page 11

Garabedian (1992) used the RASA model to simulate the effect of changes in boundary flux (underflow from tributary drainage basins) on aquifer heads and aquifer discharge to the Snake River. For example, Figure 6 shows the predicted head response at a well located approximately 10 miles from the Rexburg Bench resulting from a 50% increase or a 50% decrease in boundary flux. Change in consumptive use of groundwater for irrigation within a tributary drainage basin is one example of a change in boundary flux. Garabedian's simulations illustrate that changes in consumptive use of water outside of the RASA boundary affect aquifer heads within the RASA boundary.

This is simply a hydrologic fact of the nature of tributaries, and does not inform the admissible question. It applies to all tributary groundwater basins.

Page 12

As mentioned by Contor, other groundwater flow models of the Eastern Snake Plain aquifer system were developed after the completion of the RASA project and the promulgation of CM Rule 50. Model boundaries were different for each model, but all of the models used specified flux

The definition of hydraulic connection is that signals propagate *both directions.* Choosing a specified-flux boundary guarantees that the model cannot represent propagation of effects from the model into a tributary groundwater basin, and so by definition represents the tributary as *not* hydraulically connected.

Page 12

The Snake River Plain Aquifer Model (SRPAM) developed by Cosgrove and others (1999) described the Eastern Snake Plain as follows:

"The eastern plain is bounded structurally by faulting on the northwest and downwarping and faulting on the southeast (Whitehead, 1986).

As acknowledged by Sukow, the Bench is separated from the plain by faulting.

Page 12

The plain is bounded by Yellowstone Group rhyolite in the northeast

The aquifer on the plain adjacent and near the bench is primarily hosted in sediments and underlying basalts. The aquifer on the Bench is hosted in rhyolites and overlying basalts.

Page 13

Cosgrove and others (1999) did not describe the SRPAM model boundary as a delineation of a groundwater basin. Conversely, they stated, *"The Snake River Plain aquifer, underlying the eastern Snake River Plain, is hosted in layered basalts and interbedded sediments and is an integral part of the basin water resources."*

> A more likely interpretation is that Cosgrove and others used *basin* in the surface-water context that the RASA authors did; by convention, had they meant *groundwater* basin they would have said so. This is evidenced in Sukow's quote below, in which the authors refer to the desirability of a broader model to include both the "aquifer *and* the major tributaries" (emphasis added).

Page 13

Cosgrove and others specifically acknowledged that the SRPM model was not a basin-wide model and identify this as a limitation of the SRPAM. Cosgrove and others recommended:

> *"At some time in the future, it may be desirable to develop a basin-wide model representing the Snake River Plain aquifer and the major tributaries. This would allow prediction of impacts on the Snake River from scenarios incorporating changes in water management in both the plain and in tributary valleys."*

> To date, all the Snake Plain Aquifer models have been groundwater flow models. Calling for extension to a "basin-wide" model indicates an intent to link surface-water modeling to groundwater modeling. A derivative requirement may be to expand the horizontal extent of the model in order to capture the surface-water processes that extend over a larger horizontal landscape, necessarily requiring inclusion of tributary groundwater basins.

Page 13

While, the ESPAM2.1 model domain is still smaller than a basin-wide model, the expansion of the model domain into hydraulically-connected areas with significant irrigated acreage lessens the limitation described by Cosgrove and others. While the usefulness of the model as an administrative tool was considered in delineation of the model boundary for ESPAM, the expansion of the model into hydraulically-connected areas outside of the SRPAM and RASA model boundaries, including the Rexburg Bench, was scientifically sound and followed the recommendation of previous researchers.

> When we wrote the ESPAM1.1 report, we were very, very careful to avoid asserting that the newly included areas were part of the aquifer and the groundwater basin. We documented explicitly that the Rexburg Bench was a *tributary* incorporated for administrative convenience. Similar language appears in the ESPAM2.1 report.
>
> It is probably true that none of the model developers explicitly asserted that their model comprised the entire groundwater basin. However, neither did any assert that their model did *not* include an entire *groundwater* basin, except for the RASA authors' careful justification for separating the eastern and western plains.
>
> It is true that a groundwater model can be constructed to include a groundwater basin and adjacent tributary groundwater basins. For that matter, it could be constructed with a no-flow boundary separating two entirely unconnected aquifers in a single model, though it is hard to imagine a reason to do so.
>
> The discussions of groundwater-basin extent that *do* occur in model documentation highlight the implicit assumption that a regional aquifer model is intended to represent a groundwater basin:
>
> - The RASA authors carefully justify treating the western Snake Plain separately from the eastern Snake Plain.
> - The ESPAM1.1 and ESPAM2.1 authors carefully identify added areas as parts of *tributary* groundwater basins and avoid representing that they are part of the ESPA groundwater basin itself.

