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November 21, 2012

Mr. Matt Hicks
Senior Hydrologist
Groundwater Quality Program
South Dakota Department of Environment & Natural Resources
523 East Capitol Avenue
Joe Foss Building
Pierre, SD 57501-3181

Re: Response to August 7 Technical Comment
Dewey-Burdock Project Groundwater Discharge Plan Application

Dear Mr. Hicks:

On behalf of Powertech (USA) Inc. (Powertech), this letter is provided in response to a technical comment received by email on August 7, 2012 for the above-referenced Groundwater Discharge Plan (GDP) application. For convenience, the comment is provided below along with the response. Application replacement pages are enclosed along with an index of changes (two hard copies and one electronic copy on CD).

Technical Comment: I also have a question regarding the static water levels listed for DB11-34-ALLUV-3 and DB11-3-ALLUV-2 on Plate 3.6-10. The log for DB11-34-ALLUV-3 indicates it is a dry hole and Powertech has stated they believe the original SWL listed on the log for DB11-3-ALLUV-2 is in error. Are the SWL on Plate 3.6-10 for these two wells inferred, or were the SWL determined from additional sources not indicated on Plate 3.6-10 or well logs?

Response: The static water levels depicted on Plate 3.6-10 were based on Figure 3.7-8 (Potentiometric Contour Map, Pass Creek and Beaver Creek Alluvium), which was prepared using water level measurements from alluvial wells collected prior to June 2011. The static water levels from uncased geotechnical drill holes including DB11-34-ALLUV-3 and DB11-3-ALLUV-2 were not used to prepare Figure 3.7-8. In response to this technical comment, Powertech updated Figure 3.7-8 and Plate 3.6-10 using 2012 water level measurements, including those collected from the GDP alluvial compliance wells installed in July 2012. The alluvial compliance well data indicated a significant difference between the static water levels and water quality at compliance well BC-2 compared to well 708, which is approximately 219 feet southwest of BC-2 and outside of the proposed perimeter of operational pollution (POP) zone. During October and November 2012, work was conducted to address the discrepancy in static water level and water quality between these two wells. This work included installing and sampling six additional alluvial wells near BC-2 and revising Plate 3.6-10 and Figure 3.7-8. This comment response describes how the recent work confirms the observed water level and water quality variation between BC-2 and 708. The differences are attributed to significant

heterogeneity of the alluvial material. The results of this investigation support the use of BC-2 as a compliance well for the proposed Burdock land application system.

Water Level and Water Quality Comparison between BC-2 and 708

Table 1 summarizes July through November 2012 static water level measurements at BC-2 and 708. The horizontal distance between BC-2 and 708 is 219.22 feet, and the average difference in static water elevation is 15.61 feet. The calculated gradient in the static water elevation is therefore 7.1% between BC-2 and 708. In contrast, the typical alluvial potentiometric surface gradient along Pass Creek is 0.6%. This typical gradient was calculated using the November 2012 static water elevations from wells 678 and 679 (presented in the revised Figure 3.7-8) and an approximate distance between these wells normal to the potentiometric contours of 3.1 miles.

Table 1. BC-2 and 708 Static Water Level Measurements

Parameter	Hydro ID	
	BC-2	**708**
Northing[1]	434,253.95	434,084.74
Easting[1]	1,030,548.07	1,030,408.69
TOC Elevation[1]	3,636.33	3,634.37
Ground surface elevation	3,633.90	3,631.26
Horizontal separation (feet)	**219.22**	
Vertical separation based on ground surface elevation (feet)	**2.64**	
July 2012 static water elevation (feet AMSL[2])	3,630.42	3,615.18
August 2012 static water elevation (feet AMSL)	3,630.04	3,614.81
September 2012 static water elevation (feet AMSL)	3,629.86	3,614.53
October 2012 static water elevation (feet AMSL)	3,630.10	3,614.35
November 2012 static water elevation (feet AMSL)	3,630.73	3,614.24
Average static water elevation (feet AMSL)	3,630.23	3,614.62
Average difference in static water elevation (feet)	**15.61**	

[1] Surveyed top of casing (TOC); coordinate system is SD State Plane NAD 27 (feet); vertical datum is NGVD 29.
[2] AMSL - above mean sea level.

