Big Lost River Well Installation



Idaho Department of Water Resources

Report by Dennis Owsley

August 2019

Contents

Introduction	3
Walker Site	4
PU Ranch Site	7
Granite Trust Site	11
Barnes Site	
Rothwell Site	
Stennett Site	
Conclusions and Recommendations	23
Acknowledgements	23
Figure 1. Map of the monitoring well locations	4
Figure 2. Walker site map.	5
Figure 3. Lithologic and construction details for the Walker site wells	6
Figure 4. Drill rig at the Walker site.	7
Figure 5. Final well completions at the Walker site	7
Figure 6. PU Ranch site map.	8
Figure 7. Lithologic and construction details for the PU Ranch site	
Figure 8. Drill rig set up at the PU Ranch site	
Figure 9. Final completions of the PU Ranch wells.	
Figure 10. Granite Trust site map.	
Figure 11. Lithologic and construction details for the Granite Trust well	
Figure 12. Final wellhead completions for the Granite Trust wells.	
Figure 13. Barnes site map	
Figure 14. Lithologic and construction details for the Barnes site wells.	
Figure 15. Final wellhead completions for the Barnes site wells	
Figure 16. Rothwell site map.	
Figure 17. Lithologic and construction details for the Rothwell site wells.	
Figure 18. Drill rig at the Rothwell site.	
Figure 19. Final wellhead completions at the Rothwell site.	
Figure 20. Map of the Stennett site.	
Figure 21. Lithologic and construction details for the Stennett site wells.	
Figure 22. Well rig set up at the Stennett site.	
Figure 23. Final wellhead completions at the Stennett site.	22

Introduction

The Idaho Department of Water Resources (IDWR), through a Supplemental Environmental Project (SEP) grant from the United States Department of Energy, drilled and installed 18 shallow ground water wells in the Big Lost River valley in August of 2019. The purpose of the wells is to provide data to monitor ground water levels in the uppermost aquifer at various locations throughout the valley. Locations for the piezometers were selected based on the proximity to the Big Lost River and land owner permission. Ideally, the well locations would exist near an existing surface water gage site. Six locations were ultimately selected, ranging from south of Arco to south of Mackay (Figure 1). Four of the sites were privately owned, one was owned by the Idaho Department of Fish and Game, and one site was owned by the United States Bureau of Land Management (BLM). Access agreements were procured with all of the land owners and a contract was developed with a local drilling firm.

A hollow stem auger was used as the drilling method for these wells. IDWR staff observed and documented drill cuttings from all of the wells during the drilling, and split spoon samples were collected in five foot intervals on the deepest borehole at each site. Split spoon samples were logged and photographed to aid in the development of the lithologic profile for each site. All 18 of the wells were completed with 2" PVC casing, sand packs around the screened intervals, and full depth seals to the surface. Protective locking wellhead monuments were installed on each of the wells.

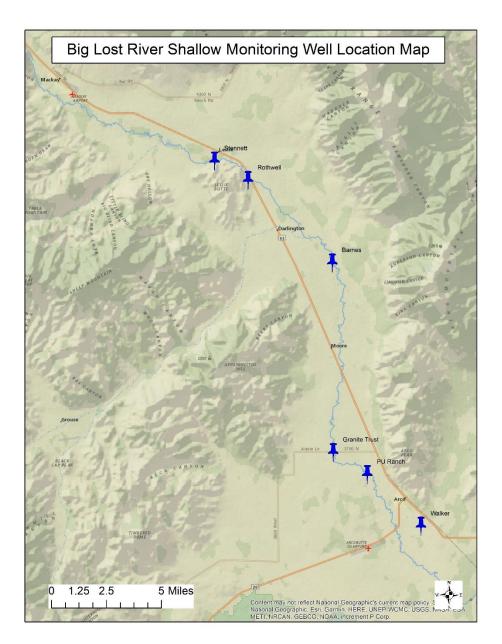


Figure 1. Map of the monitoring well locations.