Page 13-14

Comparison to Areas Not Included in the GWMA

Contor identified 21 tributary basins (or portions of tributary basins) that are not included in the GWMA and states these areas are "*presumably sufficiently distinct* *from the ESPA to warrant exclusion. Sixteen of these areas are less or similarly distinct from the ESPA than is the Rexburg Bench."* This presumption is inconsistent with the order designating the GWMA[1], which clearly states these areas were excluded from the GWMA because they are outside of the ESPAM2.1 model boundary:

> *"The ESPAM2.1 boundary is a reasonable administrative area because the Department currently lacks similar modeling tools and hydrologic data to administer outside the ESPAM2.1 model boundary, except for the Big Wood River Basin. Moreover, most of the ground-water irrigated land within the upper Snake River basin is located within the model boundary or, in the case of the Big Wood River and Raft River basins, in established management areas outside the model boundary."*

The location of the model boundary and its relationship to inclusion within a GWMA is not part of the admissible question. Nevertheless, having been raised, technical aspects of the issue require a reply.

From an administrative viewpoint, there are three technical functions required in assessing the effects that pumping in any tributary groundwater basin would have upon surface-water bodies on the plain that are hydraulically connected to the aquifer: 1) To what extent does pumping in the tributary affect the ESPA? 2) What fraction of that effect propagates to a given surface-water body? 3) What is the timing of that propagation of effect?

For the Rexburg Bench, Oakley Fan and the Big Lost River below the Mackay Dam, model estimates perform these functions. For tributary groundwater basins outside the model, these functions can be addressed as follows: 1) It is already established that pumping in all the tributaries propagates to the ESPA. 2) The steady-state fraction of effect that reaches a particular surface-water body can be readily calculated by distributing pumping in the tributary to the model's tributary-underflow cells, with results as precise as any other modeling result. For wells near the boundary, the nearest cell may be appropriate. For wells distance, the entire set of tributary-underflow cells would be more appropriate. Unless the surface-water body of interest is near the tributary in question, the practical difference will be small. 3) I addressed the question of timing of effects for IDWR while at the Idaho Water Resources

[1] *Order Designating the Eastern Snake Plain Aquifer Ground Water Management Area*, Idaho Department of Water Resources, November 2, 2016, Conclusions of Law 18 through 21.

Research Institute, for an evaluation regarding flows at Swan Falls. I used a version of the Balmer/Glover/Jenkins analytical method adapted for no-flow boundaries (Contor 2011) to estimate the timing of effects from the point of pumping to the aquifer boundary, and used the transient version of the model to propagate that effect from the aquifer boundary to the surface-water body of interest. Other analytical methods such as the Cooper-Jacob method (1946) or image-well analysis (Ferris and others 1962, Freeze and Cherry 1979) could also be used. Due to calibration of model parameters, estimates of timing within the model domain are likely to be more precise than estimates for the part of the tributary outside the model. Nevertheless, it is my experience that precise estimates of timing are not critical; for most administrative questions the decision depends on the magnitude of effect that occurs, regardless of the temporal delay that may accompany its arrival.

The hydrogeologic fact remains that there are 16 excluded groundwater basins either less or equally distinct from the ESPA than is the Rexburg Bench. Because there is no technical reason to use the model boundary as a criterion for inclusion, it is my professional opinion that it is arbitrary to include the Rexburg Bench while excluding basins that are not more distinct from the ESPA.

Page 14

Other areas identified by Contor as being "*less or similarly distinct from the ESPA than is the Rexburg Bench*" have considerably less groundwater development than the Rexburg Bench.

