POWERTECH (USA) INC.

Dewey-Burdock Project
Application for NRC
Uranium Recovery License
Fall River and Custer Counties, South Dakota

TECHNICAL REPORT RAI QUESTION AND ANSWER RESPONSES

February 2011

Prepared for
U.S. Nuclear Regulatory Commission
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Response to TR RAIs dated May 19, 2010

I. Process and Restoration

TR RAI-P&R-1

Further define the vertical location of ore bodies proposed for uranium recovery.

Background: Exhibit 3.2-1 of the Technical Report Supplement provided the vertical locations of ore bodies proposed for uranium recovery. For several of the ore bodies, NRC staff was unable to identify whether the ore body proposed for uranium recovery is contained in the Fall River aquifer or Chilson aquifer. For those where the aquifer was identifiable, staff was also unable to determine the scaled vertical location of each ore body proposed for uranium recovery within its respective aquifer. Staff compared the ore body labels in Exhibit 3.2-1 to sub-strata labels illustrated in the "Typical Log" provided in Plate 2.6-1 of the Technical Report. Staff found that one of the ore bodies was labeled as being in the Fuson Shale. The location of proposed ore bodies for uranium recovery is necessary for staff to assess the manner in which the DeweyBurdock operations will be protective of human health and the environment.

Needed: Please re-evaluate and revise Exhibit 3.2.1 to clearly indicate the aquifer (e.g., Fall River or Lakota) that contains each ore body proposed for uranium recovery. For each well field, illustrate the scaled vertical position of each ore body proposed for uranium recovery within the aquifer that contains it.

Response: TR RAI-P&R-1 (TR Section 2.7.2.2.5)

Exhibit 3.2-1 of the Technical Report Supplement provided the aerial distribution of total uranium resources within the Dewey-Burdock permit boundary. This exhibit presented a plan-view illustration of ore bodies which were designated by their containing stratigraphic interval (i.e., L1-L8 and F11-F13) throughout the Dewey-Burdock Project area. Powertech (USA) has redrawn this configuration of ore bodies to show only those that are the subject to the intent of this permit application. This was done by eliminating all Fall River ore bodies in the Burdock area because these resources were present in unsaturated host sandstones. In addition, all ore bodies closer than 1600 feet to the project boundary were also eliminated from the application.

The result of this reclassification is shown in the TR Exhibit 2.7-1 in TR RAI response December 2010, Proposed Well Fields. This plan-view illustration of the project ore bodies was simplified to show all Fall River ore bodies in "green" and all Chilson ore bodies in "blue". For this response, and because of the reclassification of project-wide resources, Exhibit 3.2-1 was not revised and NRC staff is, instead, referred to TR Exhibit 2.7-1.

To illustrate the scaled vertical location of each ore body proposed for uranium recovery within its respective aquifer, cross sections were developed through each identified mine unit shown in TR Exhibit 2.7-1. These cross sections also present a detailed interpretation of the aquifers that contain the ore bodies. This interpretation will be enhanced by future delineation drilling with well field areas. Across the project area, clay within the Fuson Member of the Lakota Formation acts as a confining unit to separate Fall River aquifers from Chilson aquifers. In addition, there are interbedded clay beds within both the Fall River and Chilson sandstones that are sufficiently continuous as to further subdivide the Fall River and Chilson into discreet, mapable channel sandstone packages (i.e., Upper Fall River, Lower Fall River, Upper Chilson, etc.). These channel sands act as individual aquifers and often contain multiple ore bodies. For example, the Lower Fall River sand channel contains the F13, F12 and F11 ore bodies. These nine cross sections are presented in TR Exhibits 2.7-1a-1j in TR RAI response December 2010. An index map showing the locations of these cross sections is on Exhibit 2.7-1. This exhibit also shows the locations of all proposed well fields within the PAA.

In this RAI, NRC staff had questions concerning the ore body designations provided in Plate 2.6-1 of the Technical Report. The "Typical Log" illustrated in Plate 2.6-1 is a single, good quality drill hole log, with the purpose of presenting the overall, general stratigraphy of the entire Dewey-Burdock permit area. This log does not precisely represent the stratigraphy at any given point across the project, however, it provides a representative example of the vertical position of the multiple ore bodies relative to the overall stratigraphic sequence. It is important to note that these "sub-strata labels" identify individual oxidation/ reduction roll fronts that contain ore bodies – not sand units. For example, on Plate 2.6-1, this drill hole log shows good sand development in the lowermost portion of the Chilson sandstone interval and the presence of an L1 ore body. At this location, the lower Chilson sandstone, immediately above the L1 ore body, is not sufficiently developed as to contain any uranium deposit. In other locations within the Dewey-Burdock Project, where facies changes within the lower Chilson interval have resulted in more extensive sand development, L2A ore bodies have been observed within this stratigraphic interval.

With respect to NRC staff's question about an ore body within the Fuson Shale, there are no ore bodies within this shale unit. The fluvial depositional environment of the Inyan Kara Group results in thickness variations within both shales and sandstones. While the thickness of the Fuson in the location of the above mentioned Typical Log is 60 feet, across the project area, the thickness of this unit varies from 20-80 feet. In locations where the Fuson contains less shale, due to facies changes, there is a corresponding presence of more sandstone within this unit interval. The representative Typical Log simply identifies stratigraphic positions within the Lakota Formation (i.e., L8, L7, etc.) where an ore body has been identified at some location within the project boundary. Certainly the ore bodies only develop in the sandstone facies where oxidizing solutions create roll fronts. There are no uranium resources identified within the Fuson Shale and there will be no mining within this unit.

To better illustrate site-specific fluvial stratigraphy, representative Type Logs have been developed for the portions of the Dewey-Burdock Project where initial production is proposed. Type Logs for the Burdock Well Field I and Dewey Well Field I are illustrated in TR Figure 2.7-12 and TR Figure 2.7-13 and show a detailed view of the Fall River and Chilson aquifers, along with a scaled vertical position of each ore body proposed for uranium recovery. The locations of these Type Logs, along with the location of the Typical Log from Plate 2.6-1 are shown on TR Exhibit 2.7-1. These Type Logs, due to the changing fluvial depositional environment of the Inyan Kara Group, illustrate distinct differences in lithology of the Fall River Formation, Fuson Member and Chilson Member between the Dewey and Burdock portions of the project area.

For reference purposes only, Inyan Kara sand channel designations from USGS Professional Paper 763 are also displayed on these Type Logs. These "Gott" sand channels are based entirely from surface mapping of the entire Southern Black Hills region and may not apply specifically to the Dewey-Burdock project area. Project-related subsurface stratigraphy of the Inyan Kara Group sediments have been based on the interpretation of electric logs from historic drilling - not the "Gott" surface geology terminology.

A brief description of these two Type Logs follows:

Figure 2.7-12, Type Log, Dewey Well Field I – This Type Log shows an interbedded shale separating Upper and Lower Fall River channels. The Upper Fall River channel has poor sand development and no uranium ore bodies. The Lower Fall River channel is well developed and contains the F13, F12 and F11 ore bodies within Dewey Well Field I. A 50-foot thickness for the Fuson Member is maintained throughout the well field area. This well field is developed entirely within the Lower Fall River sand channel, but it is also important to have an understanding of the underlying stratigraphy. Upper Chilson and Middle Chilson sand channels are divided by a consistent interbedded clay unit. There is good sand development and uranium resources within both the underlying Upper and Middle Chilson aquifers beneath Dewey Well Field I, which are part of the Dewey Mine Unit III. The Lower Chilson sand channel has pinched out and is not present beneath Dewey Well Field I.

Figure 2.7-13, Type Log, Burdock Well Field I – This Type Log shows a 30-foot thick interbedded clay unit separating an Upper Fall River sand from a Lower Fall River sand. While this clay unit may be somewhat thinner in other portions of Burdock Well Field I, it is consistently present. In fact, based on existing drill hole information, this interbedded clay unit is present in all proposed mining units within the project area, which would establish a consistent Upper and Lower Fall River sand channel throughout the project. The Type Log shows a 65-foot thick Fuson Member, consisting primarily of claystone with some minor siltstone. Within a portion of the well field, the Lower Fall River sand channel scours down into the Fuson Member and replaces the shale. This is demonstrated by an increased thickness of the Fall River and a corresponding thinning of the Fuson. However, a minimum thickness of 20 feet is maintained and acts as an aquiclude. This Type Log also shows interbedded clays dividing the Chilson Member into three separate sands. The clay unit separating the Upper and Middle Chilson sands is consistently present throughout this well field and all other mine units within the project. One L7 ore body is present within the Upper Chilson sand channel. There are no well-developed sands and no ore bodies within the Middle Chilson sand channel in this well field. The interbedded clay unit separating the Middle and Lower Chilson sand channels is interpreted to be present throughout the Burdock Well Field I. However, in some portions of the overall Burdock area, this interbedded clay pinches out and the Middle and Lower sands come together into a single sand channel. In this well field, the Lower Chilson sand channel contains the L1, L2, L3 and L4 ore bodies.

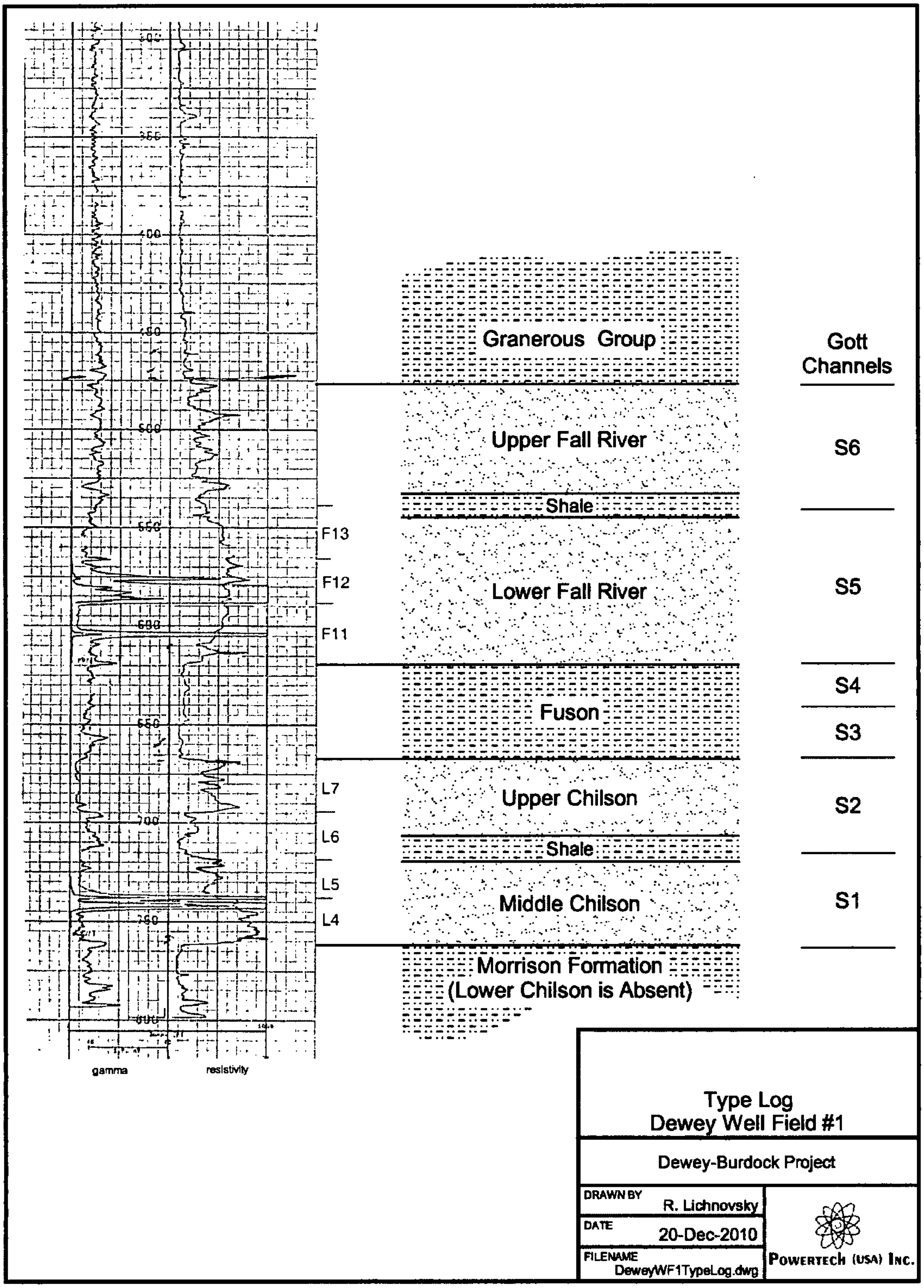

Figure 2.7-12: Type Log Dewey Well Field #1

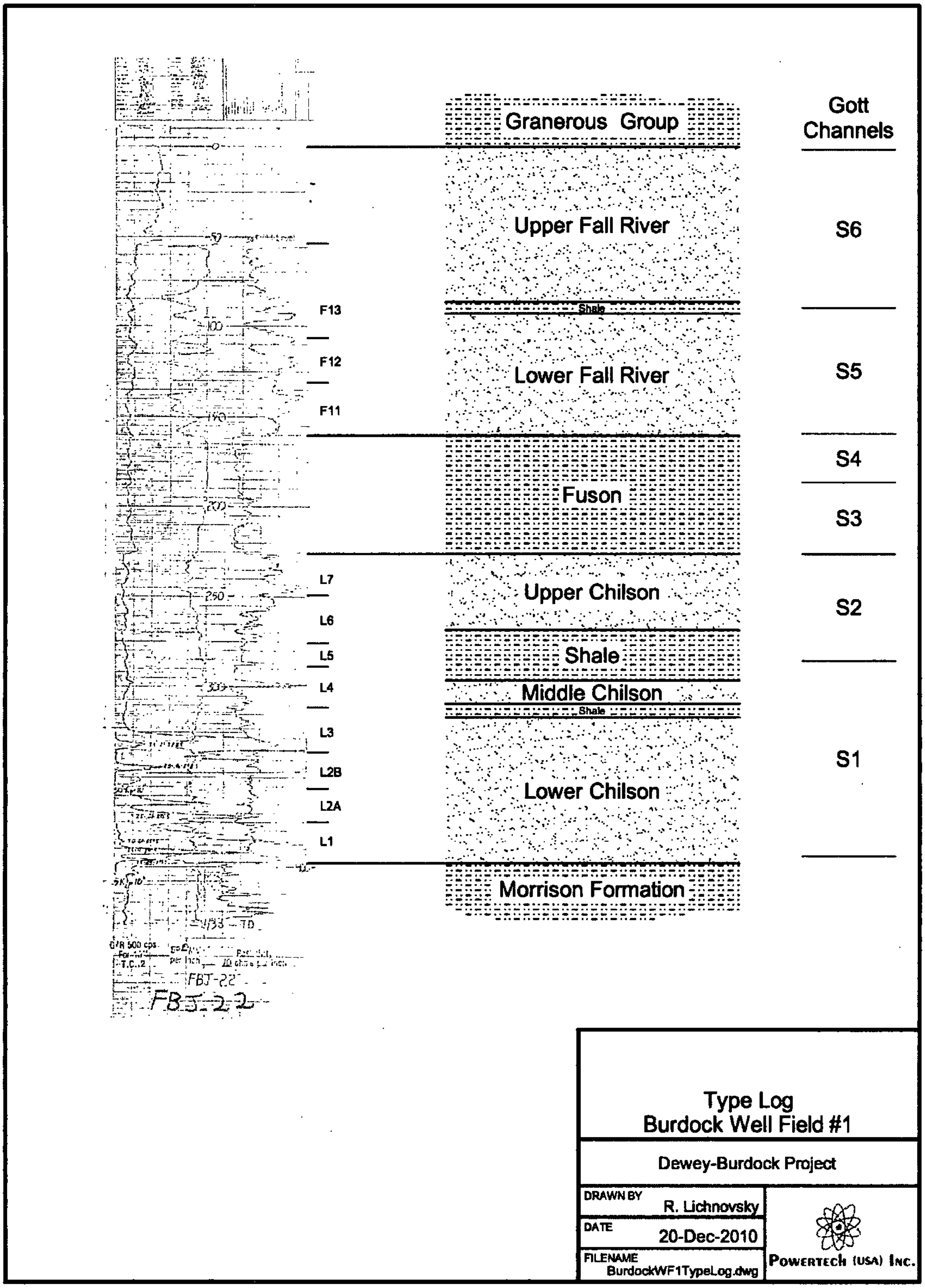

Figure 2.7-13: Type Log Burdock Well Field #1

TR RAI-P&R-2

Expand on the description of the inventory of economically significant mineral and energy-related deposits and related activities.

Background: The Technical Report provided information regarding former mining in the area of the Dewey-Burdock project. The Technical Report did not provide sufficient information concerning former and active oil and gas wells potentially at or near the project. Additionally, the Technical Report did not clearly indicate whether former or active underground mine workings are at or near the Dewey-Burdock project. This information is necessary for staff to understand the potential impacts of the operations on water resources.

Needed: Please provide sufficient information concerning former and active oil and gas wells potentially at or near the Dewey-Burdock project and indicate whether there are any known underground mine workings at or near the project.

Response: TR RAI-P&R-2 (TR Section 2.2.2)

TR Exhibit 2.2-1 shows the locations of all former and active oil and gas wells in the immediate vicinity of the PAA. There are no such oil and gas wells within the project's AOR, however, there are three "dry" oil and gas test holes that have been plugged and abandoned. Outside of the AOR and within 4-5 miles of the project boundary, there are eight producing oil wells, five oil and gas test holes that have been converted to water wells and one oil and gas well that has been converted to a salt water disposal well. The injection horizon for this disposal well is the Minnelusa Formation.

TR Exhibit 2.2-1 also shows the locations of former underground uranium mines on and adjacent to the PAA. The Freezeout Underground Mines 1 and 2 are shown outside the PAA, in Section 36, T6S, R1E within the Black Hills National Forest. The Darrow Underground Mine is located in Section 2, T7S, R1E within the PAA. There are also two small adits that tunneled a small distance into the sidewalls of the old Darrow open pit operations. All these underground operations were within sandstones of the Fall River Formation and have been inactive since the 1960s. None of these underground operations penetrated the Fuson Shale Member of the Lakota Formation, so no communication pathways to underlying Chilson sandstones were created.

TR RAI-P&R-3

Expand seismic evaluation to include the seismic event north of Dewey, South Dakota.

Background: Figure 2.6-4 of the Technical Report illustrates the location of seismic events in the region. The figure contains two maps. Within the map closest to the bottom of the figure, a seismic event is shown to have occurred immediately north of the Dewey-Burdock project. The Technical Report should include the above referenced seismic event in the evaluation of the seismicity in the project region.

Needed: Please include the above-referenced seismic event in the seismicity evaluation.

Response: TR RAI-P&R-3 (TR Section 2.6.6.1.1.1)

Seismic Event North of Dewey, South Dakota

The list provided in Appendix 2.6-G contains date of the event in question, other information included within the list are the origin time, latitude and longitude and the magnitude of this quake. The quake in question occurred 8.5 miles from the center of the Dewey-Burdock property and occurred on 05 January, 2004 at a reported 2.8 Richter Scale magnitude or modified Mercalli intensity of I (South Dakota Geologic Survey Map "Earthquakes in South Dakota, 1872 – 2007" and South Dakota Department of Environment & Natural Resources, www.sdgs.usd.edu/other/faq.html. Accessed on 03 August, 2010; page updated on 29 October, 2009).

TR RAI-P&R-4

Provide data and structure map for the top of the Morrison Formation.

Background: Section 2.7.2.2.16 of the Technical Report states "over 95 percent of exploration holes never penetrated deeper than the lower Lakota and upper Morrison." The application provided limited infonmation concerning the locations, data (e.g., geophysical logs), and associated evaluation for the five percent of the exploratory test holes that penetrate through the Lakota Formation. The applicant also did not provide a structure map of the top of the Morrison Formation. This information is necessary for staff to understand the potential impacts of the operations on water resources.

Needed: Please provide locations and documentation for exploratory test holes that penetrate through the Lakota Formation and provide a structure map of the top of the Morrison Formation.

Response: TR RAI-P&R-4 (TR Section 2.7.2.2.16)

Very few of the exploration holes that were drilled to evaluate the Lakota Formation were continued the additional 100 feet required to penetrate the entire Morrison Formation. Powertech (USA) drilled eight holes through the Morrison Formation for the following reasons: 1) one exploration drill hole, 2) 5 water wells completed into the Sundance/Unkpapa, and 3) 2 water wells that were drilled to the Unkpapa but were plugged back and completed in the Inyan Kara. Our records indicate that 12 historic TVA exploration holes penetrated the Morrison Formation. The following table provides location data on these 20 penetrations.

Morrison Formation Known Drill Hole Locations

-	*Hole No.*	*Easting*	*Northing*	*Elevation*
1	DRM11	1037607	438823	3770
2	DRJ90	1037602	438720	3762
3	FBR42	1038293	429778	3727
4	FBR43	1038034	429832	3724
5	TRR2	1034430	439921	3715
6	FBR31	1038131	433097	3800
7	RONA81	1033459	429385	3688
8	PM159	1032551	433100	3651
9	DWT48	1025864	444053	3702
10	DWT49	1025235	442634	3661
11	ELT14	1017626	444849	3617
12	DWT40	1022610	445875	3681
13	DB07-11-31	1038312	429998	3731
14	DB07-11-16C	1035139	429992	3698
15	DB08-11-18	1035133	429986	3700
16	DB08-32-12	1022352	439368	3590
17	DB08-32-11	1020339	443666	3627
18	DB08-5-1	1017626	444849	3629
19	DB08-1-7	1042271	434137	3913
20	DB09-21-1	1028628	453319	3822

State Plane Coordinate System

Many exploration holes targeting the Chilson sands of the Lakota Formation did bottom in the Morrison Formation. Based on these exploration holes, a structure contour map to the top of the Morrison (RAI_ER Exhibit WR-6.1) was developed for a response to a similar ER RAI.

TR_RAI-P&R-5

Hydraulic connection between Fall River aquifer and the ground surface.

Background: The application did not sufficiently indicate if the unconfined Fall River groundwater zone is hydraulically connected to the ground surface at or near the well fields Burdock II and IV. This information is necessary for staff to understand the potential impacts of the operations on water resources.

Needed: Please evaluate where the unconfined Fall River groundwater surface is hydraulically connected to the ground surface at or near well fields (including the bottom of open mine pits).

Response: TR_RAI-P&R-5

Refer to Response to ER_RAI-WR-2 and Response to ER_RAI-WR-3. Powertech (USA) has excluded ISR operations in Fall River resources in Burdock II and IV.

TR RAI-P&R-6

Confining capacity of Fuson Member in areas of unconfined Fall River and Chilson production.

Background: Within or near areas where the Fall River aquifer is unconfined and uranium recovery is proposed within the Chilson Member, the Technical Report did not sufficiently indicate the Fuson Shale's confining capacity (e.g., including the possible presence of Fuson permeable paleostream deposits). This information is necessary for staff's understanding of the operation's hydraulic containment of process fluids and to assess the manner in which the Dewey-Burdock operations will be protective of human health and the environment.

Needed: Using exploratory test-hole data and other data, please expand the evaluation of Fuson Shale confining capacity within or near the areas where the Fall River aquifer is unconfined and uranium recovery is proposed within the Chilson Member.

Response: TR RAI-P&R-6

Refer to Responses to ER_RAI WR-2 and ER_RAI WR-3. Included in these responses is an isopach map showing a minimum thickness of 20 feet of Fuson shale. Powertech (USA) has excluded ISR operations in Fall River resources in Burdock II and IV, which includes areas where the Fall River aquifer is unconfined.

TR RAI-P&R-7

Provide additional aquifer test information.

Background:* *The Technical Report provided limited data for the 11-day aquifer test previously conducted by TVA in the Lakota aquifer in the Dewey area. The Technical Report also referenced a paper entitled, "Hydrogeologic Investigations at Proposed Uranium Mine Near Dewey, South Dakota: (Boggs, J. M., 1983). Submittal of TVA's Dewey aquifer test report and the above-referenced paper are requested for staff to understand the potential impacts of the operations on water resources.

Needed: Please provide the TVA's Dewey aquifer test report and the above-referenced paper.

Response: TR RAI-P&R-7 (Appendix 2.7-K)

The requested report titled "Hydrogeologic Investigations at Proposed Uranium Mine near Dewey, South Dakota, "(Boggs, J.M., 1983) is provided in Appendix 2.7-K submitted within the TR_RAI Response package.

TR RAI-P&R-8

Cross sections with geophysical log results.

Cross sections with geophysical log results are requested for the southwestern corner of well field Dewey III and the eastern portion of well field Burdock III. Although a cross section of well field Dewey II was provided in Plate 2.6-12 of the Technical Report, staff requests that the cross section be revised to include geophysical log results. Additionally, staff requests the revision of the cross sections for well fields Dewey II and III to include logs from all test holes that penetrated through the Lakota Formation. This information is requested for staff to understand the potential impacts of the operations on water resources.

Needed: Please provide the above referenced cross sections with geophysical log results.

Response: TR RAI-P&R-8

This RAI requests information on Dewey Mine Unit II, Dewey Mine Unit III and Burdock Mine Unit III. In order to respond to this RAI, Powertech (USA) feels an explanation of terms is in order. In the TR Supplement, Exhibit 3.1-4 – Future Mine Units, the location of areas that will contain future mine units were identified. Many of these future mine units (i.e., Dewey Mine Unit III, Burdock Mine Unit V, etc.) will have multiple well fields situated within both Fall River and Chilson sands. Future mine unit areas are not necessarily synonymous with individual well field areas. The referenced cross section J-J', from Plate 2.6-12 of the Technical Report, is a north-south section through the Dewey Area and illustrates subsurface geology in an area corresponding to Dewey Mine Units I and II.

The cross sections developed across all future mine units, as a response to TR RAI P&R-1, contain geophysical logs and provide information required to address this RAI. The Dewey Mine Unit II, as shown on the TR Supplement, Exhibit 3.1-4, no longer exists. A Revised Future Mine Units Map (Supplement Exhibit 3.1.4) was prepared for responses to ER RAIs to allow for a buffer between resources to be mined and the permit boundary. The purpose of this buffer is to provide area for an aquifer exemption boundary and monitor well rings. In the process of applying this new mine unit boundary to the resources in the northern portion of the Dewey area, the minable resources were reduced to the point where they no longer appeared to be economical. For this permit application, future mine unit Dewey II has been removed and no mining is currently planned in the northern portion of the Dewey area.

TR RAI-P&R-9

Clarify plugging and abandonment of all exploration holes.

Background: Section 5.7.1.3 of the Technical Report states "Effluent controls for preventing migration of recovery solutions to overlying and underlying aquifers consist of plugging and abandonment of all exploration holes...." NRC staff was unsure if this statement includes the former exploration holes that may not have been plugged or plugged properly.

Needed: Please clarify if the above-referenced quote refers to former exploration holes at or near production zones.

Response: TR RAI-P&R-9 (TR Section 5.7.1.3)

Effluent controls for preventing migration of recovery solutions to overlying and underlying aquifers includes:

- Plugging and abandonment of all (historical or recent) exploration holes that may have potential to interfere with operations and/or restoration activities, as determined by the pump tests to be conducted after operational wells are drilled.

TR RAI-P&R-10
Clarify the exact number and locations of wells.

Background: Staff is uncertain of the total number of wells within 2 kilometers of the project area and whether or not the 26 abandoned wells are a subset of the total. Additionally, NRC staff is uncertain of the number of livestock or domestic wells. The Technical Report Supplement indicated that the applicant has the right to replace three Inyan Kara stock wells (ID#s 17, 49, and 628) prior to initiation of operations. These wells are located within the proposed aquifer exemption area and would be replaced with water wells that are not completed within the proposed zones of operations. Staff notes that there is a fourth well (#61) within the aquifer exemption area and in the middle of the Burdock Well field #1. The staff is unsure of the status of this well. Additionally, the application did not clarify the procedure to replace any nearby well.

Needed: Please provide a table listing the well ID, location, coordinates, and aquifer for each of the following groups within and near the license area: livestock wells, domestic wells, wells with other uses, and wells with unknown uses. Please clarify that the lease agreement applies to all wells within the licensed area and those procedures that will be used to relocate and/or monitor any impacts. If a well is to be replaced, please provide the staff with an example of a proposed location.

Response: TR RAI-P&R-10
The well information has been formatted as requested (by use category) and updated; this information is presented in TR_RAI Table P&R-10 below (see table footnote for definintion of status). Number of known wells within the combined area of the AOR and PAA total 133. Well ID 61 status is currently being used for a stock well and is located within the Lakota aquifer. The procedure for replacement of wells is discussed in the Hydrology response section of the RAI (dated May 28, 2010) document specifically in response to TR_RAI-2.7-13(a). Note: The term "Abandoned" to denote a use category for wells listed in the TR_Appendix 2.2-A, has been changed to a recognized use category such as Plugged and Abandoned, Domestic, Stock or Monitoring. Powertech (USA) used identical water well provisions in lease agreements with all land owners. Typically, wells that are to be replaced will be relocated to a deeper aquifer not within the exempted aquifer.