In addition to the difference in static water elevation between BC-2 and 708, there also is a notable difference in water quality. The water quality variation is summarized in Table 2, which compares the average water quality at BC-2 with 708 for July through September 2012. Attachment A includes a summary table of individual sample results from BC-2 and 708. Laboratory analytical results from BC-2 have been provided to DENR previously (refer to 9/6/2012, 10/22/2012, and 10/26/2012 email submittals from Lisa Scheinost, Powertech). Laboratory analytical results from 708 are included in Attachment A.

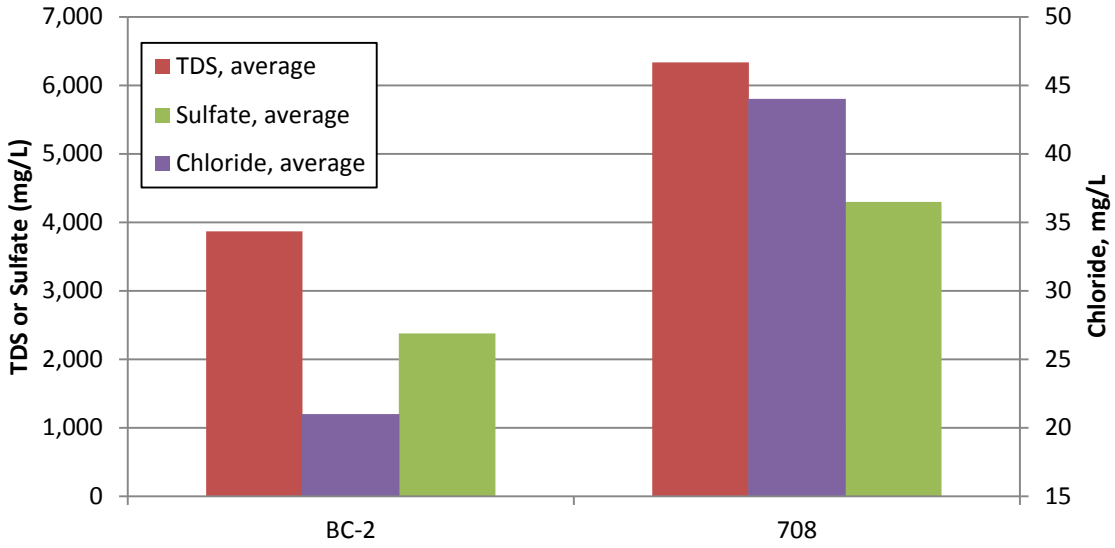
Table 2 shows that the total dissolved solids (TDS) concentration in 708 is nearly twice that of BC-2. Most major ion concentrations are higher in 708 than BC-2. The sodium and chloride concentrations in 708 are more than double those of BC-2. Calcium was the only major ion with a lower concentration in 708 compared to BC-2. Figure 1 illustrates the difference in average water quality for TDS, sulfate and chloride.

Table 2. BC-2 and 708 Average Water Quality[1]

Parameter	Hydro ID		RPD[2]
	BC-2	708	
Total dissolved solids (mg/L)	3,867	6,333	48%
Major cations			
Calcium (mg/L)	527	427	21%
Magnesium (mg/L)	213	509	82%
Sodium (mg/L)	271	704	89%
Major anions			
Bicarbonate (mg/L)	283	361	24%
Carbonate (mg/L)	<5	<5	0%
Chloride (mg/L)	21	44	71%
Sulfate (mg/L)	2,380	4,297	57%