The extent of groundwater development is irrelevant to the question of hydrogeologic distinction and is not part of the admissible question.

Page 14

As discussed previously, the ESPAM2.1 is not a basin-wide model...

It is not a model of an entire *surface-water* basin with linked surface-water and groundwater modeling.

...and groundwater use in tributary areas does affect groundwater and/or surface water inflow to the Eastern Snake Plain.

This is simply a characteristic of tributary groundwater basins. It applies equally to the excluded groundwater basins and to the Bench.

Page 14

Conclusions of law 17 through 21 acknowledge that the GWMA designation only includes part of the groundwater basin and explain the reasoning for the delineation of the GWMA boundary.

The order creates a novel concept of a macro groundwater basin comprised of aggregated adjacent groundwater basins. While the parallel reasoning to the accepted nesting of surface-water basins is attractive, the surface-basin nesting occurs in an environment of unambiguous and unchanging relationships of hydraulic gradients. I have never heard of the macro-groundwater-basin concept anywhere else and consequently know of no arguments for or against it. However, I do know the plain-language meaning of the singular word "basin" as used in the GWMA statute.

The Memo accepts this novel macro-basin construction as settled hydrogeologic and administrative fact, presents analyses through that lens, and in so doing presupposes the outcome of the hearing.

Page 15

Conclusions

Although there are topographic, geologic, and structural differences between the Rexburg Bench and the Eastern Snake Plain, formal geologic work indicates there is a strong hydrogeological connection between groundwater underlying the bench and groundwater underlying the plain. Faulting and the presence of different geologic materials do not make an area hydrogeologically distinct from an adjacent area unless they significantly impede groundwater flow or result in a significantly different bulk permeability. High yields in wells developed in multiple rock types underlying the Rexburg Bench were documented by Haskett, and also are evident in the subsequent development of groundwater rights for irrigation.

Haskett indicates that the well productivity on the Bench is from rhyolite host materials and facilitated by fracturing within the rhyolite. This speaks to difference and not to similarity; production on the adjacent plain is from sedimentary deposits and inter-flow rubble zones.

Page 16

Groundwater development on the Rexburg Bench extends to the margin of the bench, immediately adjacent to the Eastern Snake Plain, indicating groundwater underlying the bench is not remote from the Eastern Snake Plain aquifer system.

Adjacency of wells to the edge of a groundwater basin alone does not provide information about its extent. There are places such as the Little Lost where groundwater development extends to the margin of an aquifer, without indicating that adjacent geologic materials are part of the groundwater basin.

Page 16

...model developers acknowledged that activities occurring outside of the active model domain do impact the boundary flux and affect aquifer heads within the model boundary.

This is simply evidence that the Rexburg Bench is tributary, as I assert.

Page 16

The developers of the SRPAM, which was the most recent model that excluded the Rexburg Bench from the active domain, specifically identified this as a limitation of the model and recommended a "basin-wide" model be developed in the future to allow predictions of impacts on the Snake River resulting from changes in water management in areas which affect the boundary flux.

From the beginning of my membership on the modeling team in 2001, when we referred to a "basin-wide" model, I thought we meant linked surface-water/groundwater modeling.

Page 16

More recent models of the Eastern Snake Plain aquifer system were expanded to partially address the recommendation of the SRPAM developers. The expansion of the active model domain included the Rexburg Bench and other areas that are hydraulically connected with the ESPA system.

> We were very careful in our documentation of ESPAM1.1 to indicate that the included areas were tributary, and not to represent them as part of the same groundwater basin. Authors of ESPAM2.1 used similar language.

Page 16

In my professional opinion, references to the Rexburg Bench and other areas as "tributary drainage basins" or "tributary basins" in model development reports do not exclude them from being part of a larger groundwater basin. It simply means they are tributary to the active model domain, which does not represent an entire groundwater basin. Further, the Rexburg Bench is located within the active model domain in recent models of the Eastern Snake Plain aquifer system and is not represented as a "tributary basin" in models developed within the last 20 years.

> Since there is no modeling-code designation of "tributary" area, it is true that those *models* cannot explicitly represent the Rexburg Bench as tributary. However, the model documentation *does* in both cases.

Page 16

In my professional opinion, available technical evidence indicates the Rexburg Bench is neither remote...