TR RAI-P&R-10 Table: Well Information for the 133 Wells within the AOR and PAA of the Dewey-Burdock Proposed Project

HydroID	SD_St_NAD27_X	SD_St_NAD27_Y	Aquifer	Well Use	Status
40	1013415.346	447182.479	Inyan Kara	Domestic	NIU
703	1041621.331	434333.8466	Sundance	Domestic	NIU
7	1033303.803	422416.5989	Fall River	Domestic	IU
2	1026723.769	423922.3154	Lakota	Domestic	IU
18	1022811.793	428959.767	Fall River	Domestic	IU

13	1028359.948	438469.8485	Lakota	Domestic	IU
4002	1013414.27	446931.4894	Inyan Kara	Domestic	IU
96	1011629.945	451853.2213	Lakota	Domestic	IU
115	1017697.249	457640.2935	Lakota	Domestic	IU
107	1017018.156	458158.0845	Fall River	Domestic	IU
138	1017537.353	459030.1485	Fall River	Domestic	IU
109	1020800.761	459624.8194	Lakota	Domestic	IU
43	1031122.687	439435.6473	Lakota	Domestic	NIU
704	1020965.765	436647.1385	Inyan Kara	Domestic and stock	IU
638	1038269.039	437976.1978	Fall River	Monitor	NIU
658	1031234.092	426398.134	Lakota	Monitor	TBD
646	1031247.543	426408.5951	Fall River	Monitor	TBD
694	1028717.157	426835.7392	Fall River	Monitor	TBD
696	1028687.291	426946.1107	Lakota	Monitor	TBD
672	1030632.075	427480.0017	Fall River	Monitor	TBD
673	1030628.398	427511.2578	Fuson Shale	Monitor	TBD
674	1030554.854	427513.0965	Lakota	Monitor	TBD
671	1031016.371	427870.059	Fall River	Monitor	TBD
669	1031005.354	427909.7202	Lakota	Monitor	TBD
670	1031064.845	427936.1609	Fuson Shale	Monitor	TBD
664	1030634.318	428337.8486	Fall River	Monitor	TBD
663	1030658.63	428345.6136	Lakota	Monitor	TBD
605	1031814.362	428483.6888	Inyan Kara	Monitor	TBD
666	1033128.336	428870.4223	Lakota	Monitor	TBD
665	1033153.033	428901.2936	Fall River	Monitor	TBD
662	1035381.452	428928.0354	Unknown	Monitor	TBD
684	1035187.894	429745.4246	Lakota	Monitor	TBD
686	1034966.394	429751.4249	Lakota	Monitor	TBD
690	1035113.145	429970.666	Sundance	Monitor	TBD
688	1035026.789	429974.0291	Fall River	Monitor	TBD
692	1035067.878	429999.1042	Lakota	Monitor	TBD
637	1038074.885	430320.1736	Unknown	Monitor	TBD
660	1031822.021	431029.7556	Lakota	Monitor	TBD
659	1031875.51	431048.4765	Fall River	Monitor	TBD
682	1035136.439	431259.1665	Lakota	Monitor	TBD
678	1026522.329	431925.2786	Alluvium	Monitor	TBD
661	1040976.531	431970.3561	Lakota	Monitor	TBD
3026	1043638.22	432832.7602	Lakota	Monitor	TBD
677	1023526.745	434076.7574	Alluvium	Monitor	TBD
698	1035908.712	435650.5539	Fall River	Monitor	TBD
695	1022384.64	439311.9302	Fall River	Monitor	TBD

697	1022349.64	439346.7801	Lakota	Monitor	TBD
676	1030846.054	439891.0583	Alluvium	Monitor	TBD
685	1020686.735	443414.7441	Fall River	Monitor	TBD
693	1020328.587	443666.5417	Sundance	Monitor	TBD
691	1020366.063	443706.2157	Fall River	Monitor	TBD
687	1020077.667	443729.9234	Fall River	Monitor	TBD
689	1020316.258	443788.5193	Lakota	Monitor	TBD
683	1020209.145	446107.3078	Fall River	Monitor	TBD
679	1032294.334	446244.7314	Alluvium	Monitor	TBD
609	1021734.534	447807.5724	Lakota	Monitor	TBD
610	1021599.254	447968.8198	Fall River	Monitor	TBD
616	1022135.266	453141.2578	Lakota	Monitor	TBD
617	1021028.704	453585.733	Lakota	Monitor	TBD
615	1022172.181	453707.9837	Lakota	Monitor	TBD
614	1022185.009	453769.2626	Fuson Shale	Monitor	TBD
613	1022124.551	453774.8997	Fall River	Monitor	TBD
622	1022775.699	454032.8728	Fall River	Monitor	TBD
612	1021757.108	454133.3505	Lakota	Monitor	TBD
623	1022669.277	454299.4787	Lakota	Monitor	TBD
436	1021602.832	454435.6334	Fall River	Monitor	TBD
657	1021636.936	454497.111	Lakota	Monitor	TBD
147	1020878.663	456566.2851	Lakota	Monitor	TBD
653	1030679.378	422486.796	Unknown	P & A	NIU
639	1045704.084	430721.5882	Unknown	P & A	NIU
652	1036359.683	434742.1525	Inyan Kara	P & A	NIU
655	1033453.837	443306.7453	Inyan Kara	P & A	NIU
654	1032371.943	443409.5899	Inyan Kara	P & A	NIU
502	1031989.61	446360.3538	Alluvium	P & A	NIU
621	1031930.296	446397.4054	Alluvium	P & A	NIU
634	1032501.551	440167.6868	Unknown	P & A	NIU
636	1034774.226	429981.9127	Unknown	P & A	NIU
10	1043556.444	427238.672	Lakota	P & A	NIU
39	1022915.677	448655.9078	Unknown	P & A	NIU
429	1023157.091	452952.7101	Lakota	P & A	NIU
431	1023157.091	452952.7101	Lakota	P & A	NIU
432	1023157.091	452952.7101	Lakota	P & A	NIU
433	1023157.091	452952.7101	Lakota	P & A	NIU
668	1031029.213	427449.9686	Inyan Kara	Pump test	TBD
680	1035077.56	429968.6768	Lakota	Pump test	TBD
681	1020329.599	443724.6609	Fall River	Pump test	TBD
611	1021836.764	453957.9874	Lakota	Pump test	TBD
645	1027681.088	427998.0455	Unknown	Stock	NIU

606	1033712.842	428608.9489	Lakota	Stock	NIU
113	1046436.631	434416.8886	Unknown	Stock	NIU
41	1015385.104	442080.7853	Alluvium	Stock	NIU
640	1043010.319	427964.7101	Unknown	Stock	NIU
15	1035303.954	438316.8522	Lakota	Stock	NIU
116	1017991.613	458110.9714	Fall River	Stock	NIU
14	1033699.73	434722.9153	Lakota	Stock	NIU
3	1028593.377	421103.6661	Lakota	Stock	IU
9	1038003.452	421805.5831	Fall River	Stock	IU
7002	1033332.5	421930.5611	Lakota	Stock	IU
4	1032516.055	423080.3468	Unknown	Stock	IU
37	1044182.561	423947.2124	Unknown	Stock	IU
6	1037217.863	425012.1651	Unknown	Stock	IU
425	1034449.302	426207.5928	Lakota	Stock	IU
635	1035685.599	427130.4808	Sundance	Stock	IU
5	1035181.406	427283.8659	Lakota	Stock	IU
642	1042925.942	428041.6327	Unknown	Stock	IU
510	1042932.763	428177.7818	Lakota	Stock	IU
114	1045410.431	428653.5014	Sundance	Stock	IU
1	1027696.216	429227.3992	Lakota	Stock	IU
61	1036831.791	429987.0296	Lakota	Stock	IU
506	1050129	430703.6952	Sundance	Stock	IU
17	1040223.165	431328.716	Fall River	Stock	IU
51	1027411.447	431486.5373	Lakota	Stock	IU
650	1043939.546	433014.3542	Lakota	Stock	IU
12	1026977.915	434378.0457	Lakota	Stock	IU
16	1041428.464	434446.4	Lakota	Stock	IU
618	1038073.632	435906.2372	Unknown	Stock	IU
42	1021144.124	436480.8961	Fall River	Stock	IU
619	1034866.071	436728.841	Lakota	Stock	IU
656	1014229.658	442000.2759	Unknown	Stock	IU
38	1024328.053	442288.97	Lakota	Stock	IU
620	1033951.267	443209.4505	Lakota	Stock	IU
49	1018931.904	444022.1394	Fall River	Stock	IU
631	1034334.926	448992.4622	Fall River	Stock	IU
628	1022654.12	449401.8714	Inyan Kara	Stock	IU
270	1014108.25	451942.4937	Inyan Kara	Stock	IU
220	1017872.434	452334.36	Unknown	Stock	IU
48	1015294.765	453036.5831	Lakota	Stock	IU
112	1027864.205	455880.8369	Fall River	Stock	IU
111	1022074.496	459586.2253	Fall River	Stock	IU
106	1018098.899	459624.8113	Unknown	Stock	IU

110	1023777.247	459643.0909	Lakota	Stock	IU
651	1036008.74	424245.848	Lakota	Stock	NIU
117	1022177.422	460795.629	Unknown	Stock and garden	IU

Status Column:
P&A=Plugged and Abandoned
IU=in use
NIU= not in use
TBD=to be determined

TR RAI-P&R-11

Details of the applicant's pumping test for independent review.

Background: The applicant provided the calculated drawdown for the pumping tests, but did not include any groundwater elevations for that time period. This information is necessary for staff to conduct an independent review of the potential impacts of the operations on water resources.

Needed: Please provide groundwater elevations for the pumping test data.

Response: TR RAI-P&R-11

Please note that groundwater elevations for the pumping tests were provided in Tables 4.2 and 5.2 of the pumping test report (i.e. Appendix 2.7-B of the TR, Knight Piesold, 2008b). The groundwater elevations are provided under the table columns headed: (1) "Approximate Groundwater Elevation (ft amsl)" and (2) "Minimum Pumping Groundwater Elevation (ft amsl)". However, to more clearly present the information requested, the pumping test data in Appendices B (for the Dewey test) and C (for the Burdock test) have been augmented with an additional column for each well entitled "Elevation (ft amsl)" adjacent to the associated time and drawdown value. The groundwater elevation is calculated by subtracting drawdown values from the initial groundwater elevations provided in Tables 4.2 and 5.2 of the pumping test report. The updated tables: Revised Tables B.2-1, B.3-1, C.2-1, and C.3-1 are provided below.

The value of 3,529 ft amsl reported in Table 5.2, Knight Piesold, 2008b should be changed to 3,571 ft amsl). The average depth to groundwater at DB-07-11-11C is reported as 3,662 ft amsl (TR Appendix 2.7-A). This depth has been used to calculate the groundwater elevations in Revised Tables C.2-1 and C.3-1.

Revised Table B.2-1:
Time and Water Level Data Values Used in Pumping Test Analysis: Dewey Test, Drawdown Data

32-3C		3643.9	GW-49		3652	29-7		3659.3	32-4C		3644.0	32-5		3641.0	32-9C		3626.3
Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)
0.000012	16.362759	3,627.5	0.000012	-0.008329	3,652.0	0.000012	0.045472	3,659.3	0.000012	-0.002208	3,644.0	0.000000	-0.048216	3,641.0	0.000012	-0.025243	3,626.3
0.000023	19.161989	3,624.7	0.000023	-0.001406	3,652.0	0.000023	-0.000681	3,659.3	0.000023	0.004715	3,644.0	0.000012	-0.022831	3,641.0	0.000023	0.027834	3,626.3
0.000035	19.948912	3,624.0	0.000035	0.007825	3,652.0	0.000035	0.029319	3,659.3	0.000035	0.007023	3,644.0	0.000023	0.000246	3,641.0	0.000035	0.034757	3,626.3
0.000046	20.355066	3,623.5	0.000046	-0.001406	3,652.0	0.000046	-0.023758	3,659.3	0.000046	0.009331	3,644.0	0.000035	0.002553	3,641.0	0.000046	-0.009089	3,626.3
0.000058	21.017374	3,622.9	0.000058	0.035517	3,652.0	0.000058	0.013165	3,659.3	0.000058	0.007023	3,644.0	0.000046	0.000246	3,641.0	0.000058	0.011680	3,626.3
0.000069	21.402758	3,622.5	0.000069	-0.012944	3,652.0	0.000069	-0.012220	3,659.3	0.000069	0.002408	3,644.0	0.000058	0.004861	3,641.0	0.000069	0.009372	3,626.3
0.000081	21.651989	3,622.2	0.000081	-0.008329	3,652.0	0.000081	0.052395	3,659.2	0.000081	0.013946	3,644.0	0.000069	-0.011293	3,641.0	0.000081	0.023219	3,626.3
0.000093	22.035067	3,621.9	0.000093	-0.036021	3,652.0	0.000093	0.057011	3,659.2	0.000093	0.002408	3,644.0	0.000081	-0.020523	3,641.0	0.000093	0.013988	3,626.3
0.000104	22.071989	3,621.8	0.000104	0.007825	3,652.0	0.000104	0.001626	3,659.3	0.000104	0.016254	3,644.0	0.000093	0.004861	3,641.0	0.000104	-0.002166	3,626.3
0.000116	22.016603	3,621.9	0.000116	0.014748	3,652.0	0.000116	-0.028374	3,659.3	0.000116	0.000100	3,644.0	0.000104	-0.015908	3,641.0	0.000116	0.037065	3,626.3
0.000127	22.381220	3,621.5	0.000127	-0.006021	3,652.0	0.000127	-0.000681	3,659.3	0.000127	0.000100	3,644.0	0.000116	0.000246	3,641.0	0.000127	0.013988	3,626.3
0.000139	22.337374	3,621.6	0.000139	-0.001406	3,652.0	0.000139	-0.005297	3,659.3	0.000139	0.009331	3,644.0	0.000127	-0.002062	3,641.0	0.000139	-0.006781	3,626.3
0.000150	22.618912	3,621.3	0.000150	-0.008329	3,652.0	0.000150	0.045472	3,659.3	0.000150	0.009331	3,644.0	0.000139	0.002553	3,641.0	0.000150	-0.004474	3,626.3
0.000162	22.508142	3,621.4	0.000162	0.005517	3,652.0	0.000162	0.006242	3,659.3	0.000162	0.007023	3,644.0	0.000150	0.021015	3,641.0	0.000162	-0.018320	3,626.3
0.000174	22.847374	3,621.1	0.000174	-0.019867	3,652.0	0.000174	-0.021451	3,659.3	0.000174	0.011639	3,644.0	0.000162	-0.008985	3,641.0	0.000174	0.018603	3,626.3
0.000185	22.914297	3,621.0	0.000185	-0.008329	3,652.0	0.000185	-0.026066	3,659.3	0.000185	-0.004515	3,644.0	0.000174	0.014092	3,641.0	0.000185	0.000142	3,626.3
0.000197	22.999681	3,620.9	0.000197	-0.017559	3,652.0	0.000197	0.024703	3,659.3	0.000197	0.000100	3,644.0	0.000185	-0.018216	3,641.0	0.000197	0.013988	3,626.3
0.000208	22.893528	3,621.0	0.000208	-0.029098	3,652.0	0.000208	0.003934	3,659.3	0.000208	0.013946	3,644.0	0.000197	0.016400	3,641.0	0.000208	0.000142	3,626.3
0.000220	23.131220	3,620.8	0.000220	-0.003713	3,652.0	0.000220	0.020088	3,659.3	0.000220	0.013946	3,644.0	0.000208	-0.013600	3,641.0	0.000220	0.002449	3,626.3
0.000231	23.131220	3,620.8	0.000231	0.010133	3,652.0	0.000231	0.006242	3,659.3	0.000231	0.013946	3,644.0	0.000220	0.018707	3,641.0	0.000231	-0.013704	3,626.3
0.000243	23.271988	3,620.6	0.000243	-0.012944	3,652.0	0.000243	-0.014528	3,659.3	0.000243	0.011639	3,644.0	0.000231	0.023323	3,641.0	0.000243	0.011680	3,626.3
0.000255	23.121988	3,620.8	0.000255	0.017056	3,652.0	0.000255	0.031626	3,659.3	0.000255	0.004715	3,644.0	0.000243	-0.004370	3,641.0	0.000255	-0.011397	3,626.3
0.000266	23.101219	3,620.8	0.000266	0.005517	3,652.0	0.000266	0.038549	3,659.3	0.000266	0.023177	3,644.0	0.000255	-0.002062	3,641.0	0.000266	0.011680	3,626.3
0.000278	23.934296	3,620.0	0.000278	-0.022175	3,652.0	0.000278	0.006242	3,659.3	0.000278	0.009331	3,644.0	0.000266	-0.011293	3,641.0	0.000278	-0.002166	3,626.3
0.000289	24.737373	3,619.2	0.000289	-0.026790	3,652.0	0.000289	-0.032989	3,659.3	0.000289	0.007023	3,644.0	0.000278	0.009477	3,641.0	0.000289	0.009372	3,626.3
0.000301	25.408913	3,618.5	0.000301	0.007825	3,652.0	0.000301	-0.009912	3,659.3	0.000301	0.009331	3,644.0	0.000289	0.057938	3,640.9	0.000301	-0.009089	3,626.3
0.000312	26.036604	3,617.9	0.000312	-0.001406	3,652.0	0.000312	0.020088	3,659.3	0.000312	0.002408	3,644.0	0.000301	-0.008985	3,641.0	0.000312	0.002449	3,626.3
0.000324	27.222757	3,616.7	0.000324	-0.022175	3,652.0	0.000324	0.020088	3,659.3	0.000324	0.013946	3,644.0	0.000312	-0.018216	3,641.0	0.000324	-0.013704	3,626.3
0.000336	27.725836	3,616.2	0.000336	-0.008329	3,652.0	0.000336	-0.021451	3,659.3	0.000336	-0.004515	3,644.0	0.000324	0.009477	3,641.0	0.000336	-0.016012	3,626.3
0.000347	28.452759	3,615.4	0.000347	-0.029098	3,652.0	0.000347	0.010857	3,659.3	0.000347	0.007023	3,644.0	0.000336	-0.002062	3,641.0	0.000347	-0.043704	3,626.3
0.000359	29.391989	3,614.5	0.000359	0.017056	3,652.0	0.000359	0.006242	3,659.3	0.000359	0.002408	3,644.0	0.000347	-0.011293	3,641.0	0.000359	0.037065	3,626.3
0.000370	30.266603	3,613.6	0.000370	-0.017559	3,652.0	0.000370	-0.005297	3,659.3	0.000370	-0.002208	3,644.0	0.000359	0.000246	3,641.0	0.000370	-0.004474	3,626.3
0.000382	30.670450	3,613.2	0.000382	-0.012944	3,652.0	0.000382	0.013165	3,659.3	0.000382	0.013946	3,644.0	0.000370	0.000246	3,641.0	0.000382	0.018603	3,626.3
0.000394	30.815834	3,613.1	0.000394	-0.038329	3,652.0	0.000394	-0.000681	3,659.3	0.000394	0.004715	3,644.0	0.000382	0.025630	3,641.0	0.000394	0.002449	3,626.3
0.000417	30.891989	3,613.0	0.000405	-0.010636	3,652.0	0.000417	0.015472	3,659.3	0.000417	0.009331	3,644.0	0.000394	0.000246	3,641.0	0.000417	-0.004474	3,626.3
0.000451	29.811989	3,614.1	0.000417	-0.006021	3,652.0	0.000451	-0.035297	3,659.3	0.000451	0.013946	3,644.0	0.000417	-0.006677	3,641.0	0.000451	0.030142	3,626.3
0.000463	28.955835	3,614.9	0.000451	0.000902	3,652.0	0.000463	0.057011	3,659.2	0.000463	0.000100	3,644.0	0.000451	0.048707	3,641.0	0.000463	-0.022935	3,626.3
0.000486	27.504297	3,616.4	0.000463	-0.017559	3,652.0	0.000486	-0.014528	3,659.3	0.000486	0.002408	3,644.0	0.000463	0.016400	3,641.0	0.000486	-0.013704	3,626.3
0.000498	26.318142	3,617.6	0.000486	0.000902	3,652.0	0.000498	-0.000681	3,659.3	0.000498	-0.002208	3,644.0	0.000486	0.000246	3,641.0	0.000498	-0.011397	3,626.3
0.000521	25.127373	3,618.8	0.000498	0.014748	3,652.0	0.000521	0.017780	3,659.3	0.000521	0.007023	3,644.0	0.000498	-0.027447	3,641.0	0.000521	-0.025243	3,626.3
0.000532	24.181219	3,619.7	0.000521	0.012441	3,652.0	0.000532	-0.007605	3,659.3	0.000532	0.011639	3,644.0	0.000521	0.016400	3,641.0	0.000532	-0.004474	3,626.3
0.000556	23.816605	3,620.1	0.000532	-0.019867	3,652.0	0.000556	0.033934	3,659.3	0.000556	0.013946	3,644.0	0.000532	-0.004370	3,641.0	0.000556	-0.029858	3,626.3
0.000590	24.716604	3,619.2	0.000556	0.010133	3,652.0	0.000590	-0.014528	3,659.3	0.000590	-0.002208	3,644.0	0.000556	0.002553	3,641.0	0.000590	-0.048320	3,626.3
0.000625	26.325066	3,617.6	0.000590	0.042441	3,652.0	0.000625	0.003934	3,659.3	0.000625	0.011639	3,644.0	0.000590	0.016400	3,641.0	0.000625	-0.020628	3,626.3
0.000660	28.007374	3,615.9	0.000625	0.007825	3,652.0	0.000660	0.010857	3,659.3	0.000660	0.007023	3,644.0	0.000625	0.000246	3,641.0	0.000660	0.013988	3,626.3
0.000694	29.479681	3,614.4	0.000660	-0.022175	3,652.0	0.000694	-0.019143	3,659.3	0.000694	0.011639	3,644.0	0.000660	-0.002062	3,641.0	0.000694	0.011680	3,626.3
0.000729	29.885836	3,614.0	0.000694	-0.017559	3,652.0	0.000729	0.010857	3,659.3	0.000729	0.016254	3,644.0	0.000694	-0.029754	3,641.0	0.000729	0.023219	3,626.3
0.000764	30.118912	3,613.8	0.000729	0.005517	3,652.0	0.000764	0.045472	3,659.3	0.000764	0.000100	3,644.0	0.000729	-0.018216	3,641.0	0.000764	0.000142	3,626.3
0.000799	29.791220	3,614.1	0.000764	-0.012944	3,652.0	0.000799	0.020088	3,659.3	0.000799	-0.004515	3,644.0	0.000764	0.034861	3,641.0	0.000799	0.020911	3,626.3
0.000833	29.622759	3,614.3	0.000799	0.010133	3,652.0	0.000833	-0.012220	3,659.3	0.000833	0.000100	3,644.0	0.000799	0.039477	3,641.0	0.000833	0.025526	3,626.3
0.000903	29.613527	3,614.3	0.000833	-0.008329	3,652.0	0.000903	-0.026066	3,659.3	0.000903	0.007023	3,644.0	0.000833	0.021015	3,641.0	0.000903	-0.018320	3,626.3

Revised Table B.2-1:
Time and Water Level Data Values Used in Pumping Test Analysis: Dewey Test, Drawdown Data