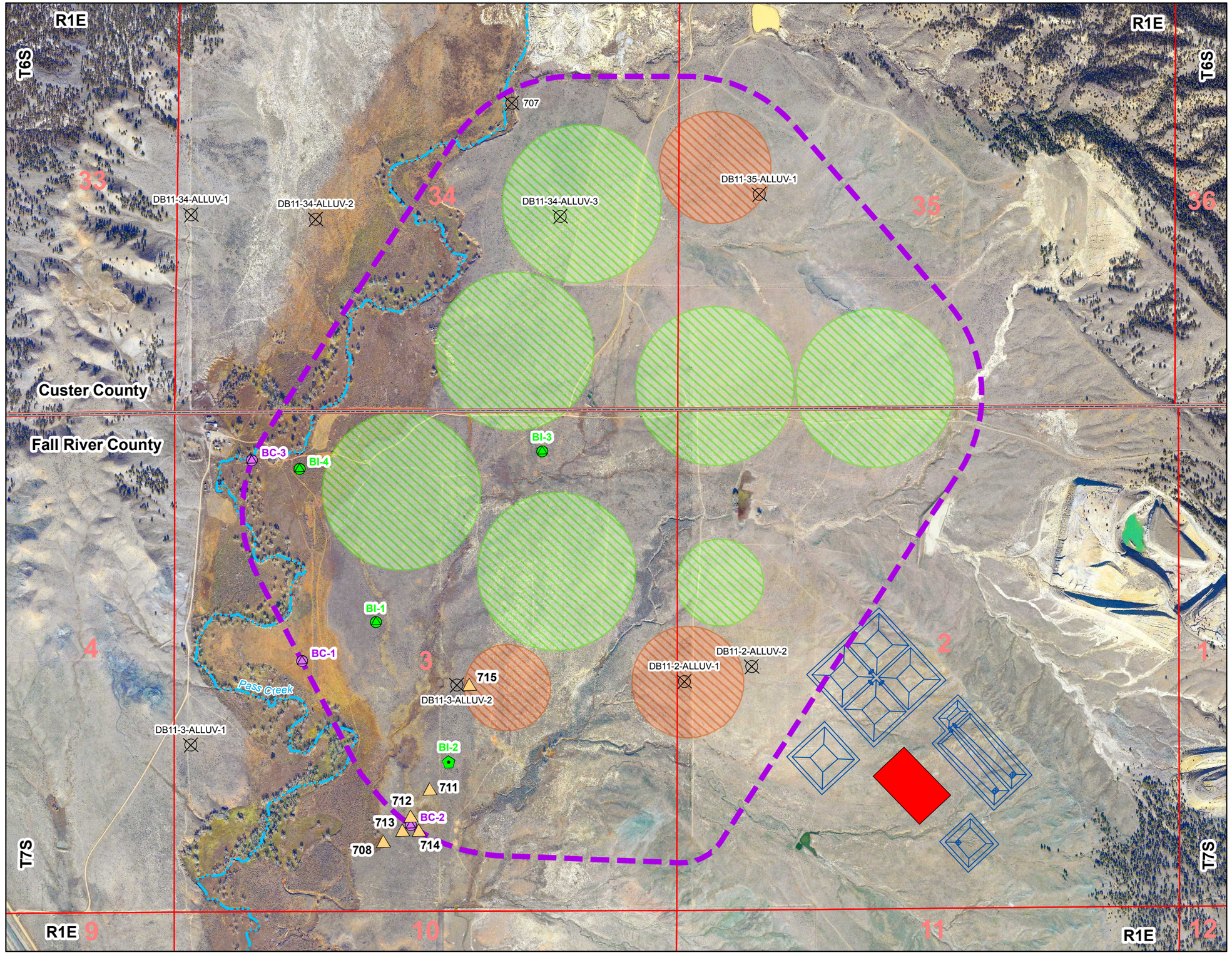
[1] Average July through September 2012 water quality.
[2] RPD - relative percent difference; calculated as the absolute difference divided by the average.