> I acknowledge that neither the Rexburg Bench nor most of the excluded tributaries are remote from the ESPA groundwater basin.

...nor hydrogeologically disconnected from the ESPA. In my professional opinion, the technical evidence indicates groundwater underlying the Rexburg Bench is hydrogeologically connected to groundwater underlying the Eastern Snake Plain, and both areas are located within the same groundwater basin.

> While the Bench is not as isolated as if it were in a porcelain bowl, porcelain bowls are rare in nature and some communication is expected between adjacent basins. Distinct lateral geologic boundaries, different sources and patterns of recharge and discharge, different hosting materials, different gradient directions, and different character of wells relative to a projected surface of the plain all indicate differences between the Rexburg Bench groundwater basin and the adjacent ESPA groundwater basin, and evidence limitations on full and unfettered communication.
>
> Other basins less distinct from the ESPA basin than is the Rexburg Bench have been arbitrarily excluded, despite the existence of technical methods to perform all analyses necessary for administration.

References

Contor, B. 2011. Adaptation of the Glover/Balmer/Jenkins Analytical Stream-Depletion Methods for No-flow and Recharge Boundaries. Idaho Water Resources Research Institute Technical Completion Report 201101.

Cooper, H.H. and C.E. Jacob, 1946. *A generalized graphical method for evaluating formation constants and summarizing well field history*, Am. Geophys. Union Trans., vol. 27, pp. 526-534.

Ferris, J.G., D.B. Knowles, R.H. Browne, and R.W. Stallman, 1962. Theory of aquifer tests. USGS WSP 1536-E

Freeze, R. A. and J.A. Cherry, 1979. Groundwater. Prentice-Hall, Inc., Englewood Cliffs, NJ, 604 pp.