32-3C		3643.9	GW-49		3652	29-7		3659.3	32-4C		3644.0	32-5		3641.0	32-9C		3626.3
Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)
0.000972	29.675835	3,614.2	0.000903	-0.022175	3,652.0	0.000972	-0.005297	3,659.3	0.000972	0.030100	3,644.0	0.000903	-0.008985	3,641.0	0.000972	0.020911	3,626.3
0.001042	29.874296	3,614.0	0.000972	0.021671	3,652.0	0.001042	-0.028374	3,659.3	0.001042	0.004715	3,644.0	0.000972	0.025630	3,641.0	0.001042	-0.016012	3,626.3
0.001111	29.814297	3,614.1	0.001042	0.023979	3,652.0	0.001111	-0.014528	3,659.3	0.001111	0.011639	3,644.0	0.001042	0.067169	3,640.9	0.001111	0.018603	3,626.3
0.001181	29.823526	3,614.1	0.001111	0.012441	3,652.0	0.001181	-0.005297	3,659.3	0.001181	0.013946	3,644.0	0.001111	0.069477	3,640.9	0.001181	0.018603	3,626.3
0.001250	29.851219	3,614.0	0.001181	0.010133	3,652.0	0.001250	-0.030681	3,659.3	0.001250	0.011639	3,644.0	0.001181	0.090246	3,640.9	0.001250	-0.013704	3,626.3
0.001319	29.989681	3,613.9	0.001250	-0.015252	3,652.0	0.001319	0.027011	3,659.3	0.001319	0.016254	3,644.0	0.001250	0.076400	3,640.9	0.001319	0.064757	3,626.2
0.001389	30.010450	3,613.9	0.001319	-0.040636	3,652.0	0.001389	-0.056066	3,659.4	0.001389	0.002408	3,644.0	0.001319	0.131784	3,640.9	0.001389	-0.041397	3,626.3
0.001493	30.190451	3,613.7	0.001389	0.007825	3,652.0	0.001493	0.001626	3,659.3	0.001493	0.016254	3,644.0	0.001389	0.152553	3,640.8	0.001493	-0.025243	3,626.3
0.001597	30.144297	3,613.8	0.001493	0.014748	3,652.0	0.001597	-0.032989	3,659.3	0.001597	0.023177	3,644.0	0.001493	0.180246	3,640.8	0.001597	-0.025243	3,626.3
0.001701	30.280451	3,613.6	0.001597	-0.019867	3,652.0	0.001701	-0.012220	3,659.3	0.001701	0.016254	3,644.0	0.001597	0.203323	3,640.8	0.001701	-0.032166	3,626.3
0.001806	30.506603	3,613.4	0.001701	-0.022175	3,652.0	0.001806	-0.000681	3,659.3	0.001806	0.030100	3,644.0	0.001701	0.274861	3,640.7	0.001806	0.013988	3,626.3
0.001944	30.497374	3,613.4	0.001806	-0.026790	3,652.0	0.001944	-0.035297	3,659.3	0.001944	0.041639	3,644.0	0.001806	0.291015	3,640.7	0.001944	-0.004474	3,626.3
0.002083	30.527374	3,613.4	0.001944	0.060902	3,651.9	0.002083	-0.014528	3,659.3	0.002083	0.030100	3,644.0	0.001944	0.330246	3,640.7	0.002083	-0.041397	3,626.3
0.002222	30.758142	3,613.1	0.002083	0.007825	3,652.0	0.002222	0.031626	3,659.3	0.002222	0.037023	3,644.0	0.002083	0.411015	3,640.6	0.002222	-0.029858	3,626.3
0.002361	30.873528	3,613.0	0.002222	-0.029098	3,652.0	0.002361	-0.009912	3,659.3	0.002361	0.039331	3,644.0	0.002222	0.452553	3,640.5	0.002361	-0.016012	3,626.3
0.002500	31.071989	3,612.8	0.002361	0.007825	3,652.0	0.002500	0.015472	3,659.3	0.002500	0.055485	3,643.9	0.002361	0.494092	3,640.5	0.002500	-0.009089	3,626.3
0.002639	30.954296	3,612.9	0.002500	-0.008329	3,652.0	0.002639	-0.012220	3,659.3	0.002639	0.050869	3,643.9	0.002500	0.512553	3,640.5	0.002639	-0.022935	3,626.3
0.002778	31.159681	3,612.7	0.002639	0.014748	3,652.0	0.002778	-0.012220	3,659.3	0.002778	0.048562	3,644.0	0.002639	0.581784	3,640.4	0.002778	-0.009089	3,626.3
0.002951	31.143528	3,612.8	0.002778	0.000902	3,652.0	0.002951	0.024703	3,659.3	0.002951	0.067023	3,643.9	0.002778	0.595630	3,640.4	0.002951	-0.013704	3,626.3
0.003125	31.323526	3,612.6	0.002951	-0.022175	3,652.0	0.003125	-0.026066	3,659.3	0.003125	0.071639	3,643.9	0.002951	0.713323	3,640.3	0.003125	-0.025243	3,626.3
0.003299	31.420450	3,612.5	0.003125	-0.006021	3,652.0	0.003299	0.006242	3,659.3	0.003299	0.080869	3,643.9	0.003125	0.701784	3,640.3	0.003299	-0.052935	3,626.4
0.003472	31.475836	3,612.4	0.003299	0.003210	3,652.0	0.003472	-0.005297	3,659.3	0.003472	0.080869	3,643.9	0.003299	0.761784	3,640.2	0.003472	-0.004474	3,626.3
0.003704	31.637373	3,612.3	0.003472	-0.006021	3,652.0	0.003704	0.015472	3,659.3	0.003704	0.099331	3,643.9	0.003472	0.791784	3,640.2	0.003704	0.009372	3,626.3
0.003935	31.695066	3,612.2	0.003704	0.010133	3,652.0	0.003935	-0.005297	3,659.3	0.003935	0.103946	3,643.9	0.003704	0.872553	3,640.1	0.003935	-0.046012	3,626.3
0.004167	31.757374	3,612.1	0.003935	0.007825	3,652.0	0.004167	0.050088	3,659.2	0.004167	0.143177	3,643.9	0.003935	0.916400	3,640.1	0.004167	-0.013704	3,626.3
0.004398	31.796604	3,612.1	0.004167	-0.019867	3,652.0	0.004398	-0.000681	3,659.3	0.004398	0.133946	3,643.9	0.004167	0.983323	3,640.0	0.004398	-0.004474	3,626.3
0.004630	32.068913	3,611.8	0.004398	0.005517	3,652.0	0.004630	0.010857	3,659.3	0.004630	0.143177	3,643.9	0.004398	1.011015	3,640.0	0.004630	-0.092166	3,626.4
0.004861	32.036606	3,611.9	0.004630	0.000902	3,652.0	0.004861	0.010857	3,659.3	0.004861	0.166254	3,643.8	0.004630	1.119477	3,639.9	0.004861	-0.006781	3,626.3
0.005208	32.232758	3,611.7	0.004861	0.000902	3,652.0	0.005208	0.017780	3,659.3	0.005208	0.187023	3,643.8	0.004861	1.158707	3,639.8	0.005208	-0.032166	3,626.3
0.005556	32.179680	3,611.7	0.005208	-0.008329	3,652.0	0.005556	0.043165	3,659.3	0.005556	0.196254	3,643.8	0.005208	1.204861	3,639.8	0.005556	0.030142	3,626.3
0.005903	32.373528	3,611.5	0.005556	-0.006021	3,652.0	0.005903	-0.012220	3,659.3	0.005903	0.221639	3,643.8	0.005556	1.304092	3,639.7	0.005903	0.041680	3,626.3
0.006250	32.382759	3,611.5	0.005903	-0.015252	3,652.0	0.006250	-0.014528	3,659.3	0.006250	0.244715	3,643.8	0.005903	1.357169	3,639.6	0.006250	0.000142	3,626.3
0.006597	32.398911	3,611.5	0.006250	-0.015252	3,652.0	0.006597	-0.021451	3,659.3	0.006597	0.260869	3,643.7	0.006250	1.421784	3,639.6	0.006597	0.023219	3,626.3
0.006944	32.641220	3,611.3	0.006597	0.007825	3,652.0	0.006944	0.008549	3,659.3	0.006944	0.283946	3,643.7	0.006597	1.530246	3,639.5	0.006944	0.048603	3,626.3
0.007292	32.781990	3,611.1	0.006944	-0.029098	3,652.0	0.007292	-0.009912	3,659.3	0.007292	0.309331	3,643.7	0.006944	1.534861	3,639.5	0.007292	0.041680	3,626.3
0.007639	32.922756	3,611.0	0.007292	-0.033713	3,652.0	0.007639	-0.002989	3,659.3	0.007639	0.309331	3,643.7	0.007292	1.567169	3,639.4	0.007639	0.080911	3,626.2
0.007986	32.874298	3,611.0	0.007639	-0.015252	3,652.0	0.007986	-0.000681	3,659.3	0.007986	0.339331	3,643.7	0.007639	1.645630	3,639.4	0.007986	0.083219	3,626.2
0.008333	32.980450	3,610.9	0.007986	0.019364	3,652.0	0.008333	-0.026066	3,659.3	0.008333	0.371639	3,643.6	0.007986	1.714861	3,639.3	0.008333	0.055526	3,626.2
0.009028	33.077374	3,610.8	0.008333	0.019364	3,652.0	0.009028	0.022395	3,659.3	0.009028	0.401639	3,643.6	0.008333	1.728707	3,639.3	0.009028	0.090142	3,626.2
0.009722	33.061218	3,610.8	0.009028	0.030902	3,652.0	0.009722	0.010857	3,659.3	0.009722	0.436254	3,643.6	0.009028	1.876400	3,639.1	0.009722	0.073988	3,626.2
0.010417	33.261990	3,610.6	0.009722	-0.006021	3,652.0	0.010417	0.010857	3,659.3	0.010417	0.480100	3,643.5	0.009722	1.954861	3,639.0	0.010417	0.099372	3,626.2
0.011111	33.460449	3,610.4	0.010417	-0.012944	3,652.0	0.011111	-0.007605	3,659.3	0.011111	0.521639	3,643.5	0.010417	2.024092	3,639.0	0.011111	0.133988	3,626.2
0.011806	33.536606	3,610.4	0.011111	-0.022175	3,652.0	0.011806	0.047780	3,659.3	0.011806	0.558562	3,643.4	0.011111	2.079477	3,638.9	0.011806	0.145526	3,626.2
0.012500	33.552757	3,610.3	0.011806	-0.036021	3,652.0	0.012500	0.010857	3,659.3	0.012500	0.581639	3,643.4	0.011806	2.178707	3,638.8	0.012500	0.131680	3,626.2
0.013194	33.728142	3,610.2	0.012500	-0.017559	3,652.0	0.013194	0.006242	3,659.3	0.013194	0.611639	3,643.4	0.012500	2.277938	3,638.7	0.013194	0.166296	3,626.1
0.013889	33.753529	3,610.1	0.013194	0.000902	3,652.0	0.013889	0.045472	3,659.3	0.013889	0.657792	3,643.3	0.013194	2.317169	3,638.7	0.013889	0.187065	3,626.1
0.014931	34.346603	3,609.6	0.013889	-0.015252	3,652.0	0.014931	-0.000681	3,659.3	0.014931	0.699331	3,643.3	0.013889	2.361015	3,638.6	0.014931	0.196296	3,626.1
0.015972	34.362759	3,609.5	0.014931	0.007825	3,652.0	0.015972	0.015472	3,659.3	0.015972	0.747792	3,643.3	0.014931	2.499476	3,638.5	0.015972	0.267834	3,626.0
0.017014	34.570450	3,609.3	0.015972	-0.012944	3,652.0	0.017014	0.001626	3,659.3	0.017014	0.796254	3,643.2	0.015972	2.568707	3,638.4	0.017014	0.288603	3,626.0
0.018056	34.745834	3,609.2	0.017014	-0.008329	3,652.0	0.018056	0.024703	3,659.3	0.018056	0.844715	3,643.2	0.017014	2.637938	3,638.4	0.018056	0.353219	3,625.9
0.019444	34.872757	3,609.0	0.018056	0.040133	3,652.0	0.019444	0.013165	3,659.3	0.019444	0.911639	3,643.1	0.018056	2.734861	3,638.3	0.019444	0.392449	3,625.9

Revised Table B.2-1:
Time and Water Level Data Values Used in Pumping Test Analysis: Dewey Test, Drawdown Data

32-3C		3643.9	GW-49		3652	29-7		3659.3	32-4C		3644.0	32-5		3641.0	32-9C		3626.3
Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)
0.020833	34.872757	3,609.0	0.019444	0.051671	3,651.9	0.020833	0.008549	3,659.3	0.020833	0.967023	3,643.0	0.019444	2.868707	3,638.1	0.020833	0.417834	3,625.9
0.022222	35.149681	3,608.8	0.020833	0.026287	3,652.0	0.022222	-0.012220	3,659.3	0.022222	1.022408	3,643.0	0.020833	2.961015	3,638.0	0.022222	0.487065	3,625.8
0.023611	35.149681	3,608.8	0.022222	0.030902	3,652.0	0.023611	-0.012220	3,659.3	0.023611	1.066254	3,642.9	0.022222	3.037169	3,638.0	0.023611	0.549372	3,625.8
0.025000	35.355064	3,608.5	0.023611	0.049364	3,652.0	0.025000	0.020088	3,659.3	0.025000	1.123946	3,642.9	0.023611	3.113323	3,637.9	0.025000	0.600142	3,625.7
0.026389	35.320450	3,608.6	0.025000	0.053979	3,651.9	0.026389	0.010857	3,659.3	0.026389	1.156254	3,642.8	0.025000	3.194092	3,637.8	0.026389	0.553988	3,625.7
0.027778	35.645836	3,608.3	0.026389	0.053979	3,651.9	0.027778	0.027011	3,659.3	0.027778	1.204715	3,642.8	0.026389	3.256400	3,637.7	0.027778	0.556296	3,625.7
0.029514	35.567375	3,608.3	0.027778	0.077056	3,651.9	0.029514	-0.026066	3,659.3	0.029514	1.285485	3,642.7	0.027778	3.300246	3,637.7	0.029514	0.616296	3,625.7
0.031250	35.588142	3,608.3	0.029514	0.083979	3,651.9	0.031250	0.036242	3,659.3	0.031250	1.315485	3,642.7	0.029514	3.408707	3,637.6	0.031250	0.623219	3,625.7
0.032986	35.680450	3,608.2	0.031250	0.134748	3,651.9	0.032986	0.036242	3,659.3	0.032986	1.363946	3,642.6	0.031250	3.482553	3,637.5	0.032986	0.690142	3,625.6
0.034722	35.735836	3,608.2	0.032986	0.100133	3,651.9	0.034722	-0.014528	3,659.3	0.034722	1.423946	3,642.6	0.032986	3.544861	3,637.5	0.034722	0.745526	3,625.6
0.037037	35.950451	3,607.9	0.034722	0.141671	3,651.9	0.037037	-0.016835	3,659.3	0.037037	1.481639	3,642.5	0.034722	3.607169	3,637.4	0.037037	0.784757	3,625.5
0.039352	35.978142	3,607.9	0.037037	0.125517	3,651.9	0.039352	0.024703	3,659.3	0.039352	1.532408	3,642.5	0.037037	3.713323	3,637.3	0.039352	0.863219	3,625.4
0.041667	35.952759	3,607.9	0.039352	0.164748	3,651.8	0.041667	0.001626	3,659.3	0.041667	1.587792	3,642.4	0.039352	3.807938	3,637.2	0.041667	0.865526	3,625.4
0.043981	36.153526	3,607.7	0.041667	0.201671	3,651.8	0.043981	0.006242	3,659.3	0.043981	1.645485	3,642.4	0.041667	3.863323	3,637.1	0.043981	0.890911	3,625.4
0.046296	36.012756	3,607.9	0.043981	0.208594	3,651.8	0.046296	0.001626	3,659.3	0.046296	1.696254	3,642.3	0.043981	3.953323	3,637.0	0.046296	0.960142	3,625.3
0.048611	36.144295	3,607.8	0.046296	0.247825	3,651.8	0.048611	0.010857	3,659.3	0.048611	1.735485	3,642.3	0.046296	4.015630	3,637.0	0.048611	0.999372	3,625.3
0.052083	36.488144	3,607.4	0.048611	0.289364	3,651.7	0.052083	-0.021451	3,659.3	0.052083	1.827792	3,642.2	0.048611	4.061784	3,636.9	0.052083	1.091680	3,625.2
0.055556	36.432758	3,607.5	0.052083	0.303210	3,651.7	0.055556	-0.016835	3,659.3	0.055556	1.887792	3,642.1	0.052083	4.200246	3,636.8	0.055556	1.147065	3,625.2
0.059028	36.527374	3,607.4	0.055556	0.402441	3,651.6	0.059028	0.033934	3,659.3	0.059028	1.940869	3,642.1	0.055556	4.253323	3,636.7	0.059028	1.243988	3,625.1
0.062500	36.478912	3,607.4	0.059028	0.471671	3,651.5	0.062500	-0.000681	3,659.3	0.062500	2.003177	3,642.0	0.059028	4.368707	3,636.6	0.062500	1.315526	3,625.0
0.065972	36.508911	3,607.4	0.062500	0.476287	3,651.5	0.065972	-0.000681	3,659.3	0.065972	2.056254	3,641.9	0.062500	4.426400	3,636.6	0.065972	1.313219	3,625.0
0.069444	36.580452	3,607.3	0.065972	0.584748	3,651.4	0.069444	0.015472	3,659.3	0.069444	2.107023	3,641.9	0.065972	4.481784	3,636.5	0.069444	1.324757	3,625.0
0.072917	36.688911	3,607.2	0.069444	0.573210	3,651.4	0.073021	0.059319	3,659.2	0.072917	2.157792	3,641.8	0.069444	4.548707	3,636.5	0.072917	1.382449	3,624.9
0.076389	36.806602	3,607.1	0.072917	0.653979	3,651.3	0.076493	0.057011	3,659.2	0.076389	2.231638	3,641.8	0.072917	4.647938	3,636.4	0.076389	1.474757	3,624.8
0.079861	36.647373	3,607.3	0.076389	0.716287	3,651.3	0.079965	0.033934	3,659.3	0.079861	2.273177	3,641.7	0.076389	4.650246	3,636.3	0.079965	1.564757	3,624.7
0.083368	36.778912	3,607.1	0.079861	0.711671	3,651.3	0.083438	0.070857	3,659.2	0.083449	2.317023	3,641.7	0.079931	4.777169	3,636.2	0.083438	1.513988	3,624.8
0.090312	37.895836	3,606.0	0.083449	0.771671	3,651.2	0.090382	0.084703	3,659.2	0.090394	2.409331	3,641.6	0.083403	4.807169	3,636.2	0.090382	1.668603	3,624.6
0.097257	37.900452	3,606.0	0.090394	0.799364	3,651.2	0.097326	0.084703	3,659.2	0.097338	2.510869	3,641.5	0.090347	4.936399	3,636.1	0.097326	1.693988	3,624.6
0.104201	38.121990	3,605.8	0.097338	0.972441	3,651.0	0.104271	-0.060681	3,659.4	0.104282	2.598562	3,641.4	0.097292	5.116400	3,635.9	0.104271	1.843988	3,624.5
0.111147	38.013527	3,605.9	0.104282	1.080902	3,650.9	0.111215	0.050088	3,659.2	0.111227	2.667792	3,641.3	0.104236	5.215631	3,635.8	0.111215	1.998603	3,624.3
0.118091	38.108143	3,605.8	0.111227	1.159364	3,650.8	0.118160	0.057011	3,659.2	0.118171	2.743946	3,641.3	0.111181	5.340246	3,635.7	0.118160	1.931680	3,624.4
0.125035	38.172756	3,605.7	0.118171	1.307056	3,650.7	0.125104	0.047780	3,659.3	0.125116	2.815485	3,641.2	0.118125	5.411784	3,635.6	0.125104	2.077065	3,624.2
0.131979	38.331989	3,605.6	0.125116	1.327825	3,650.7	0.132049	0.068549	3,659.2	0.132060	2.880100	3,641.1	0.125069	5.524861	3,635.5	0.132049	2.139373	3,624.2
0.138924	38.493526	3,605.4	0.132060	1.413210	3,650.6	0.138993	0.077780	3,659.2	0.139005	2.949331	3,641.1	0.132014	5.566400	3,635.4	0.138993	2.210911	3,624.1
0.149340	38.484295	3,605.4	0.139005	1.533210	3,650.5	0.149410	0.075472	3,659.2	0.149421	3.032408	3,641.0	0.138958	5.633323	3,635.4	0.149410	2.416296	3,623.9
0.159757	38.350449	3,605.5	0.149421	1.637056	3,650.4	0.159826	0.022395	3,659.3	0.159838	3.110869	3,640.9	0.149375	5.794861	3,635.2	0.159826	2.510911	3,623.8
0.170174	38.484295	3,605.4	0.159838	1.747825	3,650.3	0.170243	0.082395	3,659.2	0.170255	3.198562	3,640.8	0.159792	5.875630	3,635.1	0.170243	2.476295	3,623.8
0.180590	38.627373	3,605.3	0.170255	1.881671	3,650.1	0.180660	0.031626	3,659.3	0.180671	3.265485	3,640.7	0.170208	5.907938	3,635.1	0.180660	2.713988	3,623.6
0.194479	38.631989	3,605.3	0.180671	1.976287	3,650.0	0.194549	0.061626	3,659.2	0.194560	3.364715	3,640.6	0.180625	6.007169	3,635.0	0.194549	2.843219	3,623.5
0.208368	38.811989	3,605.1	0.194560	2.096287	3,649.9	0.208437	0.070857	3,659.2	0.208449	3.452408	3,640.5	0.194514	6.221784	3,634.8	0.208437	2.877834	3,623.4
0.222257	38.763527	3,605.1	0.208449	2.267056	3,649.7	0.222326	0.103165	3,659.2	0.222338	3.540100	3,640.5	0.208403	6.184861	3,634.8	0.222326	2.986295	3,623.3
0.236146	38.920452	3,605.0	0.222338	2.336287	3,649.7	0.236215	0.054703	3,659.2	0.236227	3.572408	3,640.4	0.222292	6.406400	3,634.6	0.236215	3.247065	3,623.1
0.250035	38.839680	3,605.1	0.236227	2.465518	3,649.5	0.250104	0.057011	3,659.2	0.250116	3.697023	3,640.3	0.236181	6.473323	3,634.5	0.250104	3.251680	3,623.0
0.263924	38.908913	3,605.0	0.250116	2.583210	3,649.4	0.263993	0.027011	3,659.3	0.264005	3.784715	3,640.2	0.250069	6.581784	3,634.4	0.263993	3.427065	3,622.9
0.277812	39.130451	3,604.8	0.264005	2.652441	3,649.3	0.277882	0.066242	3,659.2	0.277894	3.853946	3,640.1	0.263958	6.655631	3,634.3	0.277882	3.463988	3,622.8
0.295174	39.375065	3,604.5	0.277894	2.781671	3,649.2	0.295243	0.073165	3,659.2	0.295255	3.950869	3,640.0	0.277847	6.711015	3,634.3	0.295243	3.683219	3,622.6
0.312535	39.285065	3,604.6	0.295255	2.931671	3,649.1	0.312604	0.036242	3,659.3	0.312616	4.045485	3,640.0	0.295208	6.893322	3,634.1	0.312604	3.747834	3,622.6
0.329896	39.349682	3,604.6	0.312616	3.000902	3,649.0	0.329965	0.073165	3,659.2	0.329977	4.133177	3,639.9	0.312569	6.967169	3,634.0	0.329965	3.883988	3,622.4
0.347257	39.538914	3,604.4	0.329977	3.118594	3,648.9	0.347326	0.093934	3,659.2	0.347338	4.211638	3,639.8	0.329931	7.096400	3,633.9	0.347326	4.006296	3,622.3
0.370405	39.342758	3,604.6	0.347338	3.263979	3,648.7	0.370475	0.063934	3,659.2	0.370486	4.331638	3,639.7	0.347292	7.179477	3,633.8	0.370475	4.140141	3,622.2
0.393553	39.598911	3,604.3	0.370486	3.407056	3,648.6	0.393623	0.084703	3,659.2	0.393634	4.442408	3,639.6	0.370440	7.308707	3,633.7	0.393623	4.333988	3,622.0

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Revised Table B.2-1:
Time and Water Level Data Values Used in Pumping Test Analysis: Dewey Test, Drawdown Data

32-3C		3643.9	GW-49		3652	29-7		3659.3	32-4C		3644.0	32-5		3641.0	32-9C		3626.3
Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)
0.416701	39.898911	3,604.0	0.393634	3.510902	3,648.5	0.416771	0.077780	3,659.2	0.416782	4.548562	3,639.5	0.393688	7.401015	3,633.6	0.416771	4.453988	3,621.8
0.439965	39.430450	3,604.5	0.416782	3.647056	3,648.4	0.440035	0.066242	3,659.2	0.440046	4.650100	3,639.3	0.416736	7.537169	3,633.5	0.440035	4.562449	3,621.7
0.462998	39.878143	3,604.0	0.440046	3.753210	3,648.2	0.463067	0.061626	3,659.2	0.463079	4.765485	3,639.2	0.440000	7.645630	3,633.4	0.463067	4.772449	3,621.5
0.486146	39.965836	3,603.9	0.463079	3.912441	3,648.1	0.486215	0.080088	3,659.2	0.486227	4.857792	3,639.1	0.463032	7.784092	3,633.2	0.486215	4.832449	3,621.5
0.520868	40.173527	3,603.7	0.486227	4.004748	3,648.0	0.520938	0.084703	3,659.2	0.520949	4.970869	3,639.0	0.486181	7.864861	3,633.1	0.520938	5.026296	3,621.3
0.555590	40.101990	3,603.8	0.520949	4.136287	3,647.9	0.555660	0.082395	3,659.2	0.555671	5.095485	3,638.9	0.520903	8.028708	3,633.0	0.555660	5.208603	3,621.1
0.590312	40.249680	3,603.7	0.555671	4.283979	3,647.7	0.590382	0.114703	3,659.2	0.590394	5.213177	3,638.8	0.555625	8.107169	3,632.9	0.590382	5.317065	3,621.0
0.625035	40.685837	3,603.2	0.590394	4.424748	3,647.6	0.625104	0.114703	3,659.2	0.625116	5.337792	3,638.7	0.590347	8.259477	3,632.7	0.625104	5.483219	3,620.8
0.659757	40.494297	3,603.4	0.625116	4.523979	3,647.5	0.659826	0.114703	3,659.2	0.659838	5.420869	3,638.6	0.625069	8.423323	3,632.6	0.659826	5.653988	3,620.6
0.694479	40.639683	3,603.3	0.659838	4.678595	3,647.3	0.694549	0.135472	3,659.2	0.694560	5.522408	3,638.5	0.659792	8.527169	3,632.5	0.694549	5.836296	3,620.5
0.729549	40.833527	3,603.1	0.694560	4.768594	3,647.2	0.729618	0.123934	3,659.2	0.729630	5.635485	3,638.4	0.694514	8.571015	3,632.4	0.729618	5.974757	3,620.3
0.763924	40.755066	3,603.1	0.729630	4.826287	3,647.2	0.763993	0.147011	3,659.2	0.764005	5.700100	3,638.3	0.729583	8.702554	3,632.3	0.763993	6.064757	3,620.2
0.798646	41.034298	3,602.9	0.764005	4.937056	3,647.1	0.798715	0.181626	3,659.1	0.798727	5.808562	3,638.2	0.763958	8.827168	3,632.2	0.798715	6.212450	3,620.1
0.833368	41.082760	3,602.8	0.798727	5.098594	3,646.9	0.833438	0.200088	3,659.1	0.833449	5.947023	3,638.1	0.798681	8.944861	3,632.1	0.833438	6.332449	3,620.0
0.902814	41.218910	3,602.7	0.833449	5.190902	3,646.8	0.902882	0.234703	3,659.1	0.902893	6.161639	3,637.8	0.833403	9.046400	3,632.0	0.902882	6.581680	3,619.7
0.972951	41.555836	3,602.3	0.902893	5.433210	3,646.6	0.973021	0.204703	3,659.1	0.973032	6.307023	3,637.7	0.902847	9.254092	3,631.7	0.973021	6.800911	3,619.5
1.041701	41.576603	3,602.3	0.973032	5.627056	3,646.4	1.041771	0.276242	3,659.0	1.041782	6.487023	3,637.5	0.972986	9.424861	3,631.6	1.041771	6.907065	3,619.4
1.111146	41.629681	3,602.3	1.041782	5.779364	3,646.2	1.111215	0.310857	3,659.0	1.111227	6.620869	3,637.4	1.041736	9.572554	3,631.4	1.111215	7.170142	3,619.1
1.180590	41.911221	3,602.0	1.111227	5.890133	3,646.1	1.180660	0.340857	3,659.0	1.180671	6.722408	3,637.3	1.111181	9.699476	3,631.3	1.180660	7.343219	3,619.0
1.250035	41.809681	3,602.1	1.180671	6.007825	3,646.0	1.250104	0.391626	3,658.9	1.250116	6.844716	3,637.2	1.180625	9.821784	3,631.2	1.250104	7.516295	3,618.8
1.319479	41.920452	3,602.0	1.250116	6.148594	3,645.9	1.319549	0.417011	3,658.9	1.319560	7.010870	3,637.0	1.250069	10.041015	3,631.0	1.319549	7.650142	3,618.6
1.388924	42.229683	3,601.7	1.319560	6.298594	3,645.7	1.388993	0.430857	3,658.9	1.389005	7.167792	3,636.8	1.319514	10.024861	3,631.0	1.388993	7.786295	3,618.5
1.493090	42.545834	3,601.4	1.389005	6.467056	3,645.5	1.493160	0.463165	3,658.8	1.493171	7.389331	3,636.6	1.388958	10.255630	3,630.7	1.493160	8.090911	3,618.2
1.597257	42.432758	3,601.5	1.493171	6.704748	3,645.3	1.597326	0.557780	3,658.7	1.597338	7.603946	3,636.4	1.493125	10.532554	3,630.5	1.597326	8.335526	3,618.0
1.701424	42.813526	3,601.1	1.597338	6.898594	3,645.1	1.701493	0.580857	3,658.7	1.701505	7.770100	3,636.2	1.597292	10.733323	3,630.3	1.701493	8.522449	3,617.8
1.805590	42.917374	3,601.0	1.701505	7.087825	3,644.9	1.805660	0.627011	3,658.7	1.805671	7.989331	3,636.0	1.701458	10.841784	3,630.2	1.805660	8.739372	3,617.6
1.944479	44.018143	3,599.9	1.805671	7.272440	3,644.7	1.944549	0.735472	3,658.6	1.944560	8.307793	3,635.7	1.805625	11.028708	3,630.0	1.944549	9.013988	3,617.3
2.083368	44.029682	3,599.9	1.944560	7.604748	3,644.4	2.083437	0.830088	3,658.5	2.083449	8.510869	3,635.5	1.944514	11.467169	3,629.5	2.083437	9.277064	3,617.0
2.222257	44.138142	3,599.8	2.083449	7.805518	3,644.2	2.222326	0.807011	3,658.5	2.222338	8.670100	3,635.3	2.083403	11.667938	3,629.3	2.222326	9.452450	3,616.8
2.361146	44.244297	3,599.7	2.222338	7.997056	3,644.0	2.361215	0.996242	3,658.3	2.361227	8.845485	3,635.2	2.222292	11.787938	3,629.2	2.361215	9.558603	3,616.7
2.500035	44.426605	3,599.5	2.361227	8.121672	3,643.9	2.500104	1.086242	3,658.2	2.500116	9.090100	3,634.9	2.361181	11.997938	3,629.0	2.500104	9.870142	3,616.4
2.638924	44.592758	3,599.3	2.500116	8.357056	3,643.6	2.638993	1.217780	3,658.1	2.639005	9.244716	3,634.8	2.500070	12.251784	3,628.7	2.638993	10.087065	3,616.2
2.777813	44.657372	3,599.2	2.639005	8.516287	3,643.5	2.777882	1.210857	3,658.1	2.777894	9.413177	3,634.6	2.638958	12.422553	3,628.6	2.777882	10.220911	3,616.1
2.951423	44.666603	3,599.2	2.777894	8.696287	3,643.3	2.951493	1.381626	3,657.9	2.951505	9.646254	3,634.4	2.777847	12.574862	3,628.4	2.951493	10.474757	3,615.8
3.083843	44.781990	3,599.1	2.951505	8.933979	3,643.1	3.083843	1.480857	3,657.8	3.083843	9.766253	3,634.2	2.951458	12.708707	3,628.3	3.083843	10.599373	3,615.7
			3.083843	9.033210	3,643.0							3.083843	12.953322	3,628.0			

General Methodology: PSI, temperature, and time readings from Win-Situ™ digital data log were exported to Excel ".csv" file.
Drawdown was calculated as PSI at time after pumping minus average PSI before pumping; therefore, at small or zero changes in PSI negative drawdowns may be calculated
A FORTRAN program was written to read the ".csv" file and produce a second file by extracting the records at a frequency of 40 per log-time cycle (in minutes) in order achieve equal representation of data throughout the pumping and drawdown phases of the test.
Elevation (in ft above mean sea level) based on initial groundwater elevation (see Table 4.2) minus drawdown.