Figure 1. Comparison between BC-2 and 708 Water Quality



<u>October and November 2012 Alluvial Characterization Activities</u>

Additional characterization of the alluvial groundwater level and water quality in the vicinity of BC-2 and 708 was performed in October and November 2012. This work was conducted to assess the discrepancy in static water elevations and water quality previously observed at BC-2 and 708. Six additional alluvial wells were completed in October, the locations of which are depicted on Figure 2. The six wells included three wells offset approximately 100 feet from BC-2 in a triangular fashion, one well installed at approximately the same location as geotechnical hole DB11-3-ALLUV-2, interior well BI-2, and one well installed approximately halfway between BI-2 and BC-2. Attachment B includes a well completion report for the additional alluvial wells. Following is a brief summary of the characterization activities and results.



Legend

- Burdock POP Zone
- Ephemeral Streams
- Alluvial Well
- Alluvial Compliance Well
- Alluvial Interior Well (Proposed)
- Alluvial Interior Well (Existing)
- Central Processing Plant
- Ponds
- Land Application
- Standby Land Application
- Geotechnical Hole

Feet
0 500 1,000 2,000
0 200 400 600
Meters

N

Figure 2

Additional Drilling
near BC-2

Dewey-Burdock Project

DRAWN BY	S. Hetrick
DATE	16-Nov-2012
FILENAME	BC2WellOverallPOP.mxd

Powertech (USA) Inc.

The six new alluvial wells were drilled on October 29-31, 2012 using a geotechnical drilling rig with a hollow-stem auger. Each well was drilled 1 to 2 feet into the Graneros Shale bedrock and screened in the sand, gravel and clay alluvial material above the Graneros. The wells were developed on November 1-2, 2012 using disposable bailers and a peristaltic pump. Static water levels were measured on November 5, 2012 after the wells had stabilized. Water samples were collected on November 6, 2012 after evacuating at least three casing volumes and verifying that field water quality parameters had stabilized. Samples were analyzed for pH, TDS, electrical conductivity, and major ions. Table 3 presents the surveyed coordinates and November 5 depths to water and static water elevations for the six new wells (711 through 715 and BI-2), BC-2 and 708.

Table 3. Additional Alluvial Well Information

Hydro ID	Northing[1]	Easting[1]	TOC Elevation[1] (feet AMSL)	Ground Elevation (feet AMSL)	Depth to Water below TOC[2] (feet)	Static Water Elevation (feet AMSL)
711	434,621.05	1,030,766.04	3,646.09	3,642.99	15.17	3,630.92
712	434,347.43	1,030,551.63	3,636.90	3,633.47	6.54	3630.36
713	434,202.54	1,030,459.68	3,634.86	3,632.22	20.58	3,614.28
714	434,192.58	1,030,635.29	3,641.61	3,638.78	8.50	3633.11
715	435,702.30	1,031,225.61	3,655.88	3,653.11	16.16	3,639.72
BI-2	434,898.92	1,030,980.14	3,650.73	3,647.86	15.13	3,635.60
BC-2	434,253.95	1,030,548.07	3,636.33	3,633.90	5.60	3,630.73
708	434,084.74	1,030,408.69	3,634.37	3,631.26	20.13	3,614.24

[1] Surveyed top of casing (TOC); coordinate system is SD State Plane NAD 27 (feet); vertical datum is NGVD 29.
[2] Water level measurements performed November 5, 2012.

The static water elevations are depicted on revised Figure 3.7-8 (attached). Revised Plate 3.6-10 (attached) includes new Cross Section H-H' drawn through 708 and most of the new alluvial wells. Cross Section H-H' shows a significant thinning of the gravel alluvium at BC-2. This is highlighted by differentiating the gravel from the overlying sand in Cross Section H-H'. Because the lithology descriptions from the previous geotechnical drilling program did not make this distinction, Cross Sections F-F' and G-G' depict a single sand/gravel alluvial unit.