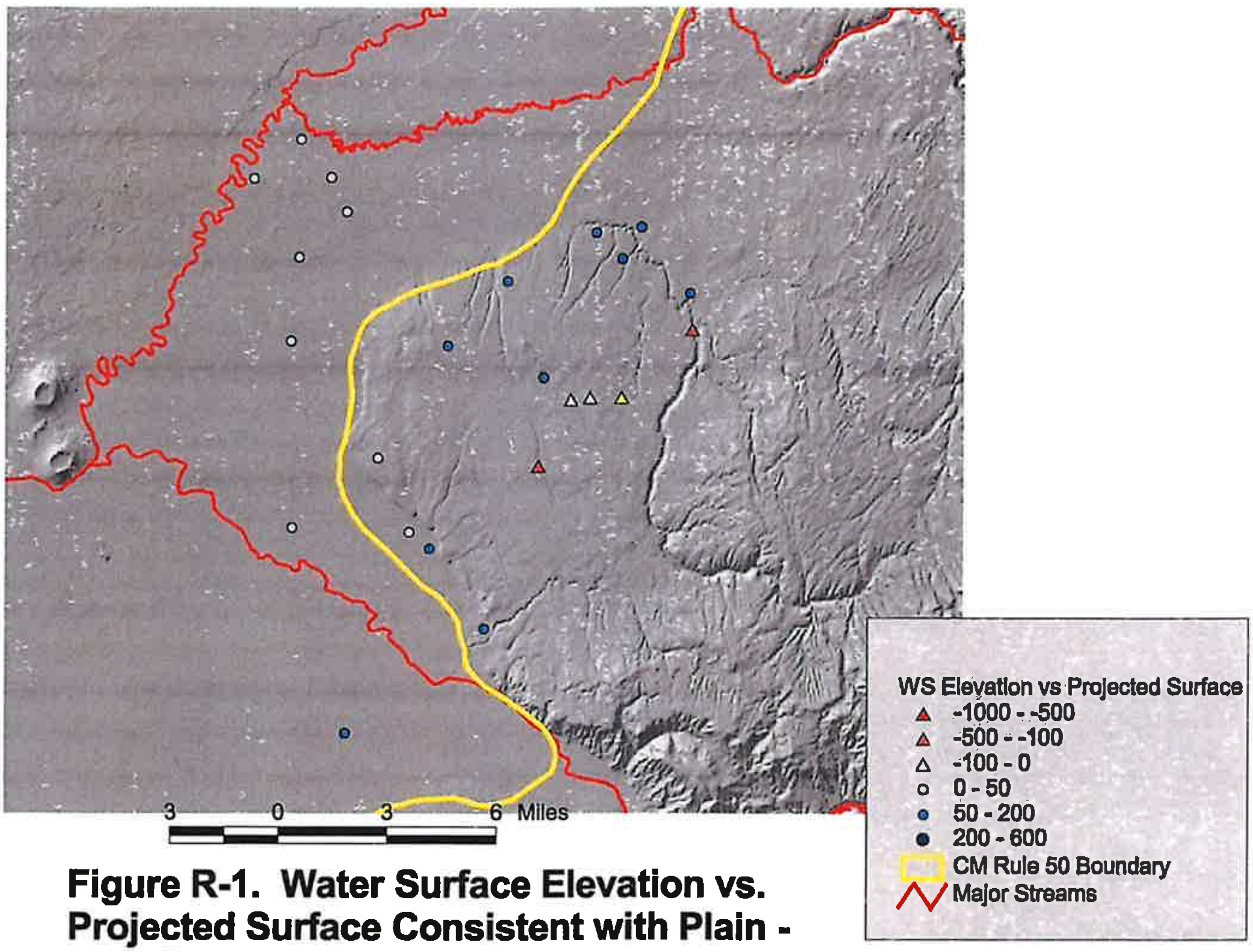


Figure R-1. Water Surface Elevation vs. Projected Surface Consistent with Plain - 2013 Data

Form 238-7
1/78

STATE OF IDAHO
DEPARTMENT OF WATER RESOURCES

WELL DRILLER'S REPORT

USE TYPEWRITER OR BALLPOINT PEN

RECEIVED JUL 7 1982
Department of Water Resources Eastern District Office

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.

1. WELL OWNER

Name Dale Jeppesen

Address North of Rexburg

Owner's Permit No. 22-7377

2. NATURE OF WORK

☒ New well ☐ Deepened ☐ Replacement
☐ Abandoned (describe method of abandoning) ________

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	20	inches +	2	feet	811	feet
.250	inches	16	inches	700	feet	865	feet
	inches		inches		feet		feet
	inches		inches		feet		feet

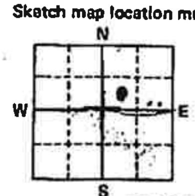
Was casing drive shoe used? ☒ Yes ☐ No
Was a packer or seal used? ☐ Yes ☒ No
Perforated? ☒ Yes ☐ No
How perforated? ☐ Factory ☒ Knife ☐ Torch
Size of perforation ____ inches by ____ inches

Number		From		To	
240	perforations	300	feet	850	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 300' Material used in seal: ☐ Cement grout ☐ Puddling clay ☒ Well cuttings
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 2" pipe north

6. LOCATION OF WELL

Sketch map location must agree with written location.



Subdivision Name ________

Lot No. ____ Block No. ____

County Madison County

SW ¼ NE ¼ Sec. 7, T. 5 N, R. #1 E

7. WATER LEVEL

Static water level 550 feet below land surface.
Flowing? ☐ Yes ☒ No G.P.M. flow ____
Artesian closed-in pressure ____ p.s.i.
Controlled by: ☐ Valve ☐ Cap ☐ Plug
Temperature 69 °F. Quality good

8. WELL TEST DATA

☒ Pump ☐ Bailer ☐ Air ☐ Other ____

Discharge G.P.M.	Pumping Level	Hours Pumped
800	700'	4 hrs.
2800	600'	4 hrs.