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Revised Table B.3-1:
Time and Water Level Data Values Used in Pumping Test Analysis: Dewey Test, Recovery Data

32-3C		3643.9	GW-49		3652	32-4C		3644.0	32-5		3641.0	32-9C		3626.3
Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)
3.083866	42.133311	3,601.8	3.083866	9.035518	3,643.0	3.083889	9.763947	3,634.2	3.083866	12.934861	3,628.1	3.083889	10.606296	3,615.7
3.083877	41.493441	3,602.4	3.083877	9.053979	3,642.9	3.083901	9.766253	3,634.2	3.083877	12.930245	3,628.1	3.083901	10.603988	3,615.7
3.083889	40.624881	3,603.3	3.083889	9.042440	3,643.0	3.083912	9.775485	3,634.2	3.083889	12.925631	3,628.1	3.083912	10.557834	3,615.7
3.083901	39.645441	3,604.3	3.083901	9.063210	3,642.9	3.083924	9.770869	3,634.2	3.083901	12.904861	3,628.1	3.083924	10.585526	3,615.7
3.083912	38.712201	3,605.2	3.083912	9.148595	3,642.9	3.083935	9.768561	3,634.2	3.083912	12.907168	3,628.1	3.083935	10.594757	3,615.7
3.083924	37.792821	3,606.1	3.083924	9.053979	3,642.9	3.083947	9.759331	3,634.2	3.083924	12.914092	3,628.1	3.083947	10.615526	3,615.7
3.083935	36.931191	3,607.0	3.083935	9.058595	3,642.9	3.083958	9.768561	3,634.2	3.083935	12.909476	3,628.1	3.083958	10.564757	3,615.7
3.083947	36.228951	3,607.7	3.083947	9.060902	3,642.9	3.083970	9.768561	3,634.2	3.083947	12.946400	3,628.1	3.083970	10.567065	3,615.7
3.083958	35.328051	3,608.6	3.083958	9.060902	3,642.9	3.083981	9.773177	3,634.2	3.083958	12.918707	3,628.1	3.083981	10.562449	3,615.7
3.083970	34.549581	3,609.4	3.083970	9.028594	3,643.0	3.083993	9.770869	3,634.2	3.083970	12.897938	3,628.1	3.083993	10.638603	3,615.7
3.083982	33.812691	3,610.1	3.083981	9.056287	3,642.9	3.084005	9.775485	3,634.2	3.083981	12.895631	3,628.1	3.084005	10.583219	3,615.7
3.083993	33.055011	3,610.8	3.083993	9.157825	3,642.8	3.084016	9.766253	3,634.2	3.083993	12.944092	3,628.1	3.084016	10.640911	3,615.7
3.084005	32.371251	3,611.5	3.084005	9.042440	3,643.0	3.084028	9.775485	3,634.2	3.084005	12.946400	3,628.1	3.084028	10.525526	3,615.8
3.084016	31.673631	3,612.2	3.084016	9.033210	3,643.0	3.084039	9.768561	3,634.2	3.084016	12.914092	3,628.1	3.084039	10.594757	3,615.7
3.084028	30.980631	3,612.9	3.084028	9.049364	3,643.0	3.084051	9.759331	3,634.2	3.084028	12.955630	3,628.0	3.084051	10.617834	3,615.7
3.084039	30.350001	3,613.5	3.084039	9.051671	3,642.9	3.084062	9.770869	3,634.2	3.084039	12.897938	3,628.1	3.084062	10.666296	3,615.6
3.084051	29.723991	3,614.2	3.084051	9.063210	3,642.9	3.084074	9.770869	3,634.2	3.084051	12.914092	3,628.1	3.084074	10.580911	3,615.7
3.084063	29.162661	3,614.7	3.084062	9.063210	3,642.9	3.084086	9.766253	3,634.2	3.084062	12.909476	3,628.1	3.084086	10.601680	3,615.7
3.084074	28.545891	3,615.4	3.084074	9.051671	3,642.9	3.084097	9.763947	3,634.2	3.084074	12.921015	3,628.1	3.084097	10.599373	3,615.7
3.084086	27.984561	3,615.9	3.084086	9.012441	3,643.0	3.084109	9.770869	3,634.2	3.084086	12.964861	3,628.0	3.084109	10.555527	3,615.7
3.084097	27.448641	3,616.5	3.084097	9.047056	3,643.0	3.084120	9.770869	3,634.2	3.084097	12.939477	3,628.1	3.084120	10.583219	3,615.7
3.084109	26.901171	3,617.0	3.084109	9.028594	3,643.0	3.084132	9.775485	3,634.2	3.084109	12.909476	3,628.1	3.084132	10.562449	3,615.7
3.084120	26.367561	3,617.5	3.084120	9.056287	3,642.9	3.084143	9.761639	3,634.2	3.084120	12.930245	3,628.1	3.084143	10.606296	3,615.7
3.084132	25.877841	3,618.0	3.084132	9.065517	3,642.9	3.084155	9.773177	3,634.2	3.084132	12.891015	3,628.1	3.084155	10.599373	3,615.7
3.084143	25.432011	3,618.5	3.084143	9.051671	3,642.9	3.084167	9.773177	3,634.2	3.084143	12.897938	3,628.1	3.084167	10.599373	3,615.7
3.084155	25.004661	3,618.9	3.084155	9.040133	3,643.0	3.084178	9.773177	3,634.2	3.084155	12.934861	3,628.1	3.084178	10.590141	3,615.7
3.084167	24.496461	3,619.4	3.084167	9.132441	3,642.9	3.084190	9.761639	3,634.2	3.084167	12.897938	3,628.1	3.084190	10.583219	3,615.7
3.084178	24.161511	3,619.7	3.084178	9.012441	3,643.0	3.084201	9.775485	3,634.2	3.084178	12.897938	3,628.1	3.084201	10.578603	3,615.7
3.084190	23.711061	3,620.2	3.084190	9.051671	3,642.9	3.084213	9.768561	3,634.2	3.084190	12.951015	3,628.0	3.084213	10.585526	3,615.7
3.084201	23.359941	3,620.5	3.084201	9.035518	3,643.0	3.084224	9.757023	3,634.2	3.084201	12.916400	3,628.1	3.084224	10.585526	3,615.7
3.084213	22.955691	3,620.9	3.084213	9.063210	3,642.9	3.084236	9.761639	3,634.2	3.084213	12.925631	3,628.1	3.084236	10.606296	3,615.7
3.084224	22.567611	3,621.3	3.084224	9.077056	3,642.9	3.084248	9.768561	3,634.2	3.084224	12.930245	3,628.1	3.084248	10.583219	3,615.7
3.084236	22.262691	3,621.6	3.084236	9.042440	3,643.0	3.084259	9.754716	3,634.2	3.084236	12.918707	3,628.1	3.084259	10.583219	3,615.7
3.084248	21.946221	3,622.0	3.084248	9.047056	3,643.0	3.084282	9.766253	3,634.2	3.084248	12.893323	3,628.1	3.084282	10.597065	3,615.7
3.084271	21.320211	3,622.6	3.084259	9.047056	3,643.0	3.084317	9.773177	3,634.2	3.084259	12.893323	3,628.1	3.084317	10.592449	3,615.7
3.084305	20.518641	3,623.4	3.084282	9.049364	3,643.0	3.084329	9.766253	3,634.2	3.084282	12.937169	3,628.1	3.084329	10.601680	3,615.7
3.084317	20.299191	3,623.6	3.084317	9.067825	3,642.9	3.084352	9.763947	3,634.2	3.084317	12.900246	3,628.1	3.084352	10.603988	3,615.7
3.084340	19.844121	3,624.1	3.084329	9.065517	3,642.9	3.084363	9.759331	3,634.2	3.084329	12.886399	3,628.1	3.084363	10.622449	3,615.7
3.084352	19.626981	3,624.3	3.084352	9.044748	3,643.0	3.084387	9.766253	3,634.2	3.084352	12.895631	3,628.1	3.084387	10.594757	3,615.7
3.084375	19.225041	3,624.7	3.084363	9.035518	3,643.0	3.084398	9.775485	3,634.2	3.084363	12.909476	3,628.1	3.084398	10.564757	3,615.7
3.084386	19.079511	3,624.8	3.084387	9.023979	3,643.0	3.084421	9.770869	3,634.2	3.084387	12.930245	3,628.1	3.084421	10.578603	3,615.7
3.084410	18.739941	3,625.2	3.084398	9.047056	3,643.0	3.084456	9.766253	3,634.2	3.084398	12.918707	3,628.1	3.084456	10.606296	3,615.7
3.084444	18.402681	3,625.5	3.084421	9.141671	3,642.9	3.084491	9.770869	3,634.2	3.084421	12.925631	3,628.1	3.084491	10.583219	3,615.7
3.084479	18.125481	3,625.8	3.084456	9.040133	3,643.0	3.084526	9.766253	3,634.2	3.084456	12.930245	3,628.1	3.084526	10.578603	3,615.7
3.084514	17.938371	3,626.0	3.084491	9.063210	3,642.9	3.084560	9.780100	3,634.2	3.084491	12.914092	3,628.1	3.084560	10.599373	3,615.7
3.084549	17.758191	3,626.1	3.084526	9.063210	3,642.9	3.084595	9.757023	3,634.2	3.084526	12.879477	3,628.1	3.084595	10.585526	3,615.7
3.084583	17.649621	3,626.3	3.084560	9.125518	3,642.9	3.084630	9.763947	3,634.2	3.084560	12.932553	3,628.1	3.084630	10.567065	3,615.7
3.084618	17.520261	3,626.4	3.084595	9.058595	3,642.9	3.084664	9.761639	3,634.2	3.084595	12.932553	3,628.1	3.084664	10.597065	3,615.7
3.084653	17.388591	3,626.5	3.084630	9.033210	3,643.0	3.084699	9.766253	3,634.2	3.084630	12.925631	3,628.1	3.084699	10.601680	3,615.7
3.084688	17.256921	3,626.6	3.084664	9.056287	3,642.9	3.084769	9.766253	3,634.2	3.084664	12.867938	3,628.1	3.084769	10.587834	3,615.7

Revised Table B.3-1:
Time and Water Level Data Values Used in Pumping Test Analysis: Dewey Test, Recovery Data

32-3C		3643.9	GW-49		3652	32-4C		3644.0	32-5		3641.0	32-9C		3626.3
Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)
3.084757	17.035161	3,626.9	3.084699	9.153210	3,642.8	3.084838	9.770869	3,634.2	3.084699	12.909476	3,628.1	3.084838	10.592449	3,615.7
3.084826	16.811091	3,627.1	3.084769	9.077056	3,642.9	3.084907	9.750100	3,634.2	3.084769	12.934861	3,628.1	3.084907	10.599373	3,615.7
3.084896	16.531581	3,627.4	3.084838	9.033210	3,643.0	3.084977	9.754716	3,634.2	3.084838	12.902554	3,628.1	3.084977	10.624757	3,615.7
3.084965	16.325991	3,627.6	3.084907	9.021671	3,643.0	3.085046	9.768561	3,634.2	3.084907	12.851785	3,628.1	3.085046	10.590141	3,615.7
3.085035	16.078821	3,627.8	3.084977	9.042440	3,643.0	3.085116	9.770869	3,634.2	3.084977	12.851785	3,628.1	3.085116	10.583219	3,615.7
3.085104	15.880161	3,628.0	3.085046	9.077056	3,642.9	3.085185	9.768561	3,634.2	3.085046	12.886399	3,628.1	3.085185	10.594757	3,615.7
3.085173	15.803931	3,628.1	3.085116	9.053979	3,642.9	3.085255	9.770869	3,634.2	3.085116	12.844861	3,628.2	3.085255	10.594757	3,615.7
3.085243	15.519801	3,628.4	3.085185	9.074748	3,642.9	3.085359	9.757023	3,634.2	3.085185	12.835630	3,628.2	3.085359	10.610911	3,615.7
3.085347	15.348861	3,628.6	3.085255	9.056287	3,642.9	3.085463	9.752408	3,634.2	3.085255	12.807938	3,628.2	3.085463	10.578603	3,615.7
3.085452	15.247221	3,628.7	3.085359	9.023979	3,643.0	3.085567	9.770869	3,634.2	3.085359	12.796400	3,628.2	3.085567	10.606296	3,615.7
3.085556	15.161751	3,628.7	3.085463	9.033210	3,643.0	3.085671	9.752408	3,634.2	3.085463	12.773323	3,628.2	3.085671	10.617834	3,615.7
3.085660	15.032391	3,628.9	3.085567	9.053979	3,642.9	3.085810	9.752408	3,634.2	3.085567	12.731784	3,628.3	3.085810	10.583219	3,615.7
3.085798	14.916891	3,629.0	3.085671	9.056287	3,642.9	3.085961	9.747792	3,634.3	3.085671	12.674092	3,628.3	3.085961	10.608603	3,615.7
3.085939	14.775981	3,629.1	3.085810	9.040133	3,643.0	3.086088	9.747792	3,634.3	3.085810	12.641785	3,628.4	3.086088	10.633987	3,615.7
3.086076	14.782911	3,629.1	3.085961	9.040133	3,643.0	3.086227	9.740870	3,634.3	3.085961	12.584092	3,628.4	3.086227	10.594757	3,615.7
3.086215	14.810631	3,629.1	3.086088	9.047056	3,643.0	3.086366	9.736254	3,634.3	3.086088	12.537938	3,628.5	3.086366	10.615526	3,615.7
3.086354	14.764431	3,629.1	3.086227	9.021671	3,643.0	3.086505	9.731639	3,634.3	3.086227	12.524092	3,628.5	3.086505	10.627065	3,615.7
3.086493	14.688201	3,629.2	3.086366	9.037826	3,643.0	3.086643	9.729331	3,634.3	3.086366	12.475631	3,628.5	3.086643	10.647834	3,615.7
3.086632	14.623521	3,629.3	3.086505	9.104749	3,642.9	3.086817	9.715485	3,634.3	3.086505	12.429477	3,628.6	3.086817	10.592449	3,615.7
3.086806	14.563461	3,629.3	3.086643	9.042440	3,643.0	3.086991	9.703946	3,634.3	3.086643	12.392553	3,628.6	3.086991	10.599373	3,615.7
3.086979	14.586561	3,629.3	3.086817	9.049364	3,643.0	3.087164	9.703946	3,634.3	3.086817	12.314092	3,628.7	3.087164	10.643219	3,615.7
3.087153	14.496471	3,629.4	3.086991	9.146287	3,642.9	3.087338	9.687793	3,634.3	3.086991	12.321015	3,628.7	3.087338	10.654757	3,615.6
3.087327	14.461821	3,629.4	3.087164	9.058595	3,642.9	3.087570	9.690100	3,634.3	3.087164	12.212553	3,628.8	3.087570	10.622449	3,615.7
3.087558	14.415621	3,629.5	3.087338	9.017056	3,643.0	3.087801	9.667023	3,634.3	3.087338	12.175631	3,628.8	3.087801	10.645526	3,615.7
3.087789	14.350941	3,629.5	3.087570	9.049364	3,643.0	3.088032	9.662408	3,634.3	3.087570	12.117938	3,628.9	3.088032	10.622449	3,615.7
3.088021	14.281641	3,629.6	3.087801	9.060902	3,642.9	3.088264	9.662408	3,634.3	3.087801	12.051015	3,628.9	3.088264	10.615526	3,615.7
3.088252	14.244681	3,629.7	3.088032	9.030902	3,643.0	3.088495	9.639331	3,634.4	3.088032	12.014091	3,629.0	3.088495	10.622449	3,615.7
3.088484	14.184621	3,629.7	3.088264	9.113979	3,642.9	3.088727	9.630100	3,634.4	3.088264	11.949476	3,629.1	3.088727	10.622449	3,615.7
3.088715	14.205411	3,629.7	3.088495	9.044748	3,643.0	3.089074	9.600101	3,634.4	3.088495	11.887169	3,629.1	3.089074	10.594757	3,615.7
3.089062	14.032161	3,629.9	3.088727	9.035518	3,643.0	3.089421	9.600101	3,634.4	3.088727	11.864092	3,629.1	3.089421	10.599373	3,615.7
3.089410	14.025231	3,629.9	3.089074	9.060902	3,642.9	3.089768	9.570100	3,634.4	3.089074	11.815630	3,629.2	3.089768	10.576296	3,615.7
3.089757	13.847361	3,630.1	3.089421	9.051671	3,642.9	3.090116	9.558561	3,634.4	3.089421	11.762553	3,629.2	3.090116	10.580911	3,615.7
3.090104	12.685431	3,631.2	3.089768	9.042440	3,643.0	3.090463	9.535484	3,634.5	3.089768	11.658708	3,629.3	3.090463	10.615526	3,615.7
3.090451	12.315831	3,631.6	3.090116	9.047056	3,643.0	3.090810	9.512407	3,634.5	3.090116	11.617168	3,629.4	3.090810	10.594757	3,615.7
3.090799	12.163371	3,631.7	3.090463	9.040133	3,643.0	3.091157	9.500870	3,634.5	3.090463	11.511015	3,629.5	3.091157	10.587834	3,615.7
3.091146	12.066351	3,631.8	3.090810	9.100133	3,642.9	3.091505	9.473177	3,634.5	3.090810	11.492554	3,629.5	3.091505	10.585526	3,615.7
3.091493	11.960091	3,631.9	3.091157	9.060902	3,642.9	3.091852	9.459331	3,634.5	3.091157	11.439477	3,629.6	3.091852	10.567065	3,615.7
3.091840	12.001671	3,631.9	3.091505	9.063210	3,642.9	3.092199	9.440869	3,634.6	3.091505	11.342553	3,629.7	3.092199	10.562449	3,615.7
3.092187	11.782221	3,632.1	3.091852	9.058595	3,642.9	3.092893	9.413177	3,634.6	3.091852	11.296400	3,629.7	3.092893	10.530142	3,615.8
3.092882	11.675961	3,632.2	3.092199	9.060902	3,642.9	3.093588	9.364716	3,634.6	3.092199	11.261785	3,629.7	3.093588	10.520911	3,615.8
3.093576	11.574321	3,632.3	3.092893	9.042440	3,643.0	3.094282	9.337023	3,634.7	3.092893	11.178707	3,629.8	3.094282	10.490911	3,615.8
3.094271	11.470371	3,632.4	3.093588	9.067825	3,642.9	3.094977	9.295485	3,634.7	3.093588	11.049477	3,630.0	3.094977	10.453988	3,615.8
3.094965	11.331771	3,632.6	3.094282	9.072440	3,642.9	3.095683	9.256254	3,634.7	3.094282	10.952554	3,630.0	3.095683	10.488604	3,615.8
3.095671	11.375661	3,632.5	3.094977	9.056287	3,642.9	3.096366	9.233177	3,634.8	3.094977	10.869476	3,630.1	3.096366	10.414757	3,615.9
3.096354	11.204721	3,632.7	3.095683	9.023979	3,643.0	3.097060	9.189331	3,634.8	3.095683	10.823322	3,630.2	3.097060	10.382449	3,615.9
3.097049	11.160831	3,632.7	3.096366	9.056287	3,642.9	3.097755	9.161638	3,634.8	3.096366	10.703322	3,630.3	3.097755	10.363988	3,615.9
3.097743	11.103081	3,632.8	3.097060	9.030902	3,643.0	3.098796	9.108562	3,634.9	3.097060	10.613322	3,630.4	3.098796	10.373219	3,615.9
3.098785	11.001441	3,632.9	3.097755	9.049364	3,643.0	3.099838	9.073946	3,634.9	3.097755	10.592553	3,630.4	3.099838	10.292449	3,616.0
3.099826	10.885941	3,633.0	3.098796	9.148595	3,642.9	3.100880	9.013947	3,635.0	3.098796	10.463323	3,630.5	3.100880	10.287834	3,616.0
3.100868	10.761201	3,633.1	3.099838	9.118594	3,642.9	3.101921	8.970100	3,635.0	3.099838	10.435631	3,630.6	3.101921	10.225526	3,616.1

Revised Table B.3-1:
Time and Water Level Data Values Used in Pumping Test Analysis: Dewey Test, Recovery Data

32-3C		3643.9	GW-49		3652	32-4C		3644.0	32-6		3641.0	32-9C		3626.3
Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)
3.101910	10.719621	3,633.2	3.100880	9.070133	3,642.9	3.103310	8.910100	3,635.1	3.100880	10.322554	3,630.7	3.103310	10.264757	3,616.0
3.103299	10.511721	3,633.4	3.101921	9.017056	3,643.0	3.104699	8.857023	3,635.1	3.101921	10.255630	3,630.7	3.104699	10.188603	3,616.1
3.104687	10.403151	3,633.5	3.103310	9.123210	3,642.9	3.106088	8.808561	3,635.2	3.103310	10.119476	3,630.9	3.106088	10.147065	3,616.2
3.106076	10.289961	3,633.6	3.104699	9.047056	3,643.0	3.107477	8.762407	3,635.2	3.104699	10.043323	3,631.0	3.107477	10.093987	3,616.2
3.107465	10.206801	3,633.7	3.106088	9.026287	3,643.0	3.108866	8.713946	3,635.3	3.106088	9.957938	3,631.0	3.108866	10.070910	3,616.2
3.108854	10.116711	3,633.8	3.107477	8.998594	3,643.0	3.110255	8.658562	3,635.3	3.107477	9.946400	3,631.1	3.110255	10.063988	3,616.2
3.110243	9.950391	3,633.9	3.108866	9.095517	3,642.9	3.111643	8.628562	3,635.4	3.108866	9.780246	3,631.2	3.111643	10.031680	3,616.3
3.111632	9.878781	3,634.0	3.110255	8.989364	3,643.0	3.113380	8.563946	3,635.4	3.110255	9.717938	3,631.3	3.113380	10.001680	3,616.3
3.113368	9.719391	3,634.2	3.111643	8.970902	3,643.0	3.115116	8.520100	3,635.5	3.111643	9.648707	3,631.4	3.115116	9.946296	3,616.4
3.115104	9.532281	3,634.4	3.113380	9.074748	3,642.9	3.116852	8.462408	3,635.5	3.113380	9.561015	3,631.4	3.116852	9.893219	3,616.4
3.116840	9.310521	3,634.6	3.115116	9.012441	3,643.0	3.118588	8.402408	3,635.6	3.115116	9.473323	3,631.5	3.118588	9.851680	3,616.4
3.118576	9.218121	3,634.7	3.116852	8.963979	3,643.0	3.120903	8.344715	3,635.7	3.116852	9.447938	3,631.6	3.120903	9.807834	3,616.5
3.120891	9.091071	3,634.8	3.118588	9.047056	3,643.0	3.123217	8.287024	3,635.7	3.118588	9.339477	3,631.7	3.123217	9.782450	3,616.5
3.123206	9.116481	3,634.8	3.120903	9.014749	3,643.0	3.125532	8.243177	3,635.8	3.120903	9.277169	3,631.7	3.125532	9.720141	3,616.6
3.125521	8.975571	3,634.9	3.123217	8.959364	3,643.0	3.127847	8.173946	3,635.8	3.123217	9.147938	3,631.9	3.127847	9.676295	3,616.6
3.127836	8.890101	3,635.0	3.125532	8.846287	3,643.2	3.130162	8.123177	3,635.9	3.125532	9.067169	3,631.9	3.130162	9.680911	3,616.6
3.130150	8.834661	3,635.1	3.127847	8.825518	3,643.2	3.132477	8.077024	3,635.9	3.127847	9.011785	3,632.0	3.132477	9.648603	3,616.7
3.132465	8.751501	3,635.1	3.130162	8.807055	3,643.2	3.135949	8.007792	3,636.0	3.130162	8.935631	3,632.1	3.135949	9.521680	3,616.8
3.135937	8.700681	3,635.2	3.132477	8.848595	3,643.2	3.139421	7.938561	3,636.1	3.132477	8.887169	3,632.1	3.139421	9.477834	3,616.8
3.139410	8.594421	3,635.3	3.135949	8.721671	3,643.3	3.142893	7.878561	3,636.1	3.135949	8.790246	3,632.2	3.142893	9.431680	3,616.9
3.142882	8.522811	3,635.4	3.139421	8.788594	3,643.2	3.146366	7.825485	3,636.2	3.139421	8.695630	3,632.3	3.146366	9.380911	3,616.9
3.146354	8.435031	3,635.5	3.142893	8.640903	3,643.4	3.149838	7.765485	3,636.2	3.142893	8.603323	3,632.4	3.149838	9.290911	3,617.0
3.149826	8.405001	3,635.5	3.146366	8.564748	3,643.4	3.153310	7.707792	3,636.3	3.146366	8.541015	3,632.5	3.153310	9.265527	3,617.0
3.153299	8.287191	3,635.6	3.149838	8.550902	3,643.4	3.156782	7.661639	3,636.3	3.149838	8.448708	3,632.6	3.156782	9.203218	3,617.1
3.156771	8.217891	3,635.7	3.153310	8.493210	3,643.5	3.160301	7.615485	3,636.4	3.153310	8.377169	3,632.6	3.160255	9.131680	3,617.2
3.160243	8.190171	3,635.7	3.156829	8.467825	3,643.5	3.163773	7.569331	3,636.4	3.156782	8.351784	3,632.6	3.163762	9.136295	3,617.2
3.163715	8.109321	3,635.8	3.160301	8.456286	3,643.5	3.167361	7.523177	3,636.5	3.160255	8.268707	3,632.7	3.167350	9.071680	3,617.2
3.167268	8.042331	3,635.9	3.163773	8.370902	3,643.6	3.174421	7.435485	3,636.6	3.163727	8.229477	3,632.8	3.174410	8.947064	3,617.4
3.174329	7.991511	3,635.9	3.167361	8.366286	3,643.6	3.181250	7.345485	3,636.7	3.167315	8.079476	3,632.9	3.181238	8.877834	3,617.4
3.181157	7.859841	3,636.0	3.174421	8.211671	3,643.8	3.188194	7.283177	3,636.7	3.174375	8.051785	3,632.9	3.188183	8.697834	3,617.6
3.188102	7.746651	3,636.2	3.181250	8.133210	3,643.9	3.195139	7.202408	3,636.8	3.181204	7.917938	3,633.1	3.195127	8.686296	3,617.6
3.195046	7.614981	3,636.3	3.188194	8.057055	3,643.9	3.202083	7.091639	3,636.9	3.188148	7.804861	3,633.2	3.202072	8.637834	3,617.7
3.201991	7.612671	3,636.3	3.195139	7.948595	3,644.1	3.209028	7.057023	3,636.9	3.195092	7.744861	3,633.3	3.209016	8.547834	3,617.8
3.208935	7.501791	3,636.4	3.202083	7.874748	3,644.1	3.215972	6.999331	3,637.0	3.202037	7.645630	3,633.4	3.215961	8.473988	3,617.8
3.215880	7.404771	3,636.5	3.209028	7.752440	3,644.2	3.222917	6.932408	3,637.1	3.208981	7.583323	3,633.4	3.222905	8.377065	3,617.9
3.222824	7.360881	3,636.5	3.215972	7.724748	3,644.3	3.233333	6.840100	3,637.2	3.215926	7.502553	3,633.5	3.233322	8.268603	3,618.0
3.233241	7.215351	3,636.7	3.222917	7.625517	3,644.4	3.243750	6.773177	3,637.2	3.222870	7.449477	3,633.6	3.243738	8.171680	3,618.1
3.243657	7.150671	3,636.7	3.233333	7.526287	3,644.5	3.254167	6.715485	3,637.3	3.233287	7.225630	3,633.8	3.254155	8.056295	3,618.2
3.254074	7.060581	3,636.8	3.243750	7.408595	3,644.6	3.264583	6.641639	3,637.4	3.243704	7.188707	3,633.8	3.264572	7.980142	3,618.3
3.264491	6.986661	3,636.9	3.254167	7.297825	3,644.7	3.278472	6.540100	3,637.5	3.254120	7.114861	3,633.9	3.278461	7.827834	3,618.5
3.278380	6.873471	3,637.0	3.264583	7.189363	3,644.8	3.292361	6.457023	3,637.5	3.264537	6.939476	3,634.1	3.292350	7.747065	3,618.6
3.292268	6.755661	3,637.1	3.278472	7.041671	3,645.0	3.306250	6.392408	3,637.6	3.278426	6.918707	3,634.1	3.306238	7.645526	3,618.7
3.306157	6.684051	3,637.2	3.292361	6.960902	3,645.0	3.320139	6.270100	3,637.7	3.292315	6.798707	3,634.2	3.320127	7.509372	3,618.8
3.320046	6.575481	3,637.3	3.306250	6.866287	3,645.1	3.334028	6.203177	3,637.8	3.306204	6.701784	3,634.3	3.334016	7.451680	3,618.8
3.333935	6.462291	3,637.4	3.320139	6.737056	3,645.3	3.347917	6.122408	3,637.9	3.320092	6.600246	3,634.4	3.347905	7.264757	3,619.0
3.347824	6.448431	3,637.5	3.334028	6.633210	3,645.4	3.361806	6.062408	3,637.9	3.333981	6.503323	3,634.5	3.361794	7.234757	3,619.1
3.361713	6.295971	3,637.6	3.347917	6.524748	3,645.5	3.379167	6.025485	3,638.0	3.347870	6.369476	3,634.6	3.379155	7.123988	3,619.2
3.379074	6.265941	3,637.6	3.361806	6.471671	3,645.5	3.396528	5.949331	3,638.1	3.361759	6.327938	3,634.7	3.396516	7.024757	3,619.3
3.396435	6.166611	3,637.7	3.379167	6.328594	3,645.7	3.413889	5.889331	3,638.1	3.379120	6.270246	3,634.7	3.413877	6.925526	3,619.4
3.413796	6.023391	3,637.9	3.396528	6.284748	3,645.7	3.431250	5.817792	3,638.2	3.396481	6.159477	3,634.8	3.431238	6.793988	3,619.5

Revised Table B.3-1:
Time and Water Level Data Values Used in Pumping Test Analysis: Dewey Test, Recovery Data