Walker Site

The Walker site is located just south of Arco, Idaho, on a parcel of privately owned property (Figure 2). Drilling commenced on July 30, 2019 and was complete on August 1, 2019. The Walker site is approximately one mile east of the Big Lost River, and approximately 50' east of a lateral off of the Ferris Slough that was actively diverting water during the time of the drilling. Three piezometers were installed to depths of 20', 40' and 60'. An existing irrigation well completed to a depth of 80' is located approximately 50' to the northeast of the monitoring wells. Construction and lithologic details can be seen in Figure 3. The subsurface material encountered in these wells included 6' of topsoil, underlain by approximately 15' of gravels and sands. Beneath the gravels, fine grained sediments (clays and sands) made up the remained of the subsurface material. Dark heaving sands were encountered in the

bottom 12' that served as a natural filter pack for the 60' well. Depths to water in all three wells were similar, between 8 to 9' below land surface.

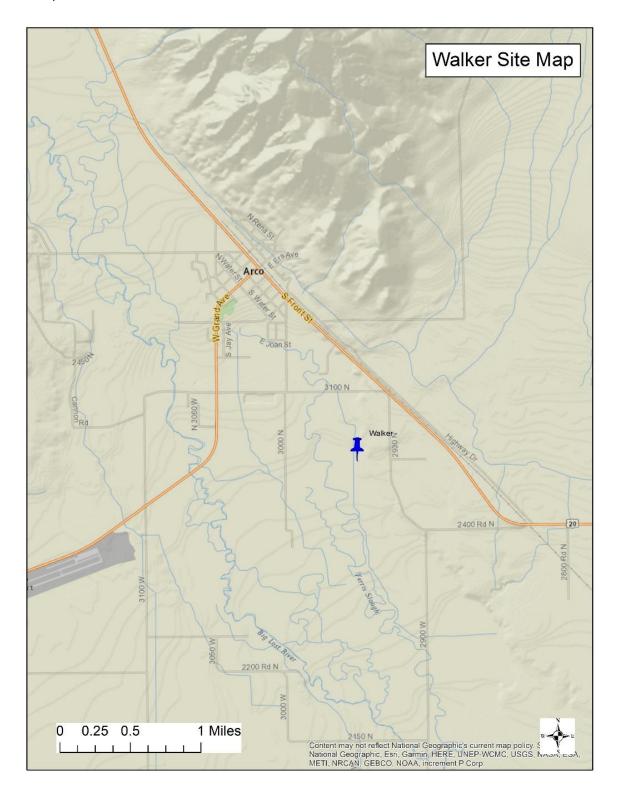


Figure 2. Walker site map.

Walker Site

by HazTech Drilling Inc (No. 470)

Start date: July 30, 2019 End date: August 1, 2019

Lithology 0-6' Silty brown topsoil. SS [5]: Brown soil, some tan clay present (85% recovery) 6-20' Gravel and sand. 10' SS [10]: Poorly sorted, variety of colors, angular gravel in a medium sand matrix. (20% recovery) SS [15]: Gravel in a sand matrix (20% recovery) 20' 20-25' Brown sticky clay. SS [20]: Sand and clay with gravel in top 5" (100% recovery) Water at 9' 25-29' Medium sands. SS [25]: Medium to fine sands, well sorted, tan clay in upper 6" (85% recovery) 30' 29-32' Clay SS [30]: Tan sticky clay with minor amounts of fine sands (85% recovery) 32-48' Sands and gravels. SS [35]: Medium to fine sands, well sorted (100% recovery) 40' SS [40]: No sample -- drill appears to be in sand SS [45]: Sand and gravel. Top 1/2 is sand, medium to fine, bottom 1/2 is gravel, poorly sorted in a sand matrix (85% recovery) 48-60' Dark heaving sands. 50' SS [50]: Sand and gravel. Top of spoon is a coarse sand grading finer with a gravel sequence in the bottom of sample (20% recovery) SS [55]: Sands, medium to fine grained, dark colored (100% recovery) SS [60]: Sands, medium to fine grained, dark colored. 2" of tan clay in bottom of sample (100% recovery) 60' Wells drilled with hollow-stem auger