9. LITHOLOGIC LOG 079418

Hole Diam.	Depth From	Depth To	Material	Water Yes	Water No
24"	0	4	top soil		X
24"	4	85	black lava (blasting steady)		X
24"	85	102	clay & red & black lava		X
24"	102	120	brown rylite		X
24	120	140	red & brown rylite		X
24	140	155	hard gray rylite		X
24	155	170	black sticky clay (oily)		X
24	170	200	brown & black rylite		X
24	200	215	black & grey rylite		X
24	215	230	red chock		X
24	230	255	black lava		X
24	255	260	brown clay		X
24	260	315	red & black lava 25GPM	X	
20	315	360	brown clay		X
20	360	385	blue clay		X
20	385	475	grey & blue gumbo clay		X
20	475	518	shale & gravel 90GPM.	X	
20	518	540	brown & grey sticky clay		X
20	540	720	blue & brown sticky clay		X
16	720	783	blue sticky clay		X
16	783	800	grey shale	X	
16	800	812	brown clay		X
16	812	835	black rylite		X
16	835	845	sand		X
16	845	890	black rylite (no cuttings)	X	
16	890	915	red cinder rock no cuttings	X	
16	915	1000	red & black rylite		X
16	1000	1020	red cinder rock no cuttings	X	
14	1020	1040	red clay		X
14	1040	1090	black hard rylite		
14	1090	1110	black cinders	X	
14	1110	1175	black rylite & grey rylite		X
14	1175	1200	black rylite (soft)	X	
14	1200	1265	brown rylite		X
14	1265	1300	black rylite	X	
14	1300	1340	cinders	X	

10.

Work started May 24, 1981 finished June 30, 1982

11. DRILLERS CERTIFICATION

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

Firm Name Rocky Mt. Well Drilling Firm No. 299

Address Box 756 Rexburg Date 6-30-82

Signed by (Firm Official) Marcus Franzen

and

(Operator) Marcus Franzen

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

Form 238-7
6/93

DWD ✓

IDAHO DEPARTMENT OF WATER RESOURCES
WELL DRILLER'S REPORT

Use Typewriter or Ball Point Pen

702333

1. DRILLING PERMIT NO. 22-93-E-132 - 000
Other IDWR No. ______

2. OWNER:
Name Shawn Webster
Address 4100 S 1100 E
City Rexburg State Id. Zip 83440

3. LOCATION OF WELL by legal description:
Sketch map location must agree with written location

T. 5 North ☒ or South ☐
R. 41 East ☒ or West ☐
Sec 8 SE 1/4 NW 1/4 ___ 1/4 (10 acres, 40 acres, 160 acres)
Gov't Lot ______ County ______

Address of Well Site 2000 S 5200 W
(Give at least Direction + Distance to Road or Landmark)

Lot No ______ Block No. ______ Subd Name ______

4. PROPOSED USE:
☒ Domestic ☐ Municipal ☐ Monitor ☐ Irrigation
☐ Thermal ☐ Injection ☐ Other ______

5. TYPE OF WORK
☒ New Well ☐ Modify or Repair ☐ Replacement ☐ Abandonment

6. DRILL METHOD
☐ Mud Rotary ☒ Air Rotary ☐ Cable ☐ Other ______

7. SEALING PROCEDURES

SEAL/FILTER PACK Material	From	To	AMOUNT Sacks or Pounds	METHOD
bentonite	0	40	200	ove bac

Was drive shoe seal tested? Y☐ N☒ How? ______

8. CASING/LINER:

Diameter	From	To	Guage	Casing	Liner	Steel	Plastic	Welded	Threaded
10	-5	20	250			☒	☐	☐	☐
6	2	238	250			☒	☐	☐	☐
						☐	☐	☐	☐
						☐	☐	☐	☐

Final location of shoes 238'
Top Packer or Headpipe ______ Bottom Tailpipe ______

9. PERFORATIONS/SCREENS
☒ Perforations Method ______
☐ Screens Type ______ Material ______

From	To	Slot Size	Number	Diameter	Tele/Pipe Size	Casting	Liner
200	238	3/8x3	40	6		☐	☒
						☐	☐
						☐	☐
						☐	☐

10. WELL TESTS:
☐ Pump ☐ Bailer ☒ Air ☐ Flowing Artesian

Yield gal./min.	Drawdown	Pumping Depth	Time
30	3	175	1 hr.