32-3C		3643.9	GW-49		3652	32-4C		3644.0	32-5		3641.0	32-9C		3626.3
Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)
3.431157	6.060351	3,637.8	3.413889	6.167056	3,645.8	3.454398	5.750869	3,638.2	3.413842	6.083323	3,634.9	3.454387	6.690142	3,619.6
3.454306	5.935611	3,638.0	3.431250	6.081671	3,645.9	3.477546	5.667792	3,638.3	3.431204	6.027938	3,635.0	3.477535	6.593219	3,619.7
3.477454	5.778531	3,638.1	3.454398	5.966287	3,646.0	3.500694	5.593946	3,638.4	3.454352	5.850246	3,635.1	3.500683	6.477834	3,619.8
3.500602	5.746191	3,638.2	3.477546	5.910902	3,646.1	3.523958	5.536254	3,638.5	3.477500	5.861784	3,635.1	3.523947	6.403988	3,619.9
3.523866	5.702301	3,638.2	3.500694	5.781672	3,646.2	3.546991	5.471639	3,638.5	3.500648	5.757938	3,635.2	3.546979	6.247065	3,620.1
3.546898	5.623761	3,638.3	3.523958	5.774748	3,646.2	3.570139	5.413946	3,638.6	3.523912	5.688707	3,635.3	3.570127	6.173219	3,620.1
3.570046	5.556771	3,638.3	3.546991	5.721671	3,646.3	3.604861	5.330869	3,638.7	3.546945	5.568707	3,635.4	3.604850	6.060142	3,620.2
3.604768	5.480541	3,638.4	3.570139	5.523210	3,646.5	3.639583	5.240870	3,638.8	3.570092	5.527169	3,635.5	3.639572	5.910141	3,620.4
3.639491	5.369661	3,638.5	3.604861	5.433210	3,646.6	3.674306	5.155485	3,638.8	3.604815	5.455630	3,635.5	3.674294	5.700142	3,620.6
3.674213	5.231061	3,638.7	3.639583	5.322441	3,646.7	3.709028	5.047023	3,639.0	3.639537	5.310246	3,635.7	3.709016	5.658603	3,620.6
3.708935	5.138661	3,638.8	3.674306	5.269363	3,646.7	3.743750	4.991639	3,639.0	3.674259	5.241015	3,635.8	3.743738	5.527065	3,620.8
3.743657	5.069361	3,638.8	3.709028	5.172441	3,646.8	3.778472	4.931639	3,639.1	3.708981	5.155631	3,635.8	3.778461	5.427834	3,620.9
3.778380	5.030091	3,638.9	3.743750	5.036287	3,647.0	3.813542	4.873946	3,639.1	3.743704	5.001015	3,636.0	3.813530	5.395526	3,620.9
3.813449	4.916901	3,639.0	3.778472	4.967056	3,647.0	3.847917	4.811638	3,639.2	3.778426	4.975630	3,636.0	3.847905	5.270911	3,621.0
3.847824	4.900731	3,639.0	3.813542	4.890902	3,647.1	3.882639	4.767792	3,639.2	3.813495	4.941015	3,636.1	3.882627	5.180911	3,621.1
3.882546	4.856841	3,639.0	3.847917	4.853979	3,647.1	3.917361	4.726254	3,639.3	3.847870	4.864861	3,636.1	3.917350	5.148603	3,621.2
3.917268	4.782921	3,639.1	3.882639	4.784748	3,647.2	3.986806	4.633946	3,639.4	3.882592	4.846400	3,636.2	3.986794	4.952449	3,621.3
3.986713	4.655871	3,639.2	3.917361	4.724748	3,647.3	4.056944	4.543946	3,639.5	3.917315	4.733323	3,636.3	4.056933	4.825526	3,621.5
4.056852	4.651251	3,639.2	3.986806	4.727056	3,647.3	4.125694	4.444715	3,639.6	3.986759	4.657169	3,636.3	4.125683	4.723988	3,621.6
4.125602	4.512651	3,639.4	4.056944	4.540133	3,647.5	4.195139	4.301639	3,639.7	4.056898	4.594861	3,636.4	4.195127	4.523219	3,621.8
4.195046	4.337091	3,639.6	4.125694	4.413210	3,647.6	4.264583	4.211638	3,639.8	4.125648	4.511784	3,636.5	4.264572	4.465526	3,621.8
4.264491	4.274721	3,639.6	4.195139	4.293210	3,647.7	4.334028	4.110100	3,639.9	4.195092	4.366400	3,636.6	4.334016	4.317834	3,622.0
4.333935	4.221591	3,639.7	4.264583	4.267825	3,647.7	4.403472	4.029331	3,640.0	4.264537	4.248707	3,636.8	4.403461	4.181680	3,622.1
4.403380	4.076061	3,639.8	4.334028	4.092441	3,647.9	4.472917	3.985485	3,640.0	4.333981	4.126400	3,636.9	4.472905	4.163218	3,622.1
4.472824	4.020621	3,639.9	4.403472	4.069364	3,647.9	4.577083	3.886254	3,640.1	4.403426	4.041015	3,637.0	4.577072	4.031680	3,622.3
4.576991	3.875091	3,640.0	4.472917	3.983979	3,648.0	4.681250	3.775485	3,640.2	4.472870	4.015630	3,637.0	4.681238	3.842449	3,622.5
4.681157	3.849681	3,640.1	4.577083	3.843210	3,648.2	4.785417	3.662408	3,640.3	4.577037	3.826400	3,637.2	4.785405	3.727065	3,622.6
4.785324	3.715701	3,640.2	4.681250	3.732440	3,648.3	4.889583	3.574715	3,640.4	4.681204	3.810246	3,637.2	4.889572	3.669373	3,622.6
4.889491	3.604821	3,640.3	4.785417	3.598594	3,648.4	5.028472	3.431638	3,640.6	4.785370	3.639477	3,637.4	5.028461	3.487065	3,622.8
5.028380	3.558621	3,640.3	4.889583	3.492440	3,648.5	5.167361	3.279331	3,640.7	4.889537	3.597938	3,637.4	5.167350	3.362449	3,622.9
5.167268	3.357651	3,640.5	5.028472	3.407056	3,648.6	5.306250	3.076254	3,640.9	5.028426	3.466400	3,637.5	5.306238	3.157065	3,623.1
5.306157	3.154371	3,640.7	5.167361	3.323979	3,648.7	5.445139	2.944715	3,641.1	5.167315	3.309477	3,637.7	5.445127	2.960911	3,623.3
5.445046	2.997291	3,640.9	5.306250	3.130133	3,648.9	5.584028	2.810869	3,641.2	5.306204	3.092553	3,637.9	5.584016	2.917065	3,623.4
5.583935	2.837901	3,641.1	5.445139	2.869364	3,649.1	5.722917	2.674716	3,641.3	5.445092	2.947169	3,638.1	5.722905	2.713988	3,623.6
5.722824	2.738571	3,641.2	5.584028	2.777056	3,649.2	5.861806	2.552408	3,641.4	5.583981	2.852553	3,638.1	5.861794	2.582449	3,623.7
5.861713	2.653101	3,641.2	5.722917	2.622441	3,649.4	6.008217	2.469331	3,641.5	5.722871	2.661015	3,638.3	6.008206	2.513219	3,623.8
6.008125	2.521431	3,641.4	5.861806	2.479364	3,649.5				5.861759	2.497169	3,638.5			
			6.008217	2.403210	3,649.6				6.008171	2.494861	3,638.5			

General Methodology: PSI, temperature, and time readings from Win-Situ™ digital data log were exported to Excel ".csv" file.
Drawdown was calculated as PSI at time after pumping minus average PSI before pumping; therefore, at small or zero changes in PSI negative drawdowns may be calculated.
A FORTRAN program was written to read the ".csv" file and produce a second file by extracting the records at a frequency of 40 per log-time cycle (in minutes) in order achieve equal representation of data throughout the pumping and drawdown phases of the test.
Elevation (in ft above mean sea level) based on initial groundwater elevation (see Table 4.2) minus drawdown.

Revised Table C.2-1:
Time and Water Level Data Values Used in Pumping Test Analysis: Burdock Test, Drawdown Data

11-2		3664.8	11-14C		3660.9	11-15		3660.2	11-19*		3662.1	11-11C**		3662
Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (f	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)
0.000012	-0.024157	3664.8	0.000012	-0.009060	3660.9	0.000012	0.000000	3660.2	0.000012	0.047297	3662.1	0.000025	1.516154	3660
0.000023	-0.047234	3664.8	0.000023	0.018633	3660.9	0.000023	-0.023077	3660.2	0.000058	0.072682	3662.0	0.000035	1.781538	3660
0.000035	-0.038003	3664.8	0.000035	0.002479	3660.9	0.000035	-0.025385	3660.2	0.000069	0.042682	3662.1	0.000046	2.453077	3660
0.000046	0.061997	3664.7	0.000046	0.002479	3660.9	0.000046	0.030000	3660.2	0.000093	0.010374	3662.1	0.000058	2.967692	3659
0.000058	0.033535	3664.8	0.000058	-0.078290	3661.0	0.000058	-0.013846	3660.2	0.000116	0.042682	3662.1	0.000069	3.648462	3658
0.000069	0.021997	3664.8	0.000069	-0.015983	3660.9	0.000069	0.009231	3660.2	0.000162	0.031143	3662.1	0.000083	4.463077	3658
0.000081	0.070458	3664.7	0.000081	0.060171	3660.8	0.000081	-0.053077	3660.3	0.000174	0.054220	3662.0	0.000093	5.010000	3657
0.000093	-0.028772	3664.8	0.000093	0.007094	3660.9	0.000093	-0.009231	3660.2	0.000185	0.031143	3662.1	0.000104	5.016923	3657
0.000104	-0.051849	3664.9	0.000104	0.011710	3660.9	0.000104	-0.018462	3660.2	0.000197	0.010374	3662.1	0.000116	5.480769	3657
0.000116	-0.040311	3664.8	0.000116	-0.027521	3660.9	0.000116	0.011538	3660.2	0.000208	0.047297	3662.1	0.000127	5.746154	3656
0.000127	-0.061080	3664.9	0.000127	-0.015983	3660.9	0.000127	-0.032308	3660.2	0.000220	0.031143	3662.1	0.000141	5.981538	3656
0.000139	-0.021849	3664.8	0.000139	-0.004444	3660.9	0.000139	0.129231	3660.1	0.000255	0.017297	3662.1	0.000150	6.256154	3656
0.000150	0.072766	3664.7	0.000150	0.016325	3660.9	0.000150	0.025385	3660.2	0.000289	0.010374	3662.1	0.000162	6.306923	3656
0.000162	-0.058772	3664.9	0.000162	0.011710	3660.9	0.000162	0.009231	3660.2	0.000370	0.042682	3662.1	0.000174	6.773077	3655
0.000174	-0.040311	3664.8	0.000174	0.002479	3660.9	0.000174	-0.011538	3660.2	0.000498	0.051912	3662.0	0.000185	6.969231	3655
0.000185	-0.044926	3664.8	0.000185	-0.013675	3660.9	0.000185	0.002308	3660.2	0.000521	0.003451	3662.1	0.000199	7.061539	3655
0.000197	-0.031080	3664.8	0.000197	-0.022906	3660.9	0.000197	0.018462	3660.2	0.000833	0.056528	3662.0	0.000208	7.377692	3655
0.000208	-0.021849	3664.8	0.000208	-0.032137	3660.9	0.000208	0.101538	3660.1	0.001111	0.051912	3662.0	0.000220	7.467692	3655
0.000220	-0.061080	3664.9	0.000220	-0.034444	3660.9	0.000220	-0.006923	3660.2	0.001319	0.012682	3662.1	0.000231	7.873846	3654
0.000231	-0.012619	3664.8	0.000231	0.023248	3660.9	0.000231	0.013846	3660.2	0.002639	0.054220	3662.0	0.000243	8.206154	3654
0.000243	-0.008003	3664.8	0.000243	0.016325	3660.9	0.000243	-0.027692	3660.2	0.004167	0.001143	3662.1	0.000257	9.445385	3653
0.000255	0.045074	3664.8	0.000255	-0.002137	3660.9	0.000255	-0.020769	3660.2	0.005903	0.033451	3662.1	0.000266	9.078462	3653
0.000266	-0.019542	3664.8	0.000266	0.030171	3660.9	0.000266	-0.004615	3660.2	0.007292	0.070374	3662.0	0.000278	9.729231	3652
0.000278	0.040458	3664.8	0.000278	0.009402	3660.9	0.000278	0.018462	3660.2	0.008333	0.008066	3662.1	0.000289	9.835384	3652
0.000289	0.001228	3664.8	0.000289	-0.020598	3660.9	0.000289	0.023077	3660.2	0.009028	0.024220	3662.1	0.000301	10.308461	3652
0.000301	0.063535	3664.7	0.000301	-0.039060	3660.9	0.000301	-0.009231	3660.2	0.020833	0.003451	3662.1	0.000312	10.712308	3651
0.000312	0.045074	3664.8	0.000312	-0.006752	3660.9	0.000312	-0.018462	3660.2	0.025000	0.019605	3662.1	0.000324	11.180769	3651
0.000324	-0.065696	3664.9	0.000324	0.000171	3660.9	0.000324	0.006923	3660.2	0.072917	0.077297	3662.0	0.000336	11.457692	3651
0.000336	0.081997	3664.7	0.000336	0.004786	3660.9	0.000336	-0.027692	3660.2	0.079896	0.005759	3662.1	0.000347	11.833846	3650
0.000347	0.070458	3664.7	0.000347	0.032479	3660.9	0.000347	-0.004615	3660.2	0.083368	0.003451	3662.1	0.000359	12.263077	3650
0.000359	0.091228	3664.7	0.000359	-0.009060	3660.9	0.000359	0.011538	3660.2	0.090313	0.028836	3662.1	0.000370	11.210770	3651
0.000370	0.058920	3664.7	0.000370	-0.029829	3660.9	0.000370	-0.002308	3660.2	0.097257	0.038066	3662.1	0.000382	11.289230	3651
0.000382	0.056612	3664.7	0.000382	0.018633	3660.9	0.000382	-0.020769	3660.2	0.104201	0.081912	3662.0	0.000394	12.422308	3650
0.000394	0.077381	3664.7	0.000394	-0.006752	3660.9	0.000394	0.013846	3660.2	0.111146	0.088836	3662.0	0.000405	12.669230	3649
0.000417	-0.070311	3664.9	0.000405	0.002479	3660.9	0.000417	0.011538	3660.2	0.118206	0.128066	3662.0	0.000417	12.837692	3649
0.000451	-0.061080	3664.9	0.000417	0.004786	3660.9	0.000451	-0.011538	3660.2	0.125035	0.155759	3661.9	0.000428	12.692307	3649
0.000463	-0.008003	3664.8	0.000451	0.002479	3660.9	0.000463	0.090000	3660.1	0.131979	0.155759	3661.9	0.000451	13.112308	3649
0.000486	-0.019542	3664.8	0.000463	0.009402	3660.9	0.000486	-0.018462	3660.2	0.138924	0.160374	3661.9	0.000463	13.324615	3649
0.000498	0.072766	3664.7	0.000486	-0.027521	3660.9	0.000498	0.000000	3660.2	0.149340	0.174220	3661.9	0.000486	13.633846	3648
0.000521	0.008151	3664.8	0.000498	-0.043675	3660.9	0.000521	0.000000	3660.2	0.159757	0.204220	3661.9	0.000498	13.970769	3648
0.000532	0.061228	3664.7	0.000521	-0.039060	3660.9	0.000532	0.006923	3660.2	0.170174	0.208836	3661.9	0.000521	14.370000	3648
0.000556	0.079689	3664.7	0.000532	-0.006752	3660.9	0.000556	0.009231	3660.2	0.180590	0.238836	3661.9	0.000532	15.939231	3646
0.000590	0.035843	3664.8	0.000556	0.014017	3660.9	0.000590	0.013846	3660.2	0.194479	0.275759	3661.8	0.000556	15.150000	3647
0.000625	-0.047234	3664.8	0.000590	0.011710	3660.9	0.000625	0.000000	3660.2	0.208368	0.326528	3661.8	0.000590	16.077692	3646
0.000660	0.045074	3664.8	0.000625	0.050940	3660.8	0.000660	-0.025385	3660.2	0.222257	0.342682	3661.8	0.000625	17.023846	3645
0.000694	-0.049542	3664.8	0.000660	0.055556	3660.8	0.000694	-0.009231	3660.2	0.236146	0.368066	3661.7	0.000660	17.820000	3644
0.000729	0.088920	3664.7	0.000694	-0.009060	3660.9	0.000729	0.016154	3660.2	0.250035	0.398066	3661.7	0.000694	18.664616	3643
0.000764	-0.040311	3664.8	0.000729	-0.004444	3660.9	0.000764	-0.027692	3660.2	0.263924	0.478836	3661.6	0.000729	19.426153	3643
0.000799	0.091228	3664.7	0.000764	0.018633	3660.9	0.000799	0.126923	3660.1	0.277812	0.485759	3661.6	0.000764	20.319231	3642
0.000833	-0.047234	3664.8	0.000799	0.014017	3660.9	0.000833	0.122308	3660.1	0.295174	0.548066	3661.6	0.000799	20.972307	3641
0.000903	0.049689	3664.8	0.000833	0.041710	3660.9	0.000903	0.018462	3660.2	0.312535	0.548066	3661.6	0.000833	21.867693	3640
0.000972	-0.012619	3664.8	0.000903	-0.004444	3660.9	0.000972	0.053077	3660.1	0.329896	0.617297	3661.5	0.000903	23.321539	3639
0.001042	-0.035696	3664.8	0.000972	-0.015983	3660.9	0.001042	0.002308	3660.2	0.347257	0.642682	3661.5	0.000972	24.676153	3637

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2/11/2011

Revised Table C.2-1:
Time and Water Level Data Values Used in Pumping Test Analysis: Burdock Test, Drawdown Data

11-2		3664.8	11-14C		3660.9	11-15		3660.2	11-19*		3662.1	11-11C**		3662
Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (f	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)
0.001111	-0.038003	3664.8	0.001042	-0.004444	3660.9	0.001111	-0.020769	3660.2	0.370405	0.753451	3661.3	0.001042	25.989231	3636
0.001181	-0.044926	3664.8	0.001111	0.004786	3660.9	0.001181	0 000000	3660 2	0.393553	0.801912	3661.3	0.001111	27 496155	3635
0.001250	-0.038003	3664.8	0.001181	0.011710	3660.9	0.001250	0.032308	3660.2	0.416701	0.799605	3661.3	0.001181	28.686924	3633
0.001319	-0.077234	3664.9	0.001250	0.023248	3660.9	0.001319	-0.041538	3660.2	0.439965	0.824989	3661.3	0 001250	30.036922	3632
0.001389	-0.019542	3664.8	0.001319	0.018633	3660.9	0.001389	-0.032308	3660.2	0.462998	0.912682	3661.2	0.001319	31.310770	3631
0.001493	-0.058772	3664.9	0.001389	0.034786	3660.9	0 001493	0.002308	3660 2	0.486146	0.947297	3661.2	0.001389	32 589230	3629
0.001597	-0.021849	3664.8	0.001493	-0.002137	3660.9	0.001597	-0.046154	3660.2	0.520868	1.004989	3661.1	0.001493	34 361538	3628
0.001701	-0.061080	3664.9	0.001597	0.027863	3660.9	0.001701	0.023077	3660.2	0.555590	1.060374	3661.0	0.001597	36.092308	3626
0.001806	-0.012619	3664.8	0.001701	0.050940	3660.8	0.001806	0.013846	3660.2	0.590312	1.099605	3661.0	0.001701	37.631538	3624
0.001944	-0.044926	3664.8	0.001806	0.037094	3660.9	0.001944	0.006923	3660.2	0.625035	1.233451	3660.9	0.001806	39.083076	3623
0.002083	-0.019542	3664.8	0.001944	0.018633	3660.9	0.002083	-0.020769	3660.2	0.659757	1.270374	3660.8	0.001944	41.026154	3621
0 002222	-0.077234	3664.9	0.002083	0.044017	3660.9	0.002222	0 018462	3660 2	0.694479	1.332682	3660 8	0.002083	42 489231	3620
0.002361	-0.001080	3664.8	0.002222	0.037094	3660.9	0.002361	-0.002308	3660.2	0.729549	1.408836	3660.7	0.002222	44.259232	3618
0.002500	-0.044926	3664.8	0.002361	0.023248	3660.9	0.002500	0 006923	3660.2	0.763924	1.466528	3660.6	0.002361	45.662308	3616
0.002639	-0.056465	3664.9	0.002500	0.101710	3660.8	0.002639	-0.046154	3660.2	0.798646	1.535759	3660.6	0.002500	47.166924	3615
0.002778	-0.038003	3664.8	0.002639	0.108633	3660.8	0.002778	-0.006923	3660.2	0.833368	1.604989	3660.5	0.002639	48.606922	3613
0.002951	-0.038003	3664 8	0 002778	0.057863	3660.8	0.002951	-0 016154	3660 2	0 902928	1.736528	3660.4	0 002778	49.860001	3612
0 003125	-0.019542	3664.8	0.002951	0.129402	3660.8	0 003125	-0.023077	3660.2	0.972951	1.794220	3660.3	0.002951	51 387692	3611
0.003299	-0.068003	3664.9	0.003125	0.090171	3660.8	0.003299	-0.011538	3660.2	1.041701	1.907297	3660.2	0.003125	52.799999	3609
0.003472	-0.084157	3664.9	0.003299	0.092479	3660.8	0.003472	0.041538	3660.2	1.111146	1.960374	3660.1	0.003299	54.080769	3608
0.003704	-0.040311	3664.8	0.003472	0.108633	3660.8	0.003704	0.027692	3660.2	1.180590	2.094220	3660.0	0.003472	55.310768	3607
0.003935	-0.051849	3664.9	0.003704	0.129402	3660.8	0.003935	-0.011538	3660.2	1.250035	2.101143	3660.0	0.003704	56.683846	3605
0.004167	-0.038003	3664.8	0.003935	0.150171	3660.7	0.004167	0.016154	3660.2	1.319479	2 193451	3659.9	0 003935	57.895386	3604
0.004398	-0.063388	3664.9	0.004167	0.164017	3660.7	0.004398	0.013846	3660.2	1.388924	2.311143	3659.8	0.004167	59.180771	3603
0.004630	-0.058772	3664.9	0.004398	0.196325	3660.7	0.004630	0 006923	3660.2	1.493090	2.396528	3659.7	0.004398	60.244614	3602
0.004861	-0.021849	3664.8	0.004630	0.228633	3660.7	0.004861	-0.053077	3660.3	1.597257	2.504989	3659.6	0.004630	61.167694	3601
0.005208	-0.035696	3664.8	0.004861	0.247094	3660.7	0.005208	-0.023077	3660.2	1.701424	2 620374	3659.5	0 004861	61.975384	3600
0.005556	-0.086465	3664.9	0.005208	0.295556	3660.6	0.005556	-0.036923	3660.2	1.805590	2.756528	3659.3	0.005208	63.325386	3599
0.005903	-0.026465	3664.8	0.005556	0.330171	3660.6	0.005903	-0 011538	3660 2	1.944479	2 848835	3659.3	0 005556	64.400772	3598
0.006250	-0.028772	3664.8	0.005903	0.374017	3660.5	0.006250	0.025385	3660.2	2.083368	2.890374	3659.2	0.005903	65.418465	3597
0 006597	-0 058772	3664.9	0.006250	0.429402	3660.5	0.006597	0 041538	3660.2	2.222257	2.915759	3659.2	0.006250	66.311539	3596
0.006944	-0.063388	3664.9	0.006597	0.498633	3660.4	0.006944	-0.016154	3660.2	2.361146	2.984989	3659.1	0.006597	67.100769	3595
0 007292	-0 051849	3664.9	0.006944	0 560940	3660.3	0.007292	0 011538	3660.2	2.500035	3 086528	3659 0	0 006944	67.728462	3594
0.007639	-0.070311	3664.9	0.007292	0.620940	3660.3	0.007639	-0.023077	3660.2	2.638924	3.148836	3659.0	0.007292	68.552307	3593
0.007986	-0.086465	3664.9	0.007639	0.653248	3660.2	0.007986	0 000000	3660.2	2.777813	3.222682	3658.9	0.007639	69 124619	3593
0.008333	-0.088772	3664.9	0.007986	0.678633	3660.2	0.008333	0.009231	3660.2	2.951423	3.358835	3658.7	0.007986	69.708458	3592
0.009028	-0.024157	3664.8	0.008333	0 745556	3660.2	0.009028	-0 002308	3660 2	2.999988	3.358835	3658 7	0.008333	70 416924	3592
0 009722	-0.021849	3664.8	0.009028	0.881710	3660.0	0.009722	-0 009231	3660.2				0.009028	71.642311	3590
0.010417	-0.033388	3664.8	0.009722	0.950940	3659.9	0.010417	0.002308	3660 2				0.009722	72.440773	3590
0.011111	0.075074	3664.7	0.010417	1.103248	3659.8	0.011111	-0.016154	3660.2				0.010417	73.167694	3589
0.011806	-0.065696	3664.9	0.011111	1.193248	3659.7	0.011806	-0.004615	3660.2				0.011111	73 636154	3588
0.012500	-0.044926	3664.8	0.011806	1.287863	3659.6	0.012500	0.025385	3660.2				0.011806	74 150772	3588
0 013194	-0.056465	3664.9	0.012500	1.424017	3659.5	0.013194	0 011538	3660.2				0.012500	74 545387	3587
0.013889	-0.031080	3664.8	0.013194	1.504786	3659.4	0.013889	-0.046154	3660.2				0.013194	74.815384	3587
0.014931	0.065843	3664.7	0.013889	1.703248	3659.2	0.014931	-0.002308	3660.2				0.013889	74.995384	3587
0 015972	-0.047234	3664 8	0.014931	1.770171	3659.1	0.015972	-0.023077	3660.2				0.014931	75.251541	3587
0 017014	-0.084157	3664 9	0.015972	1 934017	3659.0	0.017014	-0 011538	3660.2				0 015972	75 565384	3586
0.018056	-0.061080	3664.9	0.017014	2.047094	3658.9	0.018056	0.000000	3660.2				0.017014	75.904617	3586
0.019444	0.008151	3664.8	0.018056	2.213248	3658.7	0.019444	0.011538	3660.2				0.018056	76.105385	3586
0.020833	-0.061080	3664.9	0.019444	2 377094	3658.5	0.020833	0.057692	3660.1				0.019444	76 299232	3586
0.022222	-0.049542	3664 8	0.020833	2.550171	3658.3	0.022222	-0.018462	3660.2				0.020833	76 631538	3585
0.023611	-0.093388	3664.9	0.022222	2.727863	3658.2	0.023611	0.004615	3660.2				0.022222	76 746925	3585
0.025000	-0.042619	3664.8	0.023611	2.861710	3658.0	0.025000	0 025385	3660 2				0.023611	76.998459	3585

Revised Table C.2-1:
Time and Water Level Data Values Used in Pumping Test Analysis: Burdock Test. Drawdown Data