Construction Details

Walker 20 -- D0083004 10' Schedule 40 2" PVC sceen [10-20'] 10' Schedule 40 2" PVC casing [+2.5-10'] Sand pack: 225 lbs. poured [8-20'] Well seal: 125 lbs. bentonite chips poured [surface-8'] DTW = 8.2' BLS

Walker 40 -- D0083005 10' Schedule 40 2" PVC sceen [30-40'] 10' Schedule 40 2" PVC casing [+2.5-30'] Sand pack: 250 lbs. poured [28-40'] Well seal: 300 lbs bentonite chips poured [surface-28'] DTW = 8.4' BLS

Walker 60 -- D0083005 10' Schedule 40 2" PVC sceen [50-60'] 10' Schedule 40 2" PVC casing [+2.5-50'] Sand pack: Natural material [46-60'] Well seal: 560 lbs cement through tremie [surface-46'] DTW = 8.8' BLS



Figure 3. Lithologic and construction details for the Walker site wells.

Site Location Information

Lat: 43.618 Long: -113.286

PLS: T03N R27E Section 06



Figure 4. Drill rig at the Walker site.







Figure 5. Final well completions at the Walker site.

PU Ranch Site

The PU Ranch site is located north of Arco, Idaho, on a parcel of privately owned property near the Arco Diversion (Figure 6). The site is located approximately 200' from the Big Lost River, which was flowing during the drilling. Drilling commenced on August 1, 2019 and was complete by August 2, 2019. Three piezometers were installed to depths of 20', 40' and 60'. Construction and lithologic details can be seen in Figure 7. The upper 37' of the subsurface was composed of gravel with sands. Below the gravels was a thick sequence of primarily dark sands with minor amounts of gravel. Water was encountered at approximately 5' below land surface. The depths to water in the 20' and 40' wells were similar, approximately 3' below land surface. The 60' well had a water level of approximately 8' below land surface, indicating a downward gradient between the two water bearing formations.

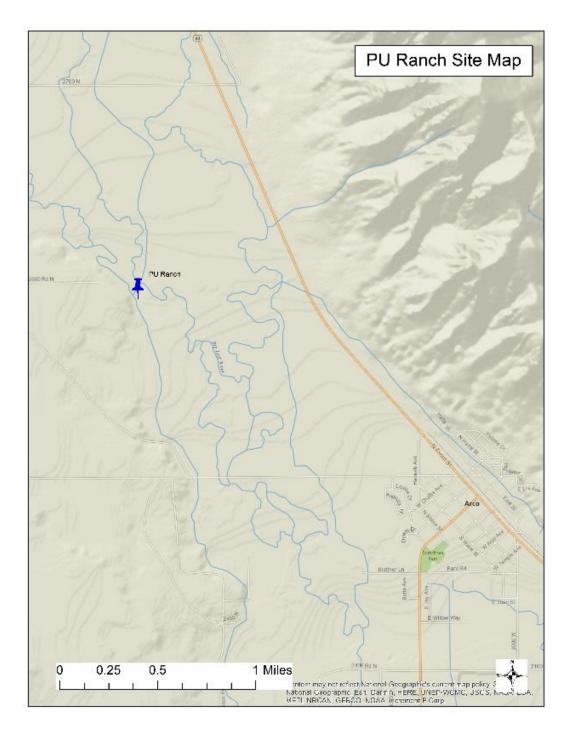


Figure 6. PU Ranch site map.