Temperature of water 50 Was a water analysis done? Yes ☐ No ☒
By whom? ______
Water Quality (odor, etc) ______
Bottom Hole Temperature ______

11. STATIC WATER LEVEL:
175 ft. below surface Depth artesian flow found ______
Artesian pressure ______ lb Describe access port well cap
Describe Controlling Devices: ______

12. LITHOLOGIC LOG: (Describe repairs or abandonment)

Bore Dia.	From	To	Remarks: Lithology, Water Quality & Temperature	GPM	SWL
10	0	11	clay		
10	11	40	black lava		
10	40	56	brown ryolite		
10	56	60	broken rock		
10	60	180	brown ryolite		
10	180	230	brown broken ryolite		
10	230	232	brown clay		
10	232	245	brown ryolite		
10	245	265	brown clay	30	175

RECEIVED
OCT 07 1993
Department of Water Resources

RECEIVED
SEP 30 1993
Department of Water Resources
Eastern District Office

OCT 26 1993

Date: Started 9-2-93 Completed 9-13-93

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

Firm Name High Plains Firm No. 299
Firm Official Marcus Francher Date 9-28-93
and
Supervisor or Operator ______ Date ______
(Sign once if Firm Official & Operator)

FORWARD WHITE COPY TO WATER RESOURCES

Form 238-7
6/02

22

IDAHO DEPARTMENT OF WATER RESOURCES
WELL DRILLER'S REPORT

Office Use Only
Well ID No.
Inspected by
Twp ___ Rge ___ Sec ___
___ 1/4 ___ 1/4 ___ 1/4
Lat: : : Long: : :

1. WELL TAG NO. D D0032441
DRILLING PERMIT NO.
Water Right or Injection Well No. 22-7515

2. OWNER:
Name SUNIMERCO INC
Address 27 NORTH 3000E
City SUGAR CITY State Id Zip 83448

3. LOCATION OF WELL by legal description:
You must provide address or Lot, Blk, Sub. or Directions to well.
Twp. 6 North ☑ or South ☐
Rge. 40 East ☑ or West ☐
Sec. 26, ___ 1/4 NW 1/4 NE 1/4 (10 acres, 40 acres, 160 acres)
Gov't Lot ___ County MADISON
Lat: : : Long: : :
Address of Well Site ___ City SUGAR CITY
(Give at least name of road + Distance to Road or Landmark)
Lt. ___ Blk. ___ Sub. Name ___

4. USE:
☐ Domestic ☐ Municipal ☐ Monitor ☑ Irrigation
☐ Thermal ☐ Injection ☐ Other ___

5. TYPE OF WORK check all that apply (Replacement etc.)
☐ New Well ☐ Modify ☐ Abandonment ☐ Other REP

6. DRILL METHOD:
☑ Air Rotary ☑ Cable ☐ Mud Rotary ☐ Other ___

7. SEALING PROCEDURES

Seal Material	From	To	Weight / Volume	Seal Placement Method

Was drive shoe used? ☑ Y ☐ N Shoe Depth(s) ___
Was drive shoe seal tested? ☐ Y ☐ N How? ___

8. CASING/LINER:

Diameter	From	To	Gauge	Material	Casing	Liner	Welded	Threaded
16"	505	696	.250	STEEL	☐	☑	☑	☐
18"	+1	520	.250	STEEL	☑	☐	☑	☐
14"	701	985	.250	STEEL	☐	☑	☑	☐

Length of Headpipe ___ Length of Tailpipe ___
Packer ☐ Y ☐ N Type ___

9. PERFORATIONS/SCREENS PACKER TYPE
Perforation Method ROLLER PERFORATOR
Screen Type & Method of Installation ___

	From	To	Slot Size	Number	Diameter	Material	Casing	Liner
16"	606	643	1"	3600	1/4	STEEL	☐	☑
14"	750	770	1"	1200	1/4	STEEL	☐	☑
14	825	860	1"	2700	1/4	STEEL	☐	☑

10. FILTER PACK

Filter Material	From	To	Weight / Volume	Placement Method

11. STATIC WATER LEVEL OR ARTESIAN PRESSURE:
324 ft. below ground Artesian pressure ___ lb.
Depth flow encountered ___ ft. Describe access port or control devices: ___
NEW WATER LEVEL

12. WELL TESTS:
☐ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian

Yield gal./min.	Drawdown	Pumping Level	Time

Water Temp. ___ Bottom hole temp. ___
Water Quality test or comments: ___
Depth first Water Encounter ___