11-2		3664.8	11-14C		3660.9	11-16		3660.2	11-19*		3662 1	11-11C**		3662
Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (f	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)
0.026389	-0.077234	3664.9	0.025000	3 018633	3657.9	0.026389	0.020769	3660.2				0 024990	77.176155	3585
0.027778	-0.065696	3664.9	0.026389	3 168633	3657.7	0.027778	0.000000	3660.2				0.026389	77.411537	3585
0.029514	-0.068003	3664.9	0.027778	3.297863	3657.6	0.029514	-0.034615	3660.2				0.027778	77.464615	3585
0.031250	-0.051849	3664.9	0.029514	3 415556	3657.5	0.031250	-0.009231	3660 2				0.029514	77.723076	3584
0.032986	-0.040311	3664.8	0.031250	3 563248	3657.3	0.032986	0.000000	3660.2				0.031250	77.755386	3584
0.034722	-0.079542	3664.9	0.032986	3.766325	3657.1	0.034722	-0.004615	3660.2				0.032986	78.025383	3584
0.037037	-0.074926	3664.9	0.034722	3.872479	3657.0	0.037037	-0.025385	3660.2				0.034722	78.302307	3584
0.039352	-0.077234	3664.9	0.037037	4.091710	3656.8	0.039352	0.030000	3660.2				0 037037	78.260773	3584
0.041667	-0.079542	3664.9	0.039352	4.195556	3656.7	0.041667	0.090000	3660.1				0.039352	78.567696	3583
0.043981	0.049689	3664.8	0.041667	4.417094	3656.5	0.043981	-0.027692	3660.2				0.041667	78.678459	3583
0.046296	0.049689	3664.8	0.043981	4.640940	3656.3	0.046296	0.057692	3660.1				0.043981	78.959999	3583
0.048611	-0.047234	3664.8	0.046296	4 664017	3656.2	0.048611	0.009231	3660.2				0.046296	79.008461	3583
0.052083	0.084304	3664.7	0.048611	4.827863	3656.1	0.052083	0.011538	3660.2				0.048611	79.151535	3583
0.055556	0.051997	3664.7	0.052083	5.035556	3655.9	0.055556	-0.009231	3660.2				0.052083	79.290001	3583
0.059028	0.049689	3664.8	0.055556	5.222479	3655.7	0.059028	0.000000	3660.2				0.055556	79.437691	3583
0.062500	-0.008003	3664.8	0.059028	5 358633	3655.5	0.062500	0.018462	3660.2				0.059028	79 666153	3582
0.065972	0.028920	3664 8	0 062500	5 568633	3655.3	0.065972	0.034615	3660 2				0.062500	79 823074	3582
0.069444	-0.012619	3664.8	0.065972	5.750940	3655.1	0.069444	0.036923	3660.2				0 065972	80 005386	3582
0.072917	0.061228	3664.7	0.069444	5.854786	3655.0	0.072917	0.027692	3660.2				0.069444	80.173843	3582
0.076470	-0.054157	3664.9	0.072917	6 044017	3654.9	0.076389	0.106154	3660.1				0.072917	80.266151	3582
0.079942	-0.003388	3664.8	0.076389	6.161710	3654.7	0.079861	0.060000	3660.1				0 076389	80.420769	3582
0.083414	-0.047234	3664.8	0.079942	6.325556	3654.6	0.083449	0.057692	3660.1				0.079861	80.533844	3581
0.090359	-0.038003	3664.8	0.083414	6.470940	3654.4	0.090394	0.101538	3660.1				0.083368	80.702309	3581
0.097303	-0.005696	3664.8	0.090359	6.738633	3654.2	0.097338	0.152308	3660.0				0.090313	80.923843	3581
0.104248	0.035843	3664.8	0.097303	6.953248	3653.9	0.104282	0.170769	3660.0				0.097257	81.223846	3581
0.111192	0.003535	3664.8	0.104248	7.172479	3653.7	0.111227	0.163846	3660.0				0 104201	81.373848	3581
0.118137	0.021997	3664.8	0.111192	7.414786	3653.5	0.118171	0.233077	3660.0				0.111146	83.363075	3579
0.125081	-0.001080	3664.8	0.118137	7.659402	3653.2	0.125116	0.267692	3659.9				0.118206	83.801537	3578
0.132025	0.026612	3664.8	0.125081	7.855556	3653.0	0.132060	0.306923	3659.9				0.125035	84 023079	3578
0.138970	0.045074	3664.8	0.132025	8.058633	3652.8	0.139005	0.346154	3659.9				0.131979	84.295387	3578
0.149387	0.047381	3664.8	0.138970	8.254786	3652.6	0.149421	0.433846	3659.8				0.138924	84 408463	3578
0.159803	0.021997	3664.8	0.149387	8.520171	3652.4	0.159838	0.450000	3659.8				0.149340	84.701538	3577
0.170220	0.045074	3664.8	0.159803	8 787864	3652.1	0 170255	0.567692	3659 6				0 159757	84 886154	3577
0.180637	0.072766	3664.7	0.170220	9.032478	3651.9	0.180671	0.634615	3659.6				0.170174	85.036156	3577
0.194525	0.102766	3664.7	0.180637	9.251710	3651.6	0.194560	0.745385	3659.5				0.180590	85.093849	3577
0.208414	0.125843	3664.7	0.194525	9.535556	3651.4	0.208449	0.860769	3659.3				0.194481	85.407692	3577
0.222303	0.169689	3664.6	0.208414	9.777864	3651.1	0.222338	0.960000	3659.2				0.208368	85.668465	3576
0.236192	0.167381	3664.6	0.222303	10.004017	3650.9	0 236227	1.112308	3659.1				0.222257	85.698463	3576
0.250081	0.190458	3664.6	0.236192	10.220941	3650.7	0.250116	1.174615	3659.0				0.236146	85.924614	3576
0.263970	0.271228	3664.5	0.250081	10.463248	3650.4	0.264005	1.359231	3658.8				0.250035	86.176155	3576
0.277859	0.268920	3664.5	0.263970	10.629402	3650.3	0.277894	1.467692	3658.7				0.263924	86.381538	3576
0.295220	0.301228	3664 5	0.277859	10.839402	3650.1	0.295255	1.615385	3658.6				0.277812	86 476151	3576
0.312581	0.342766	3664.5	0.295220	11.037864	3649.9	0.312616	1.804615	3658.4				0.295174	86.568459	3575
0.329942	0.368151	3664.4	0.312581	11.213248	3649.7	0.329977	1.929231	3658.3				0.312535	86.683846	3575
0.347303	0.411997	3664 4	0.329942	11.411710	3649.5	0.347338	2 118462	3658 1				0.329896	86.801537	3575
0.370451	0.499689	3664.3	0.347303	11.594017	3649.3	0.370486	2.303077	3657.9				0.347257	87.147690	3575
0.393600	0.548151	3664.3	0.370451	11.884787	3649.0	0.393634	2.524615	3657.7				0.370405	87.223846	3575
0.416748	0.561997	3664.2	0.393600	12.039402	3648.9	0.416782	2.764615	3657.4				0.393553	87.353073	3575
0.440012	0.619689	3664.2	0.416748	12.240171	3648.7	0.440046	2 933077	3657.3				0.416701	87.613846	3574
0.463044	0.688920	3664.1	0.440012	12.397094	3648.5	0.463079	3.168462	3657.0				0.439965	87.560768	3574
0.486192	0.762766	3664.0	0.463044	12.602479	3648.3	0.486227	3.297692	3656.9				0.462998	87.625381	3574
0.520914	0.806612	3664 0	0.486192	12.685555	3648.2	0 520949	3.620769	3656.6				0.486146	87.985382	3574
0.555637	0.820458	3664 0	0.520914	12.969402	3647.9	0.555671	3.913846	3656.3				0.520868	88.033844	3574

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Revised Table C.2-1:
Time and Water Level Data Values Used in Pumping Test Analysis: Burdock Test, Drawdown Data

11-2		3664 8	11-14C		3660.9	11-15		3660 2	11-19*		3662.1	11-11C**		3662
Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (f	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)
0.590359	0.894304	3663.9	0.555637	13 144787	3647.8	0.590394	4.144615	3656.1				0.555590	88.010773	3574
0.625081	0.995843	3663.8	0.590359	13.317863	3647.6	0.625116	4.352308	3655.8				0.590312	88.456154	3574
0.659803	1.044304	3663.8	0.625081	13 433248	3647.5	0.659838	4.668461	3655 5				0.625035	88.396156	3574
0.694525	1.097381	3663.7	0.659803	13 574018	3647.3	0.694560	4.846154	3655.4				0 659757	88.737694	3573
0.729595	1.136612	3663.7	0.694525	13.707864	3647.2	0.729630	5.088461	3655.1				0.694479	88.555382	3573
0.763970	1.224304	3663.6	0.729595	13.867094	3647.0	0.764005	5.245385	3655.0				0.729549	88.721535	3573
0.798692	1.295843	3663.5	0.763970	13.973248	3646.9	0.798727	5.476154	3654.7				0.763924	88.975388	3573
0.833414	1.399689	3663.4	0.798692	14.224787	3646.7	0.833449	5.651538	3654.5				0 798646	88.666153	3573
0.902859	1.487381	3663.3	0.833414	14.324018	3646.6	0.902893	6.032308	3654.2				0.833368	88.786156	3573
0.972998	1.598151	3663.2	0.902859	14.557095	3646.3	0.973032	6.346154	3653.9				0.902928	88.931541	3573
1.041748	1.711228	3663.1	0.972998	14.723248	3646.2	1.041782	6.643846	3653.6				0.972951	89.081535	3573
1.111192	1.757381	3663.0	1.041748	14.868632	3646.0	1.111227	6.946154	3653.3				1.041701	89.093079	3573
1.180637	1.840458	3663 0	1.111192	15.067094	3645.8	1.180671	7.181539	3653.0				1.111146	89.376923	3573
1.250081	1.900458	3662.9	1 180637	15 187094	3645.7	1.250116	7 375385	3652 8				1.180590	89 307693	3573
1 319525	2.008920	3662.8	1.250081	15.297863	3645.6	1.319560	7.629231	3652.6				1.250035	89 554619	3572
1.388970	2.117381	3662 7	1.319525	15.378633	3645.5	1.389005	7.820769	3652.4				1.319479	89.826920	3572
1.493137	2.207381	3662.6	1.388970	15.614017	3645.3	1.493171	8.093077	3652.1				1.388924	90.085388	3572
1.597303	2.299689	3662.5	1.493137	15.789402	3645.1	1.597338	8.406923	3651.8				1.493090	89.976921	3572
1 701470	2.440458	3662.4	1.597303	15 893248	3645.0	1.701505	8.614615	3651.6				1 597257	90.182304	3572
1.805637	2.486612	3662.3	1.701470	16.008633	3644.9	1.805671	8.824615	3651.4				1.701424	90.168465	3572
1.944525	2.585843	3662.2	1.805637	16.149403	3644.8	1.944560	9.115385	3651.1				1.805590	90 166153	3572
2.083414	2.634305	3662.2	1.944525	16.310940	3644.6	2 083449	9.323077	3650.9				1.944479	90 678459	3571
2.222303	2.668920	3662.1	2.083414	16.405556	3644.5	2 222338	9.459230	3650.7				2.083368	90.639229	3571
2.361192	2.724304	3662.1	2.222303	16.516325	3644.4	2.361227	9.602307	3650.6				2.222257	90.736153	3571
2.500081	2.844305	3662.0	2.361192	16.587864	3644.3	2.500116	9.766154	3650.4				2.361146	90.819229	3571
2.638970	2.837381	3662.0	2.500081	16.634018	3644.3	2.639005	9.953077	3650.2				2.500035	91.047691	3571
2.777859	2.966612	3661.8	2.638970	16.770170	3644.1	2.777894	10.040770	3650.2				2.638924	91.165382	3571
2.951470	3.084305	3661.7	2.777859	16.874018	3644.0	2.951505	10.250770	3649.9				2.777813	91.137695	3571
2.999988	3.063535	3661.7	2.951470	17.010172	3643.9	2.999988	10.373077	3649.8				2.951423	91.176926	3571
			2.999988	17.014786	3643.9							2.999988	91.066154	3571

General Methodology: PSI, temperature, and time readings from Win-Situ™ digital data log were exported to Excel ".csv" file.
Drawdown was calculated as PSI at time after pumping minus average PSI before pumping; therefore, at small or zero changes in PSI negative drawdowns may be calculated.
A FORTRAN program was written to read the ".csv" file and produce a second file by extracting the records at a frequency of 40 per log-time cycle (in minutes) in order achieve equal representation of data throughout the pumping and drawdown phases of the test.
Elevation (in ft above mean sea level) based on initial groundwater elevation (see Table 5.2) minus drawdown.
Notes: * = early time data filtered to remove calculated negative drawdown values
** = initial measurement of groundwater elevation not available; approximate initial groundwater elevation estimated from adjacent wells.

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Revised Table C.3-1:
Time and Water Level Data Values Used in Pumping Test Analysis: Burdock Test, Recovery Data

11-2		3664.8	11-14C		3660.9	11-15		3660.2	11-19		3662.1	11-11C		3662
Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)
3.000035	3.052742	3661.7	3.000035	17.052603	3643.8	3.000035	10.293365	3649.9	3.000035	3.347297	3658.8	3.002651	91.335097	3571
3.000046	3.045798	3661.8	3.000046	17.017954	3643.9	3.000046	10.353427	3649.8	3.000046	3.370374	3658.7	3.002662	89.775840	3572
3.000058	3.094334	3661.7	3.000058	17.075690	3643.8	3.000058	10.328013	3649.9	3.000058	3.455759	3658.6	3.002674	89.062054	3573
3.000070	3.050451	3661.7	3.000070	16.999449	3643.9	3.000070	10.318778	3649.9	3.000070	3.448836	3658.7	3.002685	88.339016	3574
3.000081	3.089717	3661.7	3.000081	17.036424	3643.9	3.000081	10.309544	3649.9	3.000081	3.444220	3658.7	3.002697	87.676058	3574
3.000093	3.061977	3661.7	3.000093	17.006393	3643.9	3.000093	10.328013	3649.9	3.000093	3.444220	3658.7	3.002708	87.077762	3575
3.000104	3.075829	3661.7	3.000104	17.027189	3643.9	3.000104	10.445812	3649.8	3.000104	3.358835	3658.7	3.002720	86.327019	3576
3.000116	3.055068	3661.7	3.000116	17.013337	3643.9	3.000116	10.274895	3649.9	3.000116	3.351912	3658.7	3.002732	85.668660	3576
3.000127	3.078155	3661.7	3.000127	16.997158	3643.9	3.000127	10.291038	3649.9	3.000127	3.430374	3658.7	3.002743	85.077308	3577
3.000139	3.057359	3661.7	3.000139	16.980979	3643.9	3.000139	10.399637	3649.8	3.000139	3.437297	3658.7	3.002755	84.428184	3578
3.000151	3.066594	3661.7	3.000151	17.052603	3643.8	3.000151	10.307217	3649.9	3.000151	3.335759	3658.8	3.002766	83.869172	3578
3.000162	3.055068	3661.7	3.000162	17.020246	3643.9	3.000162	10.328013	3649.9	3.000162	3.400374	3658.7	3.002778	83.215448	3579
3.000174	3.071212	3661.7	3.000174	17.001776	3643.9	3.000174	10.267951	3649.9	3.000174	3.432682	3658.7	3.002789	82.612535	3579
3.000185	3.089717	3661.7	3.000185	17.013337	3643.9	3.000185	10.445812	3649.8	3.000185	3.393451	3658.7	3.002801	82.021165	3580
3.000197	3.048124	3661.8	3.000197	17.020246	3643.9	3.000197	10.323396	3649.9	3.000197	3.409605	3658.7	3.002813	81.385929	3581
3.000208	3.050451	3661.7	3.000208	17.004067	3643.9	3.000208	10.291038	3649.9	3.000208	3.432682	3658.7	3.002824	80.928536	3581
3.000220	3.098952	3661.7	3.000220	17.013337	3643.9	3.000220	10.300273	3649.9	3.000220	3.391143	3658.7	3.002836	80.267886	3582
3.000232	3.036563	3661.8	3.000232	17.027189	3643.9	3.000232	10.300273	3649.9	3.000232	3.448836	3658.7	3.002847	79.845142	3582
3.000243	3.075829	3661.7	3.000243	16.992541	3643.9	3.000243	10.330304	3649.9	3.000243	3.356528	3658.7	3.002859	79.119812	3583
3.000255	3.085099	3661.7	3.000255	16.990214	3643.9	3.000255	10.281804	3649.9	3.000255	3.488066	3658.6	3.002870	78.657802	3583
3.000266	3.087390	3661.7	3.000266	17.020246	3643.9	3.000266	10.399637	3649.8	3.000266	3.344989	3658.8	3.002882	78.015622	3584
3.000278	3.085099	3661.7	3.000278	16.974036	3643.9	3.000278	10.314161	3649.9	3.000278	3.326528	3658.8	3.002894	77.498184	3585
3.000289	3.029654	3661.8	3.000289	17.057220	3643.8	3.000289	10.314161	3649.9	3.000289	3.483451	3658.6	3.002905	76.918375	3585
3.000301	3.071212	3661.7	3.000301	16.990214	3643.9	3.000301	10.371897	3649.8	3.000301	3.425759	3658.7	3.002917	76.403246	3586
3.000313	3.071212	3661.7	3.000313	17.034098	3643.9	3.000313	10.328013	3649.9	3.000313	3.391143	3658.7	3.002928	75.733344	3586
3.000324	3.101243	3661.7	3.000324	17.015628	3643.9	3.000324	10.295656	3649.9	3.000324	3.400374	3658.7	3.002940	75.220524	3587
3.000336	3.071212	3661.7	3.000336	17.022572	3643.9	3.000336	10.297982	3649.9	3.000336	3.432682	3658.7	3.002951	74.786254	3587
3.000347	3.038889	3661.8	3.000347	16.969418	3643.9	3.000347	10.316452	3649.9	3.000347	3.451143	3658.6	3.002963	74.093246	3588
3.000359	3.096625	3661.7	3.000359	17.006393	3643.9	3.000359	10.334957	3649.9	3.000359	3.455759	3658.6	3.002974	73.559648	3588
3.000370	3.031945	3661.8	3.000370	17.020246	3643.9	3.000370	10.323396	3649.9	3.000370	3.437297	3658.7	3.002986	73.032957	3589
3.000382	3.082773	3661.7	3.000382	16.918626	3644.0	3.000382	10.274895	3649.9	3.000382	3.421143	3658.7	3.002998	72.704941	3589
3.000394	3.043507	3661.8	3.000394	17.022572	3643.9	3.000394	10.316452	3649.9	3.000394	3.425759	3658.7	3.003009	71.935711	3590
3.000405	3.085099	3661.7	3.000405	16.997158	3643.9	3.000405	10.286421	3649.9	3.000405	3.428066	3658.7	3.003021	71.480644	3591
3.000417	3.048124	3661.8	3.000417	17.008684	3643.9	3.000417	10.284130	3649.9	3.000417	3.384220	3658.7	3.003032	70.889274	3591
3.000428	3.096625	3661.7	3.000428	17.031807	3643.9	3.000428	10.302600	3649.9	3.000428	3.458066	3658.6	3.003044	70.441134	3592
3.000451	3.082773	3661.7	3.000451	17.029480	3643.9	3.000451	10.297982	3649.9	3.000451	3.432682	3658.7	3.003067	69.438598	3593
3.000486	3.034272	3661.8	3.000486	17.027189	3643.9	3.000486	10.318778	3649.9	3.000486	3.432682	3658.7	3.003102	68.024879	3594
3.000498	3.041180	3661.8	3.000498	17.041042	3643.9	3.000498	10.311835	3649.9	3.000498	3.414220	3658.7	3.003113	67.482028	3595
3.000509	3.038889	3661.8	3.000509	17.011011	3643.9	3.000509	10.286421	3649.9	3.000509	3.451143	3658.6	3.003125	67.024652	3595
3.000532	3.055068	3661.7	3.000532	16.992541	3643.9	3.000532	10.348810	3649.9	3.000532	3.441912	3658.7	3.003148	66.121445	3596
3.000544	3.034272	3661.8	3.000544	17.008684	3643.9	3.000544	10.281804	3649.9	3.000544	3.402682	3658.7	3.003160	65.712570	3596
3.000567	3.068920	3661.7	3.000567	17.057220	3643.8	3.000567	10.286421	3649.9	3.000567	3.414220	3658.7	3.003183	64.809363	3597
3.000590	3.094334	3661.7	3.000590	17.022572	3643.9	3.000590	10.261007	3649.9	3.000590	3.448836	3658.7	3.003206	64.010101	3598
3.000625	3.052742	3661.7	3.000625	17.008684	3643.9	3.000625	10.295656	3649.9	3.000625	3.356528	3658.7	3.003241	62.806583	3599
3.000660	3.087390	3661.7	3.000660	17.036424	3643.9	3.000660	10.293365	3649.9	3.000660	3.432682	3658.7	3.003276	61.730133	3600
3.000683	3.075829	3661.7	3.000683	17.022572	3643.9	3.000683	10.288747	3649.9	3.000683	3.476528	3658.6	3.003299	60.965520	3601
3.000718	3.055068	3661.7	3.000718	17.017954	3643.9	3.000718	10.425015	3649.8	3.000718	3.340374	3658.8	3.003333	59.974528	3602
3.000764	3.061977	3661.7	3.000764	16.990214	3643.9	3.000764	10.427342	3649.8	3.000764	3.354220	3658.7	3.003380	58.627797	3603
3.000799	3.048124	3661.8	3.000799	17.015628	3643.9	3.000799	10.316452	3649.9	3.000799	3.428066	3658.7	3.003415	57.664528	3604
3.000822	3.085099	3661.7	3.000822	16.999449	3643.9	3.000822	10.286421	3649.9	3.000822	3.448836	3658.7	3.003438	57.070866	3605
3.000857	3.041180	3661.8	3.000857	16.978688	3643.9	3.000857	10.323396	3649.9	3.000857	3.340374	3658.8	3.003472	56.197673	3606
3.000938	3.041180	3661.8	3.000938	17.029480	3643.9	3.000938	10.358045	3649.8	3.000938	3.448836	3658.7	3.003553	54.402802	3608
3.000995	3.050451	3661.7	3.000995	16.976362	3643.9	3.000995	10.277186	3649.9	3.000995	3.432682	3658.7	3.003611	53.229332	3609

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Revised Table C.3-1:
Time and Water Level Data Values Used in Pumping Test Analysis: Burdock Test, Recovery Data

11-2		3664.8	11-14C		3660.9	11-15		3660.2	11-19		3662.1	11-11C		3662
Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)
3.001076	3.066594	3661.7	3.001076	17.038715	3643.9	3.001076	10.351101	3649.8	3.001076	3.354220	3658.7	3.003692	51.808687	3610
3.001134	3.055068	3661.7	3.001134	17.008684	3643.9	3.001134	10.304926	3649.9	3.001134	3.354220	3658.7	3.003751	50.990938	3611
3.001215	3.092008	3661.7	3.001215	17.038715	3643.9	3.001215	10.277186	3649.9	3.001215	3.349605	3658.8	3.003821	50.133923	3612
3.001285	3.038889	3661.8	3.001285	17.013337	3643.9	3.001285	10.346483	3649.9	3.001285	3.344989	3658.8	3.003900	49.177597	3613
3.001354	3.082773	3661.7	3.001354	17.013337	3643.9	3.001354	10.300273	3649.9	3.001354	3.328835	3658.8	3.003971	48.334434	3614
3.001423	3.094334	3661.7	3.001423	16.914009	3644.0	3.001423	10.323396	3649.9	3.001423	3.421143	3658.7	3.004039	47.567513	3614
3.001528	3.103569	3661.7	3.001528	16.987923	3643.9	3.001528	10.346483	3649.9	3.001528	3.354220	3658.7	3.004144	46.484136	3616
3.001620	3.061977	3661.7	3.001620	16.987923	3643.9	3.001620	10.385749	3649.8	3.001620	3.358835	3658.7	3.004236	45.405359	3617
3.001736	3.071212	3661.7	3.001736	16.967127	3643.9	3.001736	10.325687	3649.9	3.001736	3.384220	3658.7	3.004352	44.317348	3618
3.001840	3.075829	3661.7	3.001840	16.971745	3643.9	3.001840	10.293365	3649.9	3.001840	3.462682	3658.6	3.004457	43.307886	3619
3.001979	3.094334	3661.7	3.001979	16.976362	3643.9	3.001979	10.302600	3649.9	3.001979	3.441912	3658.7	3.004595	42.021218	3620
3.002130	3.085099	3661.7	3.002130	16.946331	3644.0	3.002130	10.334957	3649.9	3.002130	3.351912	3658.7	3.004745	40.621351	3621
3.002245	3.057359	3661.7	3.002245	16.955566	3643.9	3.002245	10.316452	3649.9	3.002245	3.363451	3658.7	3.004861	39.639594	3622
3.002396	3.031945	3661.8	3.002396	16.955566	3643.9	3.002396	10.304926	3649.9	3.002396	3.351912	3658.7	3.005012	38.581614	3623
3.002535	3.045798	3661.8	3.002535	16.946331	3644.0	3.002535	10.341866	3649.9	3.002535	3.356528	3658.7	3.005151	37.555973	3624
3.002674	3.055068	3661.7	3.002674	16.962510	3643.9	3.002674	10.337248	3649.9	3.002674	3.437297	3658.7	3.005289	36.467962	3626
3.002812	3.057359	3661.7	3.002812	16.950948	3643.9	3.002812	10.316452	3649.9	3.002812	3.437297	3658.7	3.005428	35.574007	3626
3.002986	3.048124	3661.8	3.002986	16.883978	3644.0	3.002986	10.286421	3649.9	3.002986	3.377297	3658.7	3.005602	34.502157	3627
3.003160	3.050451	3661.7	3.003160	16.918626	3644.0	3.003160	10.348810	3649.9	3.003160	3.377297	3658.7	3.005776	33.561992	3628
3.003322	3.085099	3661.7	3.003322	16.877034	3644.0	3.003322	10.364953	3649.8	3.003322	3.432682	3658.7	3.005938	32.691125	3629
3.003495	3.080446	3661.7	3.003495	16.842385	3644.1	3.003495	10.328013	3649.9	3.003495	3.425759	3658.7	3.006111	31.808696	3630
3.003727	3.064303	3661.7	3.003727	16.865472	3644.0	3.003727	10.323396	3649.9	3.003727	3.409605	3658.7	3.006343	30.702214	3631
3.003958	3.048124	3661.8	3.003958	16.840059	3644.1	3.003958	10.279512	3649.9	3.003958	3.511143	3658.6	3.006574	29.701987	3632
3.004201	3.075829	3661.7	3.004201	16.826206	3644.1	3.004201	10.328013	3649.9	3.004201	3.453451	3658.6	3.006817	28.727157	3633
3.004433	3.126656	3661.7	3.004433	16.761527	3644.1	3.004433	10.422724	3649.8	3.004433	3.358835	3658.7	3.007048	27.902481	3634
3.004664	3.048124	3661.8	3.004664	16.775379	3644.1	3.004664	10.330304	3649.9	3.004664	3.377297	3658.7	3.007280	27.126325	3635
3.004884	3.094334	3661.7	3.004884	16.724587	3644.2	3.004884	10.362662	3649.8	3.004884	3.386528	3658.7	3.007500	26.454114	3636
3.005231	3.055068	3661.7	3.005231	16.641402	3644.3	3.005231	10.302600	3649.9	3.005231	3.458066	3658.6	3.007847	25.465448	3637
3.005590	3.048124	3661.8	3.005590	16.655255	3644.2	3.005590	10.348810	3649.9	3.005590	3.393451	3658.7	3.008206	24.559915	3637
3.005926	3.186719	3661.6	3.005926	16.625259	3644.3	3.005926	10.302600	3649.9	3.005926	3.388836	3658.7	3.008542	23.811480	3638
3.006285	3.080446	3661.7	3.006285	16.549018	3644.4	3.006285	10.355718	3649.8	3.006285	3.349605	3658.8	3.008901	23.319456	3639
3.006620	3.057359	3661.7	3.006620	16.477394	3644.4	3.006620	10.302600	3649.9	3.006620	3.388836	3658.7	3.009236	22.707308	3639
3.006968	3.052742	3661.7	3.006968	16.417332	3644.5	3.006968	10.323396	3649.9	3.006968	3.368066	3658.7	3.009583	22.210649	3640
3.007315	3.048124	3661.8	3.007315	16.354979	3644.5	3.007315	10.297982	3649.9	3.007315	3.393451	3658.7	3.009931	21.700137	3640
3.007673	3.089717	3661.7	3.007673	16.301825	3644.6	3.007673	10.351101	3649.8	3.007673	3.494989	3658.6	3.010289	21.258923	3641
3.008009	3.101243	3661.7	3.008009	16.241798	3644.7	3.008009	10.358045	3649.8	3.008009	3.474220	3658.6	3.010625	20.866227	3641
3.008356	3.195954	3661.6	3.008356	16.195588	3644.7	3.008356	10.316452	3649.9	3.008356	3.508836	3658.6	3.010972	20.501254	3641
3.009062	3.034272	3661.8	3.009062	16.068520	3644.8	3.009062	10.307217	3649.9	3.009062	3.379605	3658.7	3.011678	19.852148	3642
3.009745	3.154396	3661.6	3.009745	16.054667	3644.8	3.009745	10.291038	3649.9	3.009745	3.453451	3658.6	3.012361	19.337019	3643
3.010451	3.061977	3661.7	3.010451	15.899894	3645.0	3.010451	10.316452	3649.9	3.010451	3.416528	3658.7	3.013067	18.884243	3643
3.011134	3.087390	3661.7	3.011134	15.786713	3645.1	3.011134	10.300273	3649.9	3.011134	3.361143	3658.7	3.013750	18.438429	3644
3.011840	3.112804	3661.7	3.011840	15.638884	3645.3	3.011840	10.339575	3649.9	3.011840	3.388836	3658.7	3.014456	18.108086	3644
3.012523	3.122039	3661.7	3.012523	15.544173	3645.4	3.012523	10.316452	3649.9	3.012523	3.391143	3658.7	3.015139	17.823954	3644
3.013218	3.182101	3661.6	3.013218	15.472550	3645.4	3.013218	10.314161	3649.9	3.013218	3.458066	3658.6	3.015833	17.537513	3644
3.013912	3.098952	3661.7	3.013912	15.354752	3645.5	3.013912	10.307217	3649.9	3.013912	3.379605	3658.7	3.016528	17.288046	3645
3.014954	3.025037	3661.8	3.014954	15.218448	3645.7	3.014954	10.297982	3649.9	3.014954	3.409605	3658.7	3.017570	16.902277	3645
3.015995	3.061977	3661.7	3.015995	15.045205	3645.9	3.015995	10.318778	3649.9	3.015995	3.485759	3658.6	3.018611	16.613527	3645
3.017048	3.006532	3661.8	3.017048	14.899667	3646.0	3.017048	10.344192	3649.9	3.017048	3.515759	3658.6	3.019664	16.340938	3646
3.018090	3.055068	3661.7	3.018090	14.763364	3646.1	3.018090	10.353427	3649.8	3.018090	3.506528	3658.6	3.020706	16.109941	3646
3.019479	3.108186	3661.7	3.019479	14.610917	3646.3	3.019479	10.332631	3649.9	3.019479	3.458066	3658.6	3.022095	15.758820	3646
3.020856	3.048124	3661.8	3.020856	14.421496	3646.5	3.020856	10.325687	3649.9	3.020856	3.414220	3658.7	3.023472	15.500101	3646
3.022245	3.022711	3661.8	3.022245	14.308315	3646.6	3.022245	10.341866	3649.9	3.022245	3.501913	3658.6	3.024861	15.246000	3647
3.023634	3.036563	3661.8	3.023634	14.038035	3646.9	3.023634	10.323396	3649.9	3.023634	3.504220	3658.6	3.026250	14.987281	3647