Cross Section H-H' on Plate 3.6-10 shows that the static water elevation at 713, which is approximately halfway between BC-2 and 708, is essentially the same as that at 708. The new wells installed upgradient of BC-2 support the observed static water elevation at BC-2. Generally there is a gradual drop in the static water elevation from 715 to BC-2. The gradient between 715 and BC-2 is 0.6%, which is the same as the typical gradient in the Pass Creek alluvium within the project area.

The installation of well 713, located approximately 100 feet southwest and downgradient of BC-2 and approximately 130 feet northeast of 708, confirms that the static water elevation in the area encompassing 708 and 713 is approximately 16 to 19 feet lower than the static water elevation around BC-2. The installation of additional wells upgradient of BC-2 confirms that the static

water elevations upgradient of BC-2 are consistent with the typical gradient observed along the entire Pass Creek alluvial system within the project area. Further, the data from the six new alluvial wells independently verify past observations from BC-2 and 708. These observations suggest that a lower permeability aquifer material exists somewhere between 713 and BC-2. This abrupt change in permeability manifests itself as a hydraulic barrier. This phenomenon is supported by Cross Section H-H' on Plate 3.6-10, which shows that the basal aquifer materials vary significantly immediately overlying the Graneros Shale. In addition, it is possible the difference in static water elevation is exacerbated by higher-permeability materials downgradient of 708. Water quality differences also provide evidence of a hydraulic barrier, as described below.

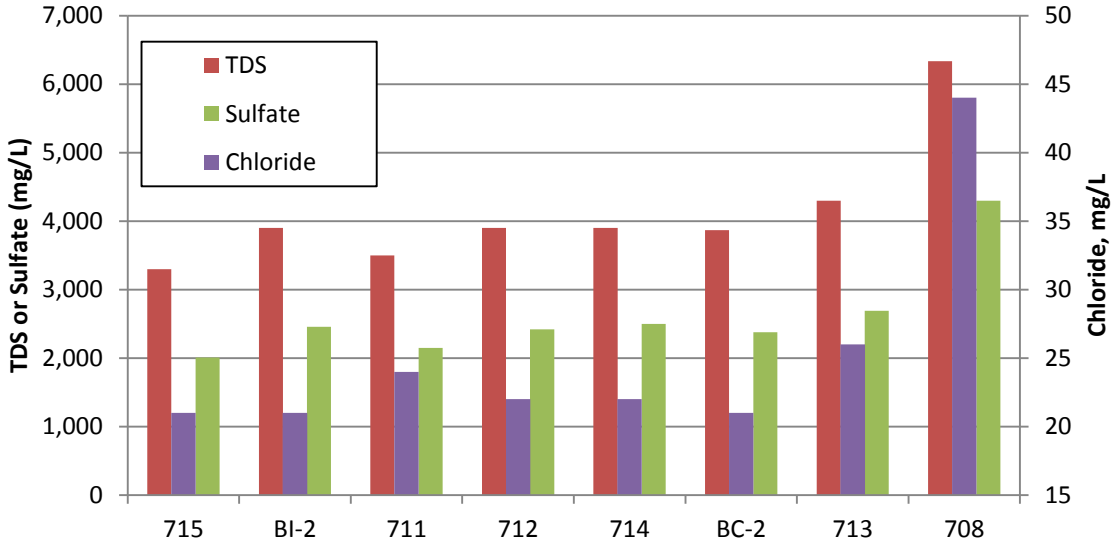
Table 4 and Figure 3 compare the water quality in the wells near BC-2. Figure 3 depicts the concentrations of TDS, sulfate and chloride in the various wells. The wells in Figure 3 are ordered from upgradient (715) to downgradient (708). The water quality is similar in BC-2 to wells upgradient (northeast) of BC-2. The concentrations of TDS, sulfate and chloride increase slightly from BC-2 to 713 then increase significantly from 713 to 708. Notably, the calcium concentration decreases from BC-2 to 713 and from 713 to 708. The wells including and upgradient of BC-2 consistently display lower dissolved solids concentrations, indicating different matrix geochemistry, solubility, and residence time as compared to well 708. Downgradient of BC-2, the dissolved solids concentrations increase markedly, suggesting longer residence times and limited flushing. These results support the conclusion that there is a hydrologic barrier between BC-2 and 708, likely caused by heterogeneity of the basal alluvial material. Attachment A includes laboratory results from November samples from wells 711 through 715 and BI-2. Note that this laboratory report also includes the results of a sample collected from Dewey compliance well DC-3. Those results are unrelated to the investigation around BC-2. Laboratory reports for samples collected from 708 during July through November are included in Attachment A.