PU Ranch Site

Start date: August 1, 2019 End date: August 2, 2019

Lithology 0-3' Silty brown topsoil. 3-37' Sands and gravel. SS [5]: Poorly sorted, angular, dark sand with multiple colored gravels (15% recovery) 10' SS [10]: Medium/fine sand with gravel in bottom of sample (20% recovery) SS [15]: Coarse gravel in a medium/fine sand matrix (20% recovery) SS [20]: Large gravel in a sand matrix (15% recovery) 20' SS [25]: Gravel in a sand matrix (30% recovery) SS [30]: Fine gravel in a sandy clay matrix (30% recovery) SS [35]: Medium sand with small gravels (30% recovery) 37-60' Dark sands. 40' SS [40]: Sand. Dark colred, medium to fine grained (100% recovery) SS [45]: Fine sand with gravel. Dark sand with fine gravel. Minor amount of tan clay at bottom (80% recovery) 50' SS [50]: Very fine sand to silt (60% recovery) SS [55]: Fine to medium dark colored sands, well sorted (70% recovery) SS [60]: Fine to medium dark colored sand grading to silt. 60' Gravel at bottom (100% recovery) Wells drilled with hollow-stem auger Site Location Information by HazTech Drilling Inc (No. 470) Lat: 43.653 Long: -113.334

Construction Details

PU Ranch 20 -- D0082992 10' Schedule 40 2" PVC sceen [10-20'] 10' Schedule 40 2" PVC casing [+2.5-10'] Sand pack: 325 lbs. poured [8-20'] Well seal: 50 lbs. bentonite chips poured [surface-8'] DTW = 3.1' BLS

PU Ranch 40 -- D0082993 10' Schedule 40 2" PVC sceen [30-40'] 10' Schedule 40 2" PVC casing [+2.5-30'] Sand pack: 175 lbs. poured [28-40'] Well seal: 290 lbs cement through tremie [surface-28'] DTW = 3.3' BLS

PU Ranch 60 -- D0082994

10' Schedule 40 2" PVC sceen [50-60']

10' Schedule 40 2" PVC casing [+2.5-50']

Sand pack: 350 lbs poured [46-60']

Well seal: 540 lbs cement through tremie [surface-46']

DTW = 8.5' BLS



Figure 7. Lithologic and construction details for the PU Ranch site.

PLS: T04N R26E Section 23



Figure 8. Drill rig set up at the PU Ranch site.



Figure 9. Final completions of the PU Ranch wells.

Granite Trust Site

The Granite Trust site is located approximately five miles northwest of Arco, Idaho, on a parcel of privately owned property (Figure 10). The site is approximately 50' west of the Big Lost River channel, which was flowing at the time of the drilling. Drilling commenced on August 2, 2019 and was complete on August 3, 2019. Three piezometers were installed to depths of 20', 40' and 60'. Construction and lithologic details can be seen in Figure 11. Sequences of sands and gravels (primarily gravels) made up the lithology encountered while drilling these three wells. Depths to water were similar in all three wells, around 18' below land surface.

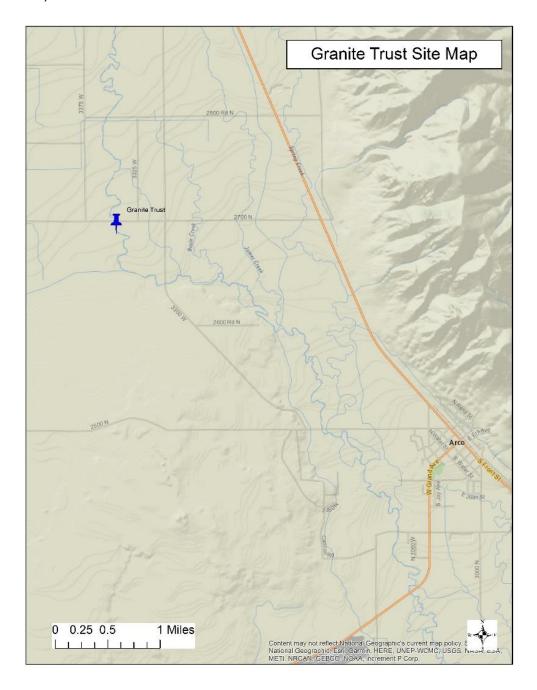


Figure 10. Granite Trust site map.