Revised Table C.3-1:
Time and Water Level Data Values Used in Pumping Test Analysis: Burdock Test, Recovery Data

11-2		3664.8	11-14C		3660.9	11-15		3660.2	11-19		3662.1	11-11C		3662
Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)
3.025035	3.038889	3661.8	3.025035	13.987207	3646.9	3.025035	10.267951	3649.9	3.025035	3.448836	3658.7	3.027651	14.830199	3647
3.026423	3.075829	3661.7	3.026423	13.850939	3647.0	3.026423	10.311835	3649.9	3.026423	3.529605	3658.6	3.029039	14.666191	3647
3.027812	3.094334	3661.7	3.027812	13.663809	3647.2	3.027812	10.358045	3649.8	3.027812	3.414220	3658.7	3.030428	14.379750	3648
3.029537	3.027328	3661.8	3.029537	13.550628	3647.3	3.029537	10.316452	3649.9	3.029537	3.402682	3658.7	3.032153	14.231903	3648
3.031285	3.055068	3661.7	3.031285	13.342737	3647.6	3.031285	10.316452	3649.9	3.031285	3.441912	3658.7	3.033901	13.991672	3648
3.033009	3.075829	3661.7	3.033009	13.254934	3647.6	3.033009	10.325687	3649.9	3.033009	3.430374	3658.7	3.035625	13.827664	3648
3.034745	3.061977	3661.7	3.034745	13.146371	3647.8	3.034745	10.321070	3649.9	3.034745	3.511143	3658.6	3.037361	13.647477	3648
3.037060	3.101243	3661.7	3.037060	12.896887	3648.0	3.037060	10.355718	3649.8	3.037060	3.384220	3658.7	3.039676	13.469616	3649
3.039375	3.075829	3661.7	3.039375	12.797559	3648.1	3.039375	10.328013	3649.9	3.039375	3.499605	3658.6	3.041991	13.236294	3649
3.041701	3.168249	3661.6	3.041701	12.642786	3648.3	3.041701	10.330304	3649.9	3.041701	3.471912	3658.6	3.044317	12.996062	3649
3.044005	3.064303	3661.7	3.044005	12.469543	3648.4	3.044005	10.330304	3649.9	3.044005	3.476528	3658.6	3.046620	12.827437	3649
3.046331	3.057359	3661.7	3.046331	12.388684	3648.5	3.046331	10.321070	3649.9	3.046331	3.501913	3658.6	3.048947	12.681899	3649
3.048634	3.045798	3661.8	3.048634	12.099934	3648.8	3.048634	10.297982	3649.9	3.048634	3.488066	3658.6	3.051250	12.517891	3649
3.052106	3.048124	3661.8	3.052106	12.032963	3648.9	3.052106	10.328013	3649.9	3.052106	3.444220	3658.7	3.054722	12.203727	3650
3.055590	3.034272	3661.8	3.055590	11.838924	3649.1	3.055590	10.291038	3649.9	3.055590	3.483451	3658.6	3.058206	12.018923	3650
3.059062	3.041180	3661.8	3.059062	11.656446	3649.2	3.059062	10.316452	3649.9	3.059062	3.379605	3658.7	3.061678	11.797179	3650
3.062535	3.057359	3661.7	3.062535	11.453137	3649.4	3.062535	10.311835	3649.9	3.062535	3.464989	3658.6	3.065151	11.580035	3650
3.065995	3.029654	3661.8	3.065995	11.242954	3649.7	3.065995	10.364953	3649.8	3.065995	3.374990	3658.7	3.068611	11.395230	3651
3.069468	3.057359	3661.7	3.069468	11.085855	3649.8	3.069468	10.431959	3649.8	3.069468	3.464989	3658.6	3.072083	11.210426	3651
3.072951	3.048124	3661.8	3.072951	11.011940	3649.9	3.072951	10.263334	3649.9	3.072951	3.361143	3658.7	3.075567	11.048727	3651
3.076470	3.087390	3661.7	3.076412	10.850259	3650.0	3.076505	10.302600	3649.9	3.076412	3.368066	3658.7	3.079028	10.907824	3651
3.079942	3.061977	3661.7	3.079942	10.653893	3650.2	3.079977	10.286421	3649.9	3.079896	3.370374	3658.7	3.082500	10.704532	3651
3.083530	3.006532	3661.8	3.083530	10.515299	3650.4	3.083449	10.270277	3649.9	3.083484	3.351912	3658.7	3.086100	10.554394	3651
3.090590	3.087390	3661.7	3.090590	10.221931	3650.7	3.090509	10.247155	3650.0	3.090544	3.340374	3658.8	3.093160	10.263335	3652
3.097419	3.048124	3661.8	3.097419	10.027892	3650.9	3.097338	10.205563	3650.0	3.097373	3.326528	3658.8	3.099988	10.020778	3652
3.104363	3.041180	3661.8	3.104363	9.868502	3651.0	3.104282	10.191710	3650.0	3.104317	3.342682	3658.8	3.106933	9.722793	3652
3.111308	3.001914	3661.8	3.111308	9.542777	3651.4	3.111227	10.161679	3650.0	3.111262	3.261913	3658.8	3.113877	9.533371	3652
3.118252	3.013476	3661.8	3.118252	9.351064	3651.5	3.118171	10.177858	3650.0	3.118206	3.268836	3658.8	3.120822	9.297757	3653
3.125197	3.018093	3661.8	3.125197	9.136229	3651.8	3.125116	10.170914	3650.0	3.125151	3.280374	3658.8	3.127766	9.062125	3653
3.132141	3.001914	3661.8	3.132141	8.946807	3652.0	3.132060	10.085473	3650.1	3.132095	3.261913	3658.8	3.134711	8.865778	3653
3.139086	2.997297	3661.8	3.139086	8.755059	3652.1	3.139005	10.043881	3650.2	3.139039	3.259605	3658.8	3.141655	8.678665	3653
3.149502	3.025037	3661.8	3.149502	8.542550	3652.4	3.149421	10.020794	3650.2	3.149456	3.201912	3658.9	3.152072	8.394532	3654
3.159919	3.018093	3661.8	3.159919	8.369307	3652.5	3.159838	9.988436	3650.2	3.159873	3.197297	3658.9	3.162488	8.124270	3654
3.170336	2.964975	3661.8	3.170336	8.092118	3652.8	3.170255	9.875255	3650.3	3.170289	3.178836	3658.9	3.172905	7.951027	3654
3.180752	2.953413	3661.8	3.180752	7.958106	3652.9	3.180671	9.771310	3650.4	3.180706	3.144220	3659.0	3.183322	7.696925	3654
3.194641	2.925709	3661.9	3.194641	7.593150	3653.3	3.194560	9.674272	3650.5	3.194595	3.104990	3659.0	3.197211	7.368892	3655
3.208530	2.941852	3661.9	3.208530	7.445286	3653.5	3.208449	9.611919	3650.6	3.208484	3.132682	3659.0	3.211100	7.227988	3655
3.222419	2.916438	3661.9	3.222419	7.110361	3653.8	3.222338	9.440967	3650.8	3.222373	3.102682	3659.0	3.224988	6.978505	3655
3.236308	2.877172	3661.9	3.236308	6.913996	3654.0	3.236227	9.343965	3650.9	3.236262	3.102682	3659.0	3.238877	6.726712	3655
3.250197	2.854085	3661.9	3.250197	6.789254	3654.1	3.250116	9.253872	3650.9	3.250151	3.044989	3659.1	3.252766	6.521129	3655
3.264086	2.821728	3662.0	3.264086	6.609067	3654.3	3.264005	9.133747	3651.1	3.264039	3.042682	3659.1	3.266655	6.370973	3656
3.277974	2.796349	3662.0	3.277974	6.359618	3654.5	3.277893	9.057506	3651.1	3.277928	2.998836	3659.1	3.280544	6.190804	3656
3.295336	2.805584	3662.0	3.295336	6.246402	3654.7	3.295255	8.875028	3651.3	3.295289	2.964220	3659.1	3.297905	5.945938	3656
3.312697	2.872555	3661.9	3.312697	6.077777	3654.8	3.312616	8.766465	3651.4	3.312651	2.941143	3659.2	3.315266	5.779621	3656
3.330058	2.810202	3662.0	3.330058	5.916095	3655.0	3.329977	8.583952	3651.6	3.330012	3.038066	3659.1	3.332627	5.627157	3656
3.347419	2.784788	3662.0	3.347419	5.733582	3655.2	3.347338	8.438414	3651.8	3.347373	2.945759	3659.2	3.349988	5.426191	3657
3.370567	2.727017	3662.1	3.370567	5.514129	3655.4	3.370486	8.295202	3651.9	3.370521	2.890374	3659.2	3.373137	5.204430	3657
3.393715	2.715491	3662.1	3.393715	5.336269	3655.6	3.393634	8.068841	3652.1	3.393669	2.844220	3659.3	3.396285	5.054274	3657
3.416863	2.634632	3662.2	3.416863	5.156082	3655.7	3.416782	7.932537	3652.3	3.416817	2.830374	3659.3	3.419433	4.848691	3657
3.440127	2.639250	3662.2	3.440127	4.957425	3655.9	3.440046	7.729263	3652.5	3.440081	2.784220	3659.3	3.442697	4.696227	3657
3.463160	2.655428	3662.1	3.463160	4.832683	3656.1	3.463079	7.556020	3652.6	3.463113	2.731143	3659.4	3.465729	4.548398	3657
3.486308	2.576896	3662.2	3.486308	4.701033	3656.2	3.486227	7.412773	3652.8	3.486262	2.682682	3659.4	3.488877	4.389007	3658
3.521030	2.537630	3662.3	3.521030	4.520846	3656.4	3.520949	7.110171	3653.1	3.520984	2.687297	3659.4	3.523600	4.261956	3658

Revised Table C.3-1:
Time and Water Level Data Values Used in Pumping Test Analysis: Burdock Test, Recovery Data

11-2		3664.8	**11-14C**		3660.9	**11-15**		3660.2	**11-19**		3662.1	**11-11C**		3662
Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)	Time (days)	Drawdown (ft)	Elevation (ft)
3.555752	2.445211	3662.4	3.555752	4.262127	3656.6	3.555671	6.911514	3653.3	3.555706	2.613451	3659.5	3.558322	4.070226	3658
3.590474	2.401327	3662.4	3.590474	4.142003	3656.8	3.590393	6.645887	3653.6	3.590428	2.509605	3659.6	3.593044	3.922379	3658
3.625197	2.387475	3662.4	3.625197	3.984938	3656.9	3.625116	6.458756	3653.7	3.625151	2.541913	3659.6	3.627766	3.806872	3658
3.659919	2.320469	3662.5	3.659919	3.855544	3657.0	3.659838	6.262426	3653.9	3.659873	2.486528	3659.6	3.662488	3.647481	3658
3.694641	2.281203	3662.5	3.694641	3.696188	3657.2	3.694560	6.059117	3654.1	3.694595	2.414989	3659.7	3.697211	3.541227	3658
3.729711	2.269641	3662.5	3.729711	3.603769	3657.3	3.729630	5.839664	3654.4	3.729664	2.368835	3659.7	3.732280	3.393398	3659
3.764086	2.198053	3662.6	3.764086	3.490588	3657.4	3.764005	5.659512	3654.5	3.764039	2.350374	3659.7	3.766655	3.300995	3659
3.798808	2.174930	3662.6	3.798808	3.361229	3657.5	3.798727	5.483943	3654.7	3.798762	2.331913	3659.8	3.801377	3.134679	3659
3.833530	2.131047	3662.7	3.833530	3.296549	3657.6	3.833449	5.363819	3654.8	3.833484	2.297297	3659.8	3.836100	3.104648	3659
3.902974	2.059459	3662.7	3.902974	3.146393	3657.8	3.902893	5.033476	3655.2	3.902928	2.267297	3659.8	3.905544	2.956801	3659
3.973113	2.089490	3662.7	3.973113	3.010090	3657.9	3.973032	4.802497	3655.4	3.973067	2.179605	3659.9	3.975683	2.804336	3659
4.041863	1.948569	3662.9	4.041863	2.797581	3658.1	4.041782	4.504512	3655.7	4.041817	2.274220	3659.8	4.044433	2.663433	3659
4.111308	1.927773	3662.9	4.111308	2.605868	3658.3	4.111227	4.303529	3655.9	4.111262	2.031913	3660.1	4.113877	2.538691	3659
4.180752	1.796087	3663.0	4.180752	2.529627	3658.4	4.180671	4.035576	3656.2	4.180706	1.974220	3660.1	4.183322	2.340035	3660
4.250197	1.752204	3663.0	4.250197	2.402559	3658.5	4.250116	3.811505	3656.4	4.250151	1.928066	3660.2	4.252766	2.270737	3660
4.319641	1.708320	3663.1	4.319641	2.354058	3658.5	4.319560	3.635936	3656.6	4.319595	1.907297	3660.2	4.322211	2.125199	3660
4.389086	1.664436	3663.1	4.389086	2.250112	3658.6	4.389005	3.476545	3656.7	4.389039	1.828836	3660.3	4.391655	2.072063	3660
4.493252	1.664436	3663.1	4.493252	2.160019	3658.7	4.493171	3.296359	3656.9	4.493206	1.798836	3660.3	4.495822	1.975044	3660
4.597419	1.560491	3663.2	4.597419	2.065308	3658.8	4.597338	3.109263	3657.1	4.597373	1.734220	3660.4	4.599988	1.963500	3660
4.701586	1.535077	3663.3	4.701586	1.919770	3659.0	4.701505	2.919842	3657.3	4.701539	1.701913	3660.4	4.704155	1.820288	3660
4.805752	1.456545	3663.3	4.805752	1.910535	3659.0	4.805671	2.751216	3657.4	4.805706	1.688066	3660.4	4.808322	1.732504	3660
4.944641	1.433422	3663.4	4.944641	1.792737	3659.1	4.944560	2.612622	3657.6	4.944595	1.618836	3660.5	4.947211	1.644719	3660
5.083530	1.361834	3663.4	5.083530	1.665668	3659.2	5.083449	2.460140	3657.7	5.083368	1.549605	3660.6	5.086100	1.554625	3660
5.222419	1.347946	3663.5	5.222419	1.540926	3659.4	5.222338	2.229161	3658.0	5.222373	1.480374	3660.6	5.224988	1.439136	3661
5.361308	1.165469	3663.6	5.361308	1.370010	3659.5	5.361227	2.097475	3658.1	5.361146	1.436528	3660.7	5.363877	1.337481	3661
5.500197	1.075375	3663.7	5.500197	1.339979	3659.6	5.500116	1.917288	3658.3	5.500150	1.471143	3660.6	5.502766	1.191961	3661
5.639086	1.015313	3663.8	5.639086	1.268355	3659.6	5.639005	1.797164	3658.4	5.633947	1.401912	3660.7	5.641655	1.044114	3661
5.777974	0.971429	3663.8	5.777974	1.092786	3659.8	5.777894	1.688601	3658.5	5.777813	1.187297	3660.9	5.780544	1.030262	3661
5.909340	0.927546	3663.9	5.909340	1.182879	3659.7	5.909375	1.612395	3658.6	5.893901	1.094989	3661.0	5.911910	1.062601	3661

General Methodology: PSI, temperature, and time readings from Win-Situ™ digital data log were exported to Excel " csv" file.
Drawdown was calculated as PSI at time after pumping minus average PSI before pumping, therefore, at small or zero changes in PSI negative drawdowns may be calculated.
A FORTRAN program was written to read the ".csv" file and produce a second file by extracting the records at a frequency of 40 per log-time cycle (in minutes) in order achieve equal representation of data throughout the pumping and drawdown phases of the test.
Elevation (in ft above mean sea level) based on initial groundwater elevation (see Table 5.2) minus drawdown

Note [dashed box] Extracted manually from digital data log.

TR RAI-P&R-12
Clarification of breccia pipes

TR RAI-P&R-12(a)

a. Background: Exhibit 2.2-1 of the Technical Report Supplement includes a reference to Geological Survey Professional Paper 763 (Gott et al. 1974). NRC staff found that the illustrated breccia pipe study area within the 1974 document does not appear to include the Dewey half of the license area.

Needed: Please specify the source(s) of information used to illustrate breccia pipe locations in Exhibit 2.2-1 of the Technical Report Supplement. Additionally, please specify the specific area of the map in Exhibit 2.2-1 that illustrates known breccia pipe locations. This information is necessary for staff to understand the potential impacts of the operations on water resources.

Response: TR RAI-P&R-12(a) (TR Section 2.7.2.1.7)
Plate 4 of the USGS Professional Paper 763 (Gott et al., 1974) was the source of information used to illustrate the locations of breccia pipes or collapse features on the "Location of Breccia pipe or collapse structure" map (Supplement Exhibit 2.2-1). On Gott's map, three categories of features were mapped; 1) "breccia pipes or collapse features", 2) "structures of possible solution origin" and 3) "topographic depressions". On Supplement Exhibit 2.2-1, only "breccia pipes or collapse features" were plotted. The Dewey half of the PAA is included in this Plate 4. The Dewey portion of the project is contained on the Dewey and Twentyone Divide USGS 7½º quadrangle maps. On the Dewey quadrangle, the Gott et al., 1974, map contained no "breccia pipes or collapse features" – but showed one "topographic depression" and one "structure of possible solution origin". There were no features mapped on the Twentyone Divide quadrangle map. Accordingly, no breccia pipe or collapse features were illustrated on Exhibit 2.2-1 for the Dewey area.

Breccia pipes and collapse breccias have been mapped in the southern Black Hills since Darton in 1905. These collapse features originate in anhydrite and gypsum sequences within the upper portion of the Minnelusa Formation of Pennsylvanian age. Dissolution of these evaporite sequences by underlying Minnelusa artesian water created solution cavities into which overlying Permian and Triassic sediments collapsed. All breccia pipes or collapse structures shown on Exhibit 2.2-1 and labeled as occurring in the Minnelusa Formation, Opeche Shale, Minnekahta Limestone or Spearfish Formation should be considered to be "known" features.

In Professional Paper 763, Gott presented the theory that breccia pipes may extend upward into the Inyan Kara sediments. However, without specific confirming evidence, the presence of breccia pipes higher in the stratigraphic column becomes more speculative. For example, Powertech (USA) geologists conducted field examinations of several suspected breccia pipes or collapse features outside of the PAA and illustrated on Exhibit 2.2-1 as occurring within the Sundance Formation. There were local, small-scale normal faults associated with these features, but no evidence of solution collapses. Without the presence of specific supporting field evidence, all these features shown on Supplement Exhibit 2.2-1 should not be considered to be "known" breccia pipes.

Powertech (USA) geologists also examined all suspected breccia pipes or collapse features shown on Plate 4 of the USGS Professional Paper 763 outside of the PAA that supposedly penetrated the Morrison and Inyan Kara sediments. Due to the high-grade uranium deposits that occur and have been mined within breccia pipes in the Arizona Strip, the uranium industry has extensive experience in surface exploration techniques for these features. Arizona Strip evaluation criteria were applied to these features in the field. These criteria consisted of displaced sediments, brecciation, dip changes of surface beds, fracture patterns and alteration. In addition, due to Gott's theory that breccia pipes were conduits for migration of tremendous amounts of ascending groundwater as recharge to the Inyan Kara aquifer, Powertech (USA) geologic team specifically searched for evidence of solution movement at these sites.

In all cases, no geologic field evidence was found to support the upward stoping of breccia pipes and aquifer recharge from the Minnelusa Formation, through the hundreds of feet of Jurassic-age, clastic sediments and into the Inyan Kara. The geologic field evidence indicates that all features identified as breccia pipes or collapse features within the Inyan Kara Group or Morrison Formation on Supplement Exhibit 2.2-1 were the result of surface erosion and slump block activity. Therefore, all these above-described breccia pipes or collapse features shown on this exhibit should not be considered to be "known". The signature surface expressions for breccia pipes are lacking within the PAA. Nevertheless, well field pump tests in areas peripheral to the initial and future mining areas will be performed and will provide analytical data to confirm this conclusion.

TR RAI-P&R-12(b)
Clarification of breccia pipes

b. Background: Exhibit 3.2.1 of the Technical Report Supplement and Figures 2.7-15 of the Technical Report indicate that uranium recovery in the Lakota formation is proposed within the northern portion of the Dewey license area where the Lakota's potentiometric surface is relatively high and flat compared to the steeper gradient in the southern portion of the license area. NRC staff is uncertain whether this anomaly in the Lakota's potentiometric surface is linked to significant local recharge. For example, considering the absence of complete information for the TVA Lakota aquifer test, Unkpapa potentiometric data, and coverage of the 1974 breccia pipe study area (refer to 12a above) in the northern portion of Dewey license area, staff is uncertain whether this anomaly in the Lakota's potentiometric surface is linked to a pathway of significant local recharge from the Unkpapa (e.g., Lakota breccia pipes) to areas that are adjacent to proposed Lakota well field production zones. Staff notes that significant localized groundwater flow from the Unkpapa to an area that is adjacent to a proposed Lakota well field production zone may potentially have an adverse effect on the hydraulic containment of process fluids.

Needed: Staff requests further clarification of the cause of the relatively high and flat potentiometric surface of the Lakota in the northern portion of the Dewey license area. This information is necessary for staff to understand the potential impacts of the operations on water resources.

Response: TR RAI-P&R-12b (TR Section 2.7.2.2.5 and 2.7.2.2.8)
The potentiometric surface drawn in Figure 2.7-15 does display an area near Dewey where the hydraulic gradient is much shallower than down dip areas and locations near the Burdock side of the project. Overall, the locally flat portion of gradient is based upon approximately three measurement locations, with sparse data up and down gradient from which the contours were drawn. There are relatively small differences between the measured potentiometric elevations at these wells, and the reported errors of measurement are significant to the interpretation of the contours. These errors could be sufficient enough to provide the sole explanation. Therefore, it is not conclusive of a true local difference in the gradient.

However, assuming a local difference in the gradient is accurate, two explanations are possible:

1) This change in gradient is the result of an area of the aquifer that simply has higher hydraulic conductivity and transmissivity values. Based on a Lakota aquifer pump test in 1982 (Boggs, 1983), the transmissivity in that area is approximately 590 ft2/day. Two Lakota aquifer pumping tests conducted in the Burdock area (Boggs and Jenkins, 1980 and Powertech (USA)'s 2008 test) had average transmissivity values of 190 and 150 ft2/day, respectively. Based on the pump test data alone, the transmissivity in the Dewey area is about 3 to 4 times greater than in the Burdock area. The Dewey test results also indicated that results were influenced by the Dewey Fault acting as a barrier boundary and/or a decrease in transmissivity with distance from the test site (Boggs, 1983). Given the heterogeneous nature and fluvial depositional environment of the Inyan Kara aquifer, this change in transmissivity is reasonable.

2) The change in the gradient may also be caused by "mounding" as the result of localized recharge up gradient. Pass Creek flows from a significant basin up stream of the Lakota outcrop. The location where Pass Creek crosses the Lakota outcrop is up gradient of central location where the locally flat gradient is observed at Dewey. It is theorized that a relatively large portion of the total local recharge into the Lakota may be from Pass Creek and thus focused into that location causing a locally elevated potentiometric surface.

In response to the possibility of upwelling from the Unkpapa or breccia pipes connecting the Unkpapa to the Lakota aquifer, this hypothesis is very unlikely. Two aquifer pump tests conducted by Powertech (USA) in May 2008 revealed that the Unkpapa showed no hydraulic response to pumping in the Inyan Kara at either Dewey or Burdock. Additionally, core data from the underlying Morrison aquitard has a much lower permeability (TR 2.7.2.2.4). There is no data to indicate the Morrison is not an effective confining layer.

Water quality data has been collected for the Lakota and Unkpapa aquifers. If significant upwelling of water from the Unkpapa to the Lakota was occurring in the Dewey area, it would be expected that water quality at Dewey would be noticeably different from water quality in the Burdock area. When comparing water quality results, it is also important to note differences in water chemistry that are primarily attributable to the well location and its proximity to an ore body, with a well either being up gradient, within, or down gradient of a uranium ore body. Based on comparison of median water quality within the Lakota and Unkpapa, the Unkpapa has a higher median total dissolved solids (TDS) and lower sulfate concentrations. Comparing wells in the ore zone at both Dewey and Burdock, there is little statistical difference between wells. However, because of the variability in water quality within the Inyan Kara across the region, there does not appear to be data that supports or negates the possibility for Unkpapa upwelling.

TR RAI-P&R-13

Proposed operations I infrastructure outside of the license boundary.

Background: The Technical Report Supplement indicated that some of the proposed operations I infrastructure may be outside of the proposed license boundary. NRC staff notes that Exhibit 3.1-3 shows a portion of the plant to plant pipeline to be outside of the license boundary. NRC staff also notes that operations I infrastructure for the associated well fields (e.g., upgradient portion of the horizontal excursion monitoring well ring) may also be outside of the license boundary.

NRC staff found that the application did not sufficiently address the control and containment of process fluids for operations I infrastructure that is outside of the proposed license boundary. This information is necessary for staff to understand the potential impacts of the operations on water resources and to assess the manner in which the Dewey-Burdock operations will be protective of human health and the environment.

Needed: NRC staff requests confirmation of the above-referenced well field locations relative to the license boundary. Please further clarify the control and containment of process fluids for proposed operations I infrastructure outside of the license boundary. Please further clarify the composition of the material that will flow through the plant to plant pipeline.

NRC: The monitoring well ring appears to be outside the license area.

Clarification: Referring to Exhibit 3.1-4 and using the township range blocks for scale, the mine unit outline of Dewey II and Burdock IV well fields appear to be located such that one or more of the proposed horizontal excursion monitoring wells will be outside of the license boundary. Additionally, cross referencing the proposed Burdock IV ore body for uranium recovery in Exhibit 3.1-4 to Exhibit 3..2-1, NRC is uncertain of the exact location of the Burdock IV well field relative to the license boundary (Exhibit 3.-2-1 suggests both monitoring and production wells will be outside of the license boundary).

Response: TR RAI-P&R-13

1. Confirmation of location of well fields and infrastructure is described and referenced below.

Confirmation of the first two well field and infrastructure locations are provided in the Updated SR Exhibits- 3.1-2 and 3.1-3; the locations for the deep well facilities have also been included by reference; see TR_RAI Table P&R-13 below. All infrastructure associated with the proposed project will be located within the project boundary.

TR_RAI Table P&R-13: Obsolete and Replacement Exhibits and Figure for the TR and SR.

Obsolete Figure or Exhibit and version date	Purpose of Figure	Title of Updated Replacement Figure or Exhibit
SR Exhibit 3.1-4 (28-Jun-09)	Proposed Well Field Locations	TR Exhibit 2.7-1
SR Exhibit 3.1-2 (05-Aug-09) SR Exhibit 3.1-3 (06-Aug-09) SR Exhibit 3.2-1 (01-Jul-09)	Proposed Initial Well Fields Plant-to-Plant Pipeline Deep Disposal Well Option Land Application Option	SR Exhibit 3.1-2 (12-17-10) SR Exhibit 3.1-3 (12-17-10)
TR Figure 3.1-8	Facility Location-Deep Disposal Well Option	SR Exhibit 3.1-3 and Appendix WR-7 of the ER RAI Response Class V Application; Figure B-2b

2. Clarification of the materials that will flow through the plant-to-plant pipeline is described below.

The PA proposes to install up to eight underground conduits between the Central Processing Plant and the Satellite Facility. These conduits include pipelines that may transport any of the various fluids present during ISL operations as well as conduits for electronic communication and control purposes; the fluids that may be transported include but are not limited to barren and pregnant production fluids, restoration fluids, RO reject brines, waste water resulting from well drilling and maintenance operations, and Madison or other aquifer water.

3. Clarification of monitoring well ring location is described below.

All well fields and their associated perimeter monitor well rings will be located within the proposed license boundary. The proposed locations of well fields are depicted in revised TR Exhibit 2.7-1, Proposed Well Fields.