Table 4. Water Quality in Additional Alluvial Wells[1]

Hydro ID	TDS (mg/L)	Calcium (mg/l)	Magnesium (mg/L)	Sodium (mg/L)	Bicarbonate (mg/L)	Chloride (mg/L)	Sulfate (mg/L)
711	3,500	497	154	260	275	24	2,150
712	3,900	508	216	294	283	22	2,420
713	4,300	472	274	363	312	26	2,690
714	3,900	491	232	275	280	22	2,500
715	3,300	507	158	166	266	21	2,010
BI-2	3,900	481	246	255	285	21	2,460
BC-2	3,867	527	213	271	283	21	2,380
708	6,333	427	509	704	361	44	4,297

[1] Avg. July-September 2012 concentrations shown for BC-2 and 708; November concentrations shown for all other wells.

Figure 3. Water Quality Comparison in Wells near BC-2



Note: Avg. July-September 2012 concentrations shown for BC-2 and 708; November concentrations shown for all other wells

Static Water Elevation in the Burdock Land Application Area

The results of the recent work confirm the initial depth to water measured at DB11-3-ALLUV-2. Powertech noted in the July 3, 2012 technical comment response that the initial measurement, which was made in an open borehole, was suspected of being made in error. The recent measurement of static water elevation in well 715 confirms that the depth to water is approximately 13 feet below ground surface at this location. The DB11-3-ALLUV-2 borehole log in Appendix 3.6-A has been revised to remove the note that the water level measurement was believed to be in error. In addition, the minimum anticipated depth to groundwater described in Section 8.1.1 of the GDP application has been revised from 25 to 13 feet.

Potential Impacts on the Effectiveness of BC-2 as an Alluvial Compliance Well

The potentiometric surface depicted in Figure 3.7-8 and Cross Section H-H' in Plate 3.6-10 demonstrates that there is a downward hydraulic gradient between the proposed land application areas and BC-2. The results of the recent alluvial characterization work show that BC-2 is upgradient of the postulated lower permeability hydraulic barrier, which is believed to be the cause of the significant difference in static water elevation and water quality between BC-2 and 708. These findings support the conclusion that BC-2 can be used as an effective compliance well to detect potential changes in the alluvial groundwater system from the proposed land application systems.

Please direct any questions regarding this comment response to Richard Blubaugh at (303) 790-7528 or Jack Fritz at (307) 672-0761.

Sincerely,

Jack Fritz, P.E.
WWC Project Manager

cc: Richard Blubaugh
Mark Hollenbeck
John Mays
Mike Cepak, DENR Minerals & Mining Program*
Ronald Burrows, U.S. NRC*
Valois Shea, U.S. EPA, Region 8*
Marian Atkins, BLM*
Max Main, Bennett, Main & Gubbrud, P.C.

*Enclosures provided on CD only

Encl: Change Index and Replacement Pages
Attachment A: Additional Alluvial Characterization Water Quality
Attachment B: Additional Alluvial Characterization Well Completion Report
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