Granite Trust Site

Lithology 0-3' Silty brown topsoil. 3-28' Sands and gravel. SS [5]: Small gravel in a medium/fine sand (80% recovery) 10' SS [10]: Small gravel in a medium/fine sand (80% recovery) SS [15]: Gravel in a medium fine sand (70% recovery) SS [20]: Saturated gravel in a fine sand/silt matrix (60% recovery) SS [25]: Gravel in a medium sand matrix with some clay (40% recovery) 28-38' Sands with gravel. 30' SS [30]: Medium sand with large gravel (60% recovery) SS [35]: Coarse to medium sand, minor gravel (40% recovery) 38-42' Gravels and sand. 40' SS [40]: No sample, cobble blocking spoon 42-48' Medium sands. SS [45]: Medium to fine sand with some rounded gravels (60% recovery) 48-58' Gravel with sand. SS [50]: Poorly sorted gravel in medium sand matrix (50% recovery) SS [55]: Fine gravels in coarse sand (50% recovery) 58-60' Sands, medium to fine. SS [60]: Medium to fine sand grading into silt (80% recovery) 60' Wells drilled with hollow-stem auger Site Location Information by HazTech Drilling Inc (No. 470) Lat: 43.666 Long: -113.365 Start date: August 2, 2019 End date: August 3, 2019 PLS: T04N R26E Section 21

Construction Details

Granite Trust 20 -- D0082989
10' Schedule 40 2" PVC sceen [10-20']
10' Schedule 40 2" PVC casing [+2.5-10']
Sand pack: 325 lbs. poured [8-20']
Well seal: 150 lbs. bentonite chips poured [surface-8']
DTW = 17.9' BLS

Granite Trust 40 -- D0082990

10' Schedule 40 2" PVC sceen [30-40']

10' Schedule 40 2" PVC casing [+2.5-30']

Sand pack: 250 lbs. poured [28-40']

Well seal: 400 lbs bentonite chips poured [surface-28']

DTW = 17.8' BLS

Granite Trust 60 -- D0082991

10' Schedule 40 2" PVC sceen [50-60']

10' Schedule 40 2" PVC casing [+2.5-50']

Sand pack: 200 lbs poured [45-60']

Well seal: 540 lbs cement through tremie [surface-45']

DTW = 18' BLS



Figure 11. Lithologic and construction details for the Granite Trust well







Figure 12. Final wellhead completions for the Granite Trust wells.

Barnes Site

The Barnes site is located north of Moore, Idaho, on a parcel of privately owned property (Figure 13). The Big Lost River channel is approximately one quarter mile east of the drill site and was flowing during the time of the drilling. Drilling commenced on August 3, 2019 and was complete on August 4, 2019. Three piezometers were installed to depths of 20′, 40′ and 60′. Construction and lithologic details can be seen in Figure 14. Beneath the top 7′ of topsoil, saturated sands and gravels composed the majority of the subsurface encountered. The depth to water in all three wells was very similar, around 7′ below land surface.

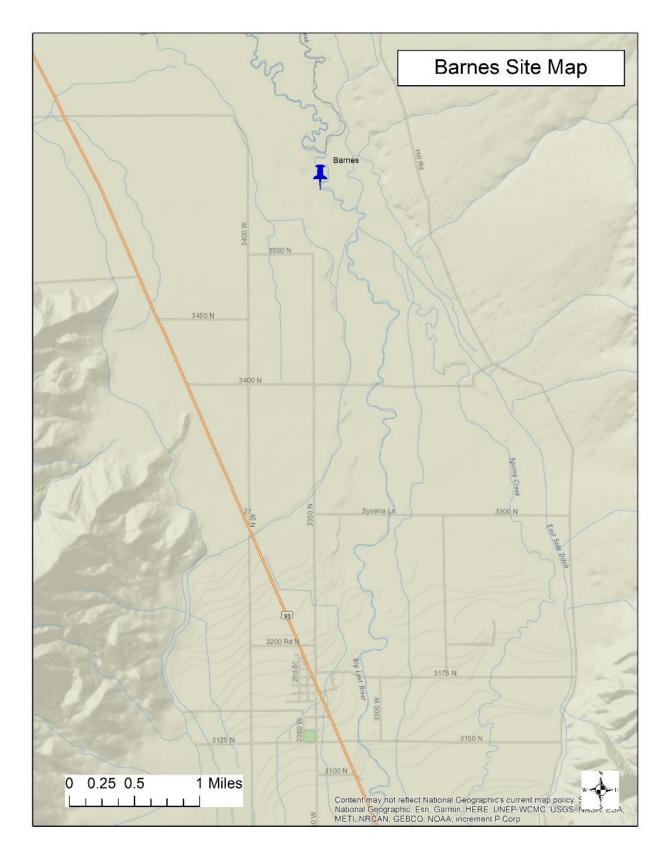


Figure 13. Barnes site map.