13. LITHOLOGIC LOG: (Describe repairs or abandonment)

Bore Dia.	From	To	Remarks: Lithology, Water Quality & Temperature	Water Y	Water N
18"	660	696	SANDSTONE & CLAY		
16"	696	708	RHIOLITE BROWN		
16"	708	735	BLACK LAVA		
16"	735	737	BROWN CLAY		
16"	737	765	HARD BLACK BASALT		
16"	765	780	DECOMPOSED BASALT		
16"	780	795	BLACK LAVA		
	795	830	RED CLAY HARD STICKY		✓
	830	865	BLACK LAVA	✓	
	865	880	RED CLAY STICKY		✓
	880	920	BLACK RHIOLITE	✓	
	920	935	RED CLAY STICKY		✓
	935	985	BLACK RHYOLITE	✓	
14"	985	1097	BLACK LAVA	✓	
12	1097	1120	GRAY RHIOLITE	✓	
12	1120	1127	BROKEN RHIOLITE	✓	
12	1127	1195	REDISH RHIOLITE		✓
12	1195	1215	BROKEN RHIOLITE	✓	

RECEIVED
JAN 05 2005
Department of Water Resources
Eastern Region

TE-R PERF
14" PERF 879' TO 922' (2400) STEEL
14" PERF 939' TO 975' (2160) STEEL

Completed Depth 1215 (Measurable)
Date: Started 3/23/04 Completed 12/29/04

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 VOLLMER WELL DRILL Firm No. 383
Principal Driller [signature] Date 12/30/04
and
Driller or Operator II [signature] Date 12/30/04
Operator I [signature] Date 12/30/04
Principal Driller and Rig Operator *Required.*
Operator I must have signature of Driller/Operator II.

FORWARD WHITE COPY TO WATER RESOURCES

C25982 LOG AND REPORT TO THE
STATE RECLAMATION ENGINEER OF IDAHO

RECEIVED
APR 1 1960
Log No. Department of Reclamation
Rec. ________, 19__
Well No. ________
Permit No. G-8492
(DO NOT FILL IN)

~~Permit No.~~:

Owner Roy and Bert Summers Address Rexburg, Idaho.

Driller Lee Harris Address Rexburg, Idaho Lic. No. 139

Location of Well: ~~N.E.~~ NW ¼ NE ¼ Sec. 26 T. 6 N/S, R. 40 E/W Madison County,
S.E.¼ of 2E. and S.W.¼ of 23 6N 40E. S½ of S.W.½ Sec. 23
and ____ feet N/S, and ____ feet E/W from ____ Corner of ____ ¼ ____ ¼ Sec. ____

Size of Drilled Hole 19 inch Total depth of Well 330 ft.

Give depth of standing water from surface 270 ft. Water Temp. 54 °Farenheit

On pumping test delivery was 1680 g.p.m. or ____ c.f.s. Drawdown was 0 feet.

Size of pump and motor used to make the test 8inch column 200 horse motor

Length of time pumped during check was 4 hr., ____ minutes.

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

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

Water will be used for irrigation Weight of casing per linear foot ____

Thickness of casing no casing in hole Casing material ____
E.G., PIPE, CONCRETE, WOOD.

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

Number and size of perforations ____ located ____ feet to ____ feet from surface of ground.

Other perforations ____

Date of commencement of well ____ Date of completion of well Feb. 5 1960.

Type of well rig 28L Bucyrus-Erie Spudder

CASING RECORD

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

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

6N-40E —— 26 NWNE (4676)

22

025193

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	8	Topsoil				
8	70	Greysandstone med. hard				
70	80	Brown sand, hard				
80	86	Brown clay				
86	95	Brown and red sandy cinders				
95	130	Cinders and lava, crevices- cemented with 5 Yds. cement				
130	155	Grey lava				
155	175	Black and grey cinders				
175	190	Grey lava, crevices cemented with 3½ yds. cement				
190	200	Black lava, hard				
200	220	Brown cinders				
220	285	Brown, Grey and Red lava, very hard				
285	286	Soft spot, first water. Filled to 278'				
286	305	Black lava, sandy, very hard				
305	307	Soft break, water up to 270 ft.				
307	315	Black lava, very hard				
315	317	Hard shell				
317	330	Black cinders, soft				
		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 Lee Harris

By

License No. 139

Dated 8 Feb. 1960