Barnes Site Lithology 0-7' Silty dark brown topsoil. SS [5]: Silt and clay, dark brown black (15% recovery) 7-60' Sands and gravel. 10' SS [10]: Saturated coarse sands grading into gravels (5% recovery SS [15]: Coarse sand and gravel (40% recovery) 20' SS [20]: Coarse gravel in a coarse sand matrix (50% recovery) SS [25]: Fine to coarse gravel in a coarse sand matrix (50% recovery) SS [30]: Fine to medium gravel, sub rounded and sub angular in coarse sand matrix (80% recovery) SS [35]: Very large gravel in silty sand matrix (60% recovery) SS [40]: Fine to coarse gravel in a coarse sand matrix (60% recovery) SS [45]: Mixed gravel in a mediume sand matrix (70% recovery) SS [50]: Fine gravel in a sand matrix (30% recovery) SS [55]: Fine to medium gravel in a fine sand/silt matrix (70% recovery) SS [60]: Coarse to fine gravel in sand and silt layers (70% recovery) Site Location Information

Construction Details

Barnes 20 -- D0082995
10' Schedule 40 2" PVC sceen [10-20']
10' Schedule 40 2" PVC casing [+2.5-10']
Sand pack: Natural material [8-20']
Well seal: 125 lbs. bentonite chips poured [surface-8']
DTW = 6.6' BLS

Barnes 40 -- D0082996
10' Schedule 40 2" PVC sceen [30-40']
10' Schedule 40 2" PVC casing [+2.5-30']
Sand pack: Natural material [30-40']
Well seal: 400 lbs cement through tremie [surface-30']
DTW = 7.3' BLS

Barnes 60 -- D0082997
10' Schedule 40 2" PVC sceen [50-60']
10' Schedule 40 2" PVC casing [+2.5-50']
Sand pack: 100 lbs poured [46-60']
Well seal: 500 lbs cement through tremie [surface-46']
DTW = 6.8' BLS



Wells drilled with hollow-stem auger by HazTech Drilling Inc (No. 470) Start date: August 3, 2019 End date: August 4, 2019

Figure 14. Lithologic and construction details for the Barnes site wells.

Lat: 43.792 Long: -113.367 PLS: T05N R26E Section 04



Figure 15. Final wellhead completions for the Barnes site wells.

Rothwell Site

The Rothwell site is located south of Leslie, Idaho, on a parcel of property owned by the United States Bureau of Land Management (Figure 16). The site is approximately 50' east of the Big Lost River, which was flowing at the time of the drilling. Drilling commenced on August 4, 2019 and was complete on August 5, 2019. Three piezometers were installed to depths of 20', 40' and 60'. Construction and lithologic details can be seen in Figure 17. The 20' well was dry upon completion and the water levels in the 40' and 60' wells were 28' and 43'BLS, respectively. The subsurface lithology was primarily sands and gravels.



Figure 16. Rothwell site map.

Rothwell Site

Lithology

0-24' Gravels with sands.

SS [5]: Mixed gravel (rounded and broken), various sizes, in a coarse sand matrix (40% recovery)

SS [10]: Gravels (mixed) in a dark sand matrix (80% recovery)

SS [15]: Gravels (mixed) in a dark sand matrix (85% recovery)

SS [20]: Gravels in a sand matrix. Old plastic and wood present (30% recovery)

24-38' Sands and gravel.

SS [25]: Sand with gravels. Moist at bottom, mostly sands with gravel intermixed. Wood fragments and traces of clay (85% recovery)

SS [30]: Sands and gravel. Water present. Coarse sands with gravels intermixed (60% recovery)

SS [35]: Saturated sands and gravel. Wide range of sizes, shapes, and colors (60% recovery)

38-60' Gravel and sands.

SS [40]: Saturated gravel in sand. Minor tan clay present. Clean washed gravel on top, grading into a sandy gravel (60% recovery)

SS [45]: Saturated gravel in sand. Clean, washed, well rounded gravel in top 6", grades into a sandy clay with gravel at bottom (50% recovery)

SS [50]: Large gravel in a fine sand/silt matrix. (45% recovery)

SS [55]: Large gravel in a clayey sand matrix (50% recovery)

SS [60]: Mixed gravel (rounded and broken), various sizes, in a sand matrix (70% recovery)

Wells drilled with hollow-stem auger by HazTech Drilling Inc (No. 470) Start date: August 4, 2019 End date: August 5, 2019

Il Site Construction Details

Rothwell 20 -- D0082998 10' Schedule 40 2" PVC sceen [10-20'] 10' Schedule 40 2" PVC casing [+2.5-10'] Sand pack: 350 lbs poured [8-20']

Well seal: 125 lbs. bentonite chips poured [surface-8'] DTW = DRY

Rothwell 40 -- D0082999

10' Schedule 40 2" PVC sceen [30-40']

10' Schedule 40 2" PVC casing [+2.5-30']

Sand pack: 100 lbs poured [28-40']

Well seal: 425 lbs bentonite chips poured [surface-28']

DTW = 27.9' BLS

Rothwell 60 -- D0083000 10' Schedule 40 2" PVC sceen [50-60'] 10' Schedule 40 2" PVC casing [+2.5-50'] Sand pack: 200 lbs poured [45-60'] Well seal: 500 lbs cement through tremie [surface-45'] DTW = 43.2' BLS



Figure 17. Lithologic and construction details for the Rothwell site wells.

Site Location Information

Lat: 43.847 Long: -113.442

PLS: T06N R25E Section 14

20'

30'



Figure 18. Drill rig at the Rothwell site.



Figure 19. Final wellhead completions at the Rothwell site.

Stennett Site

The Stennett site is located west of Darlington, Idaho, on a parcel of property owned by the Idaho Department of Fish and Game (Figure 19). Drilling commenced on August 4, 2019 and was complete on August 5, 2019. Three piezometers were installed to depths of 20', 40' and 50'. Construction and lithologic details can be seen in Figure 20. In general, the upper 50' of the subsurface at this site was gravel, underlain by a sequence of tan clay. Bedrock was encountered at 46' in the deep well and limited the total depth to 50', rather than the proposed 60' target depth. Based on the depths to water in the wells, it appears the river is perched in this area as the 20' well was dry, and depth to water in the 40' well was 39' and the depth to water in the 50' well was 47'.

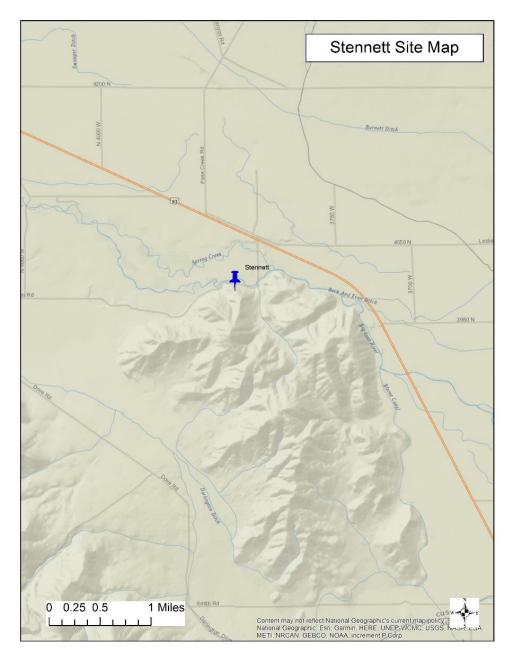


Figure 20. Map of the Stennett site.

Stennett Site

Lithology 0-7' Brown topsoil SS [5]: Brown topsoil. Silty and sandy (50% recovery) 7-19' Gravel in sands. 10' SS [10]: Rounded gravels in a dark sand matrix, large gravel blocking spoon opening (25% recovery) SS [15]: Small angular gravel in a dark sand matrix, large gravel blocking spoon opening, damp (5% recovery) 19-29' Sands with gravel. 20' SS [20]: Saturated mixed gravels in a dark silty sand martix (15% recovery) SS [25]: No sample. Traces of sands and water 29-34' Gravel with sands. 30' SS [30]: Saturated mixed gravels in a dark silty sand martix, some tan clay present (20% recovery) 34-46' Clay with sands. SS [35]: Mixed gravel in a sand matrix into a tan clay at bottom of spoon (20% recovery) 40' SS [40]: Brown/tan sticky clay grading into a medium coarse sand (50% recovery) SS [45]: Tan sticky clay. Bedrock in bottom 4". Bent spoon (60% recovery) 46-50' Bedrock. 50' SS [50]: No sample. Bedrock Site Location Information Wells drilled with hollow-stem auger Lat: 43.859 Long: -113.471 by HazTech Drilling Inc (No. 470)

Start date: August 6, 2019

Construction Details

Stennett 20 -- D0083001
10' Schedule 40 2" PVC sceen [10-20']
10' Schedule 40 2" PVC casing [+2.5-10']
Sand pack: 225 lbs poured [8-20']
Well seal: 75 lbs. bentonite chips poured [surface-8']
DTW = DRY

Stennett 40 -- D0083001 10' Schedule 40 2" PVC sceen [30-40'] 10' Schedule 40 2" PVC casing [+2.5-30'] Sand pack: 250 lbs poured [28-40'] Well seal: 350 lbs bentonite chips poured [surface-28'] DTW = 39.1' BLS

Stennett 50 -- D0083002 10' Schedule 40 2" PVC sceen [40-50'] 10' Schedule 40 2" PVC casing [+2.5-40'] Sand pack: 300 lbs poured [38-50'] Well seal: 700 lbs bentonite chips poured [surface-38'] DTW = 47.3' BLS



Figure 21. Lithologic and construction details for the Stennett site wells.

PLS: T06N R25E Section 10



Figure 22. Well rig set up at the Stennett site.



Figure 23. Final wellhead completions at the Stennett site.

Conclusions and Recommendations

The drilling and installation of 18 shallow wells along the Big Lost River was successfully completed in August 2019. The proposed total depth goals for 17 of the 18 wells were met; the Stennett site had one exception where bedrock was encountered limiting the 60' proposed well to only 50'. The wells are scheduled to be equipped with vented pressure transducers on direct read cables. The wells were not developed at the time of the completions. The intent is to develop the wells at the time of the instrument installation. As such, the depths to water reported in this report may change once the wells are developed.

Wellhead elevations need to be measured using a high accuracy GPS unit to further refine any vertical gradients between the wells. This data can be collected in conjunction with a future upcoming monitoring visit.

Even with the addition of the 18 new wells, there are still locations in the valley where data gaps exist for shallow aquifer monitoring. For example, there is a multiple mile stretch from just north of Arco to north of Moore where additional shallow well drilling would provide useful information to the Department and local water users. Another data gap exists near Darlington, an area known to have historic river losses. If funding is available, it is recommended that additional sites be sought to help fill in the existing data gaps in the valley.

Another recommendation for the use of these new wells is to conduct dye tracer tests in the shallow aquifer. Dye could either be released in one of the wells and monitored down-valley, or released into the river and monitored for in the new shallow wells. Research needs to be conducted to develop a potential plan for dye tracing tests.

<u>Acknowledgements</u>

The Department would like to thank the following property owners who allowed access for the well installations, and ultimately the success of this project. Harvey Walker (Walker site), Scott Slocum (PU Ranch site), Camille Babcock (Granite Trust site), Larry Barnes (Barnes site), the United States Bureau of Land Management (Rothwell site), and the Idaho Department of Fish and Game (Stennett site).