TR RAI-P&R-14

Provide revised and additional information on plans for the disposal of liquid wastes.

Background: The NRC needs to determine that liquid effluents generated from the process bleed, process solutions (e.g., backwash, resin transfer waters), wash-down water, well development water, pumping test water, and restoration waters are properly controlled.

TR RAI-P&R-14(a)

*a. **The supplemental information provided on the liquid waste disposal options needs to be integrated into the application in a clearer manner. Rather than just indicating that here is some supplemental information, the sections of the original application that no longer apply should be identified, and other sections that need modification based on the new information should be updated (e.g., 6.1.9). As is, the documentation on liquid waste disposal is confusing and inconsistent.***

Needed: The applicant needs to bring greater clarity and organization to the new information on liquid disposal options.

Response: TR RAI-P&R-14(a) (TR Section 6.1)

Clarification and organization to new information on the topic of liquid disposal is described below in TR-RAI Table P&R-14.1.

TR-RAI Table P&R-14.1: Modifications and Clarification to Prior Submissions

Document	Section No.	Topic/original statement	Revised
TR	3.1.5.2	Disposal of CPP brines by trucking to disposal well at Burns Wyoming	The offsite disposal of CPP brines is no longer being considered
	6.1.3	No section on Groundwater sweep was provided.	A new TR Section 6.1.3.2 on groundwater sweep is provided with a revised TR Section 6.1.3 in the response to TR-RAI-6.1-4.
		Use of Reverse Osmosis technology	RO will be utilized only with the deep well option.
	6.1.3.1	Class I Disposal wells	Class I injection well is no longer an option. Application has been made to US EPA for Class V deep disposal wells.
	6.1.6	Target disposal zone stated to be the Minnelusa formation	Both the Minnelusa Formation and the Deadwood Formations are target disposal zones
	6.1.9	Waste Water disposal methods	A revised TR section 6.1.9 is provided.
SR; 2009	4.2	Number of deep disposal wells stated to be two	A maximum of eight disposal wells will be utilized.
	4.2	Target disposal zone stated to be "the Minnelusa formation, or deeper."	Both the Minnelusa Formation and the Deadwood Formation are target disposal zones.
	Exhibit 3.1-3	Location of Disposal wells	Locations of the first four Class V wells are shown in updated SR Exhibit 3.1-3

TR RAI-P&R-14(b)
Provide revised and additional information on plans for the disposal of liquid wastes.

Background: The NRC needs to determine that liquid effluents generated from the process bleed, process solutions (e.g., backwash, resin transfer waters), wash-down water, well development water, pumping test water, and restoration waters are properly controlled.

b. ***It appears that the applicant is proposing several options for liquid waste disposal: direct disposal in deep wells; disposal in deep wells after extracting radium in settling ponds; or land application after extracting radium in settling ponds. This is not clearly stated in the application.***

Needed: The applicant (upfront in Section 4.2) needs to clearly state the options being considered and their preference of use.

Response: TR RAI-P&R-14(b) (TR Section 4.2 and TR Section 6.1.9)
The PA is proposing two options for the disposal of wastewater from well field operations: Injection into Class V deep disposal wells and land application. The deep disposal well option ... is Powertech (USA)'s preferred option, and will be selected following approval by the US Environmental Protection Agency (EPA). The alternate disposal method of land application of waste water... will be selected if either the class V injection well permit(s) cannot be obtained, or the injection wells lack sufficient disposal capacity; in the latter case, both deep well disposal and land application will be utilized for disposal of waste water.

TR Section 6.1.9. As noted earlier, the method selected for wastewater disposal will determine the method of groundwater restoration. The preferred disposal option is to dispose of wastewater by injection into Class V disposal wells completed within the Minnelusa or Deadwood Formation(s) (SR Section 4.2). If disposal wells are either unavailable or have insufficient capacity, then the land application method of wastewater disposal will be utilized either alone or in parallel with the deep disposal well option. Wastewater to be disposed of includes RO reject water, barren restoration water, production bleed streams, waste resin transfer water, CPP wastewater including spent elution brines and wash-down water, well field development wastewater including pump test water and well development and maintenance wastewater.

The wastewater disposal options and the associated treatment are depicted in TR Figure 6.1-3 where the stream identifiers I and N are consistent with the identifiers on the water balance diagram provided in TR Figure 3.1-7. A separate surge pond (not shown) will be available at each site with a deep disposal well option for the temporary storage of wastewater that is barren of uranium and other metals, but contains radium that will be removed in the radium removal ponds. For the land application disposal option, the storage ponds will provide surge capacity. As indicated in the project water balance in TR Figure 6.1-5 the flow rate of wastewater will depend on the choice of wastewater disposal option, as well as on the actual aquifer bleed rates during both recovery and restoration operations. The final design may entail both deep well disposal and land application systems if the completed Class V disposal wells have insufficient disposal capacity.

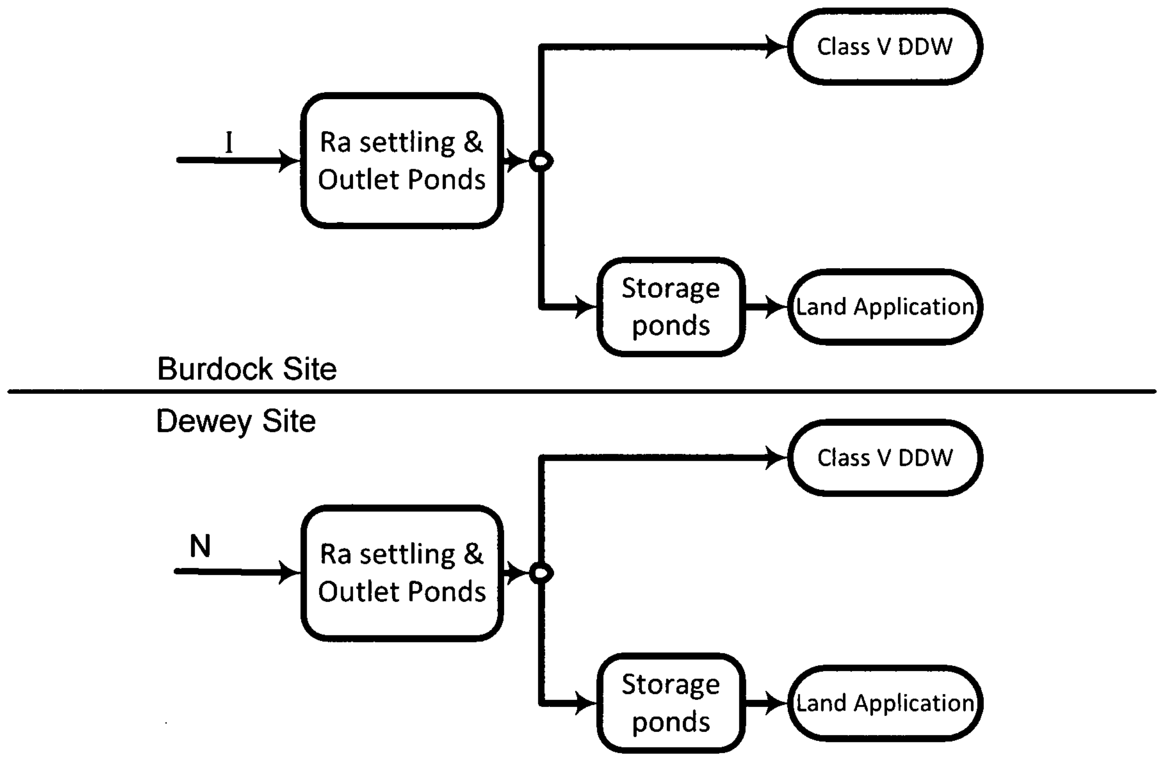


Figure 6.1-3: Project Wastewater Disposal Options and Associated Treatment

Regardless of the option chosen for wastewater disposal, groundwater removed during aquifer restoration operations will first be treated to remove uranium and other dissolved species by ion exchange, the purified effluent of which forms the barren restoration composite (BRC). With the deep disposal well option, the BRC exiting the ion exchange step is treated by RO; the resulting RO reject brine, after subsequent removal of radium, will be suitable for injection via the disposal wells; with the land application option, the entire BRC stream will be treated to remove radium and disposed of by applying it to the surface of the ground for evaporation and possible agricultural irrigation.

TR RAI-P&R-14 (c)

Provide revised and additional information on plans for the disposal of liquid wastes.

Background: The NRC needs to determine that liquid effluents generated from the process bleed, process solutions (e.g., backwash, resin transfer waters), wash-down water, well development water, pumping test water, and restoration waters are properly controlled.

c. ***No water balance diagrams have been provided in support of the discussion on handling liquid wastes.***

Needed: The applicant needs to provide water balance diagrams for the Dewey and Burdock facilities during normal operation and during restoration.

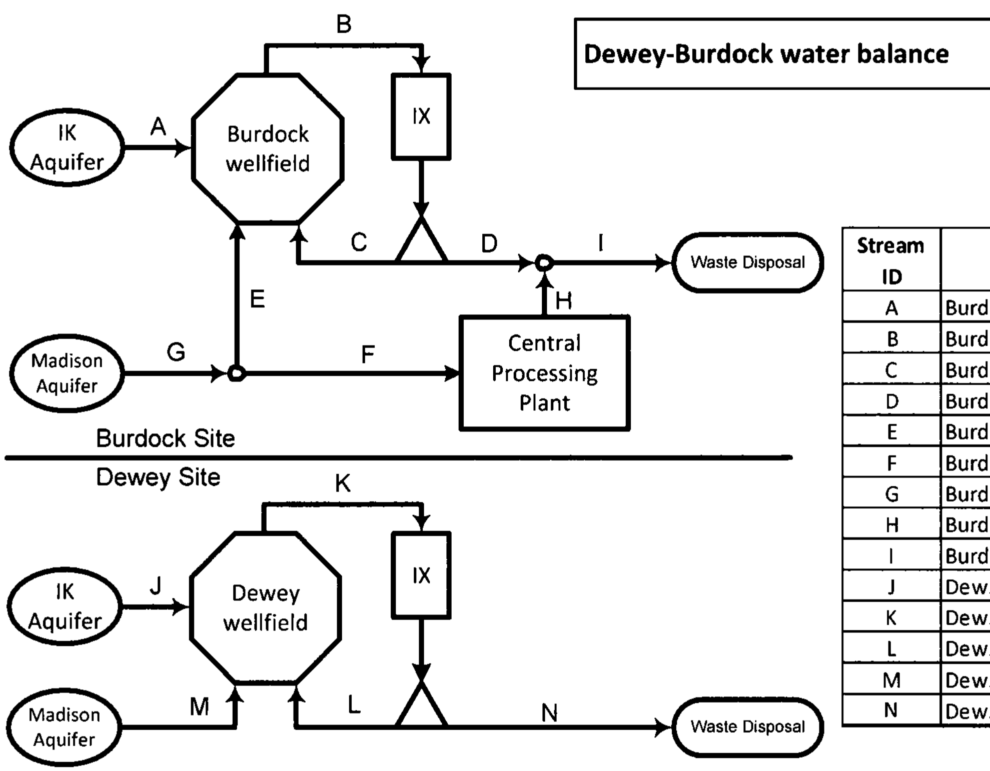
Response: TR RAI-P&R-14(c) (TR Section 3.1.5)

Powertech (USA) proposes two methods of wastewater disposal, Class V disposal wells and land application, that are described in detail in TR Section 6.1.9. The disposal method selected will determine the method of aquifer restoration, groundwater treatment or groundwater sweep, as described in detail in TR Section 6.1.3. In addition to these options, the PA proposes two aquifer bleed options during aquifer restoration, a 1.0 percent aquifer bleed or a one pore volume bleed, as described in detail in TR Section 6.1.3. The water balanced for both the production and the restoration phases, at both the Burdock site and the Dewey site, for these options is presented in Figure 3.1-7. Typical flow rates are provided for both the deep well disposal option, in which the groundwater treatment restoration method is utilized, and the land application disposal option, in which the groundwater sweep restoration method is utilized.

For recovery operations, the water balance flow rates are identical for both disposal options, producing, for a recovery bleed of 0.875 percent of the groundwater extraction rate, approximately 32 gpm of wastewater at the Burdock site and 15 gpm of wastewater at the Dewey site.

With a restoration aquifer bleed rate equal to 1% of the groundwater withdrawal rate, the deep disposal well option produces approximately 80 gpm of wastewater at the Burdock site and 82 gpm at the Dewey site, while the land application disposal option produces approximately 267 gpm and 274 gpm of wastewater at the Burdock and Dewey sites, respectively. Note that these flow rates are mean values estimated over only those periods in which aquifer restoration is to be conducted; periods when no aquifer restoration operations will be conducted are not included in the computation of the average flow rates.

With the alternate restoration aquifer bleed option, consisting of the removal of 1.0 pore volume of Inyan Kara aquifer water during restoration, the deep well disposal option will produce approximately 50 gpm of wastewater at the Burdock site and 45 gpm of wastewater at the Dewey site. With the land application disposal option, these wastewater flow rates will be approximately 167 gpm at the Burdock site and 149 gpm at the Dewey site.



Stream ID	Description
A	Burd. Aquifer bleed
B	Burd. Extraction composite
C	Burd. Reinjection
D	Burd. Wellfield bleed
E	Burd. Madison Injection
F	Burd. Fresh brine make-up
G	Burd. Madison aquifer
H	Burd. CPP brine
I	Burd. Wastewater
J	Dew. IK Aquifer bleed
K	Dew. Exraction composite
L	Dew. Reinjection
M	Dew. Madison Injection
N	Dew. Wastewater

Water balance flow rates (gal/min)																
Operation phase	Aquifer bleed	Disposal Option	Stream ID													
			A	B	C	D	E	F	G	H	I	J	K	L	M	N
Recovery	0.8750%	DDW	20	2280	2260	20	0	12	12	12	32	15	1720	1705	0	15
		LA	20	2280	2260	20	0	12	12	12	32	15	1720	1705	0	15
Restoration	1.0%	DDW	2.7	267	187	80	77	0	77	0	80	2.7	274	192	79	82
		LA	2.7	267	0	267	264	0	264	0	267	2.7	274	0	271	274
	1.0 PV	DDW	28	167	117	50	22	0	22	0	50	25	149	104	20	45
		LA	28	167	0	167	139	0	139	0	167	25	149	0	124	149

Figure 3.1-7: Water Balances for the Dewey-Burdock Project

TR RAI-P&R-14 (d)

Provide revised and additional information on plans for the disposal of liquid wastes.

Background: The NRC needs to determine that liquid effluents generated from the process bleed, process solutions (e.g., backwash, resin transfer waters), wash-down water, well development water, pumping test water, and restoration waters are properly controlled.

d. The applicant has indicated that the waste streams from operations and restoration would fall under the classification of non-hazardous, 11(e).2 waste suitable for deep injection well disposal under EPA Class V regulations. However, there is no specific table of projected quality of operational or restoration wastewater that would be disposed of in the deep wells.

Needed: The applicant needs to provide waste quality data tables and demonstrate the liquid waste will meet EPA Class V regulations as stated.

Response: TR RAI-P&R-14(d) (TR Section 4.2.2.2)

The anticipated water chemistry of the well field bleed and the restoration reject streams is represented by the column labeled "Restoration Wastes" in TR_RAI Table P&R-14d-1. This table represents a typical waste stream for an ISL facility. Minor concentrations of corrosion inhibitors, scale inhibitors, and/or biocides may be used as needed to maintain the disposal wells in optimum condition. The anticipated water chemistry of the CPP wastewater is represented by the column labeled "Elution Bleed" in this same table.

TR_RAI Table P&R-14d-1: Estimated water quality of waste streams from an ISL facility. (excerpt from NUREG-1910)

Table 2.7-3. Estimated Flow Rates and Constituents in Liquid Waste Streams for the Highland In-Situ Leach Facility*

	Water Softener Brine	Resin Rinse	Elution Bleed	Yellowcake Wash Water	Restoration Wastes
Flow Rate, gal/min	1	<3	3	7	450
As, ppm					0.1–0.3
Ca, ppm	3,000–5,000				
Cl, ppm	15,000–20,000	10,000–15,000	12,000–15,000	4,000–6,000	
CO_3, ppm		500–800			300–600
HCO_3, ppm		600–900			400–700
Mg, ppm	1,000–2,000				
Na, ppm	10,000–15,000	6,000–11,000	6,000–8,000	3,000–4,000	380–720
NH_4, ppm			640–180		
Se, ppm					0.05–0.15
Ra-226, pCi/L	<5	100–200	100–300	20–50	50–100
SO_4, ppm					100–200
Th-230, pCi/L	<5	50–100	10–30	10–20	50–150
U, ppm	<1	1–3	5–10	3–5	<1
Gross Alpha, pCi/L					2,000–3,000
Gross Beta, pCi/L					2,500–3,500

*NRC. NUREG–0489, "Final Environmental Statement Related to Operation of Highland Uranium

Since the two disposal options will involve removal of radionuclides (uranium and radium) prior to disposal, the above table references water quality prior to disposal. Water disposal streams will be treated to concentrations below those listed in 10 CFR Part 20 Appendix B Table 2, Column 2. EPA Class V regulations will be met as radioactive waste disposal will not occur in any of the Class V disposal wells.

TR RAI-P&R-14 (e)
Provide revised and additional information on plans for the disposal of liquid wastes.

Background: The NRC needs to determine that liquid effluents generated from the process bleed, process solutions (e.g., backwash, resin transfer waters), wash-down water, well development water, pumping test water, and restoration waters are properly controlled.

e. **Additional information regarding the applicant's plans for deep well disposal is needed by the NRC staff to complete its review of the liquid waste disposal options.**

Needed: The applicant needs to provide: (1) the results of the analyses to determine the targeted disposal zone; (2) the basis for reaching the conclusion of needing only one well at each site, including information on how the applicant will ensure backup storage capacity for liquid waste in the event that the deep wells need to be shut down for a short time (particularly for the option of deep well only); (3) the status of the application for the EPA Class V Permit; and (4) a discussion as to how it meets the requirements of 20.2002.

Response: TR RAI-P&R-14(e)
1) Applicant directs reviewer's attention to the Appendix WR-7 "Class V Application", Section 2.H Operating Data; pg. 2-28. This document was submitted with the ER_RAI Response package to the Uranium Recovery Licensing Branch on August 11, 2010.

2) During development of the Class V application, it was determined that between four and eight disposal wells will be necessary to handle the volume of waste. Redundancy is provided within a multiple well system that is interconnected by the plant to plant pipeline. Because of this redundancy, shut down of a single Class V well is not expected to impact operations.

3) The Class V Application was submitted to EPA on March 30, 2010. Jurisdiction for a Class V permit rests with EPA and the application was deemed complete on April 28, 2010. This subject was also addressed in ER_RAI Response to WR-7 and ER_RAI Response to PA-5.1 "ER Table 1.6.1: Permits and Licenses for the Proposed Project". See also ER_RAI Response to PA-5.2.

4) Powertech (USA) is not disposing of radioactive wastes via a Class V well.

TR RAI-P&R-14 (f)

Provide revised and additional information on plans for the disposal of liquid wastes.

Background: The NRC needs to determine that liquid effluents generated from the process bleed, process solutions (e.g., backwash, resin transfer waters), wash-down water, well development water, pumping test water, and restoration waters are properly controlled.

f. The calculation of storage volumes for the radium settling ponds for the deep well disposal option only assumes a 10-year project life for sludge accumulation.

Needed: The applicant needs to provide the pond contingencies for project life extending beyond 10 years.

Response: TR RAI-P&R-14(f)

TR Section 4 for revisions and additional information.

Revisions to previous submissions

Values of pond retention times and sludge accumulation rates presented in this section supersede the values presented in the Technical Report Section 4 and Appendix B of the Supplemental Report, as listed in TR_RAI Table P&R-14f-1

TR_RAI Table P&R-14f-1: Revisions to pond sludge accumulation rates and pond retention times.

Parameter	Disposal Option	Original document and value		Revised Value
		Section/page	Value	
Pond Sludge Accumulation Rate	Unspecified	TR/4.4.1.1	100 yd^3/y (sludge + misc.)	
	Deep Well	SR/B-4-2	321 ft^3/y	795 ft^3/y
	Land App.	SR/B-3-4	790 ft^3/y	1780 ft^3/y
Pond Retention (days) in single pond	Deep Well	SR/B-4-2	14 d @ 252 gpm	12.8 d @ 282 gpm
	Land App.	SR/B-3-4	14 d @ 620 gpm	14.1 d @ 632 gpm
Pond Life / Project Life	Deep Well	SR/B-4-3	"10-year Project life"	Pond life is greater than 10 years as described below.
	Land App.	SR/B-3-4	"10-year Project life"	

Pond life

The statements in the SR regarding a 10-year life, as referenced in TR_RAI Table P&R-14-1, described the pond storage capacity that will be occupied by the sludge that will accumulate over a "10-year project life." These statements were not intended to describe the pond life as being limited to 10 years. The volume of accumulated sludge after 10 years, or even after 15 years, is small compared to the total pond volume. For example, after 15 years of pond operation at the maximum production bleed of 3%, the liquid retention times in the ponds would be reduced by approximately 0.3 days, a reduction of only 2%. If for any reason it becomes advisable to remove the sludge from a radium settling pond, a spare settling pond will be available at each site. The radium settling operation would be shifted to the spare (secondary) pond while the primary pond is emptied by pumping of its liquid phase to the secondary pond and subsequent removal of the sludge layer for disposal at a licensed 11e.(2) byproduct disposal facility.

Revised Pond Retention times

The radium settling ponds have been sized conservatively in that each radium settling pond has been designed to process the entire project-wide wastewater stream with a minimum retention time of approximately 13 days, utilizing the maximum value of well field bleed from recovery operations of 3%. In actual practice, the PA expects the bleed from recovery operations to be approximately 1%, with higher bleed rates, up to 3%, utilized for relatively short time periods, as required to control the sub-surface movement of lixiviant. CPP waste water will be blended with well field wastewater. As noted in Appendix B of the Supplemental Report, a literature survey of radium settling ponds indicated that typical retention times range from 8 to 14 days; the present design, with a minimum retention time of 12.8 days under maximum flow rate conditions, is therefore considered adequate.

Revised Sludge volume accumulation rates

The revised estimates of the sludge volumes produced by the radium-settling process, shown in TR_RAI Table P&R-14f-1, were computed assuming the maximum production bleed of 3%, with an assumed 365 days of operation per year. The volume of sludge was computed based on a continuous addition of barium chloride at a rate of 20 mg/L and assuming the pond sludge is comprised of the resultant barium sulfate, with a solids content of 40 percent by weight and a specific gravity of 1.4. These values are considered to be conservative, in that they may overestimate the volume of sludge that accumulates in the ponds.

TR RAI-P&R-14 (g)
Provide revised and additional information on plans for the disposal of liquid wastes.

Background: The NRC needs to determine that liquid effluents generated from the process bleed, process solutions (e.g., backwash, resin transfer waters), wash-down water, well development water, pumping test water, and restoration waters are properly controlled.

g. ***The application does not clearly indicate the purpose of the central processing plant brine ponds, and why the sizes are different under the two disposal options.***

Needed: The applicant needs to provide information to clarify this.

Response: TR RAI-P&R-14(g)

Clarification of name of "Central plant pond."
The name of the pond in which wastewater from the central plant will be temporarily stored is the "central plant pond."
Revisions to previous documents (SR Appendix B)
The capacity of the central plant pond for the land application option, in days of CPP wastewater production is revised to be 660 days, which supersedes the value of 2 years, as stated on page 3-5 of the SR Appendix B. The flow rate of CPP waste water is revised to be approximately 12 gpm, regardless of the selection of waste disposal option, which supersedes the value of 10.81 gpm stated for the land application option on page 3-5 of SR Appendix B.
Purpose of the central plant pond (TR Section 4.2)
The CPP wastewater stream will consist of spent elution brines, and to a lesser extent may contain laboratory chemical sink waste, yellowcake filtercake wash water, process washdown water, laundry water, plant sump water, and other minor sources of waste water but excluding domestic sewage. In both the deep disposal well option and the land application option, a CPP pond is provided for the purpose of temporary storage of the CPP waste water. Temporary storage of CPP waste water may be desirable for the following reasons:

- If CPP wastes contain significant levels of dissolved uranium or other constituents it is stored until returned to the CPP for re-processing;
- When blending the CPP wastewater would produce unacceptably high levels of dissolved solids in the blended stream. For example, with the land application disposal option, this situation may occur during the 18-month startup period prior to the initiation of restoration activities.

Once aquifer restoration activities begin, restoration wastes will usually comprise the largest component of the well field waste water, and will contain dissolved solids at levels that typically decrease as restoration progresses through a particular well field; during recovery operations, the concentration of dissolved solids will typically increase as recovery progresses. The flow rate of the CPP wastewater from the CPP pond to the radium removal pond can be adjusted according to the concentration of dissolved solids in the CPP wastewater stream.

Reason for CPP pond capacity difference between the deep well disposal option and the land application disposal option. (TR Section 4.2.2.1)

The CPP waste pond for the deep disposal option is smaller (15.9 ac-ft), as compared to the pond size for the land application option (36.2 ac-ft), because the loading of dissolved solids in wastewater is less of a concern with the deep well disposal option. In the deep well disposal option, the combined waste stream will be injected into a deep formation that already has elevated levels of dissolved solids; consequently, the concentrations of dissolved salts in the CPP wastewater can be blended with the available well field bleed stream and directed to the disposal wells. For the land application option, it is desirable to decrease concentrations of dissolved solids in the water that is to be applied to the land surface; therefore, the CPP waste water can be stored until both recovery bleed and restoration wastewater are available to dilute the dissolved solids in the CPP wastewater prior to land application. The capacity of the central plant pond for the deep well disposal option, excluding the allowance for water from a 100-year precipitation event, is 288 days of waste production at 12 gpm. For the land application option, the larger central plant pond will allow storage of up to 661 days (approximately 22 months) of waste production at 12 gpm.

TR RAI-P&R-14 (h)

Provide revised and additional information on plans for the disposal of liquid wastes.

Background: The NRC needs to determine that liquid effluents generated from the process bleed, process solutions (e.g., backwash, resin transfer waters), wash-down water, well development water, pumping test water, and restoration waters are properly controlled.

h. Regarding the design and construction of the ponds, a quality control program should be established for the following factors: (i) clearing, grubbing, and stripping; (ii) excavation and backfill; (iii) rolling; (iv) compaction and moisture control; (v) finishing; (vi) sub-grade sterilization; and (vii) liner sub-drainage and gas venting.

Needed: The applicant needs to provide impoundment construction specs for all these aspects and a description of the testing and inspection program during construction, including frequency of earthwork testing.

Response: TR RAI-P&R-14(h) (TR Appendix 5.1-B)

See Appendix 3-A Pond and Land Application Technical Specifications and QA/QC Plan Part 1 through Part 3 for the Dewey-Burdock Project. A copy of the plan was provided in RAI Response submitted in December of 2010. Subgrade sterilization and liner sub-drainage and gas venting do not apply to the design provided in the plan document.

TR RAI-P&R-14 (i)

Provide revised and additional information on plans for the disposal of liquid wastes.

Background: The NRC needs to determine that liquid effluents generated from the process bleed, process solutions (e.g., backwash, resin transfer waters), wash-down water, well development water, pumping test water, and restoration waters are properly controlled.

i. ***Information on inspection of the impoundment systems is insufficient.***

The applicant needs to provide a commitment for and details of the periodic inspection of all impoundment systems in accordance with Regulatory Guide 3.11, including commitments to the following:

- ***Inspections should be made of the liner, liner slopes, and other earthwork features. Any damage or defects that could result in leakage should be immediately reported to the NRC staff. Appropriate repairs should be implemented as soon as possible.***
- ***The monitoring and inspection program should include documented daily checks of impoundment freeboard and the leak detection system.***
- ***When significant water levels are detected by the leak detection system, the water in the standpipes must be sampled for indicator parameters to confirm that the water in the detection system is from the impoundment.***

Needed: The applicant should specify and provide the basis for selecting the indicator parameter(s) used to verify leaks.

Response to TR RAI-P&R-14(i) (TR Section 3.1.6.1.1)

A daily inspection program will be implemented for all impoundments constructed. These inspections will be by trained personnel and include but not limited to the following:

- Inspections of the liner, liner slopes, and other earthwork features.
- Inspections of impoundment freeboard
- Inspection of leak detection system.

When significant water levels are detected by the leak detection system, the water in the standpipes will be sampled immediately for indicator parameters to confirm that the water in the detection system is from the impoundment. If the analysis confirms a leak, a secondary sample shall be collected and analyzed within 24 hours. Upon confirmation of a leak by the second analysis, the impoundment will be taken out of service until repairs can be completed. The leak reported within 24 hours of the confirmation to NRC. Any damage or defects that could result in leakage will be reported to the NRC within 24 hours of such occurance. The Health, Safety, and Environment department shall keep all records of the impoundment inspections. Indicator species are expected to be chloride and conductivity based on expected large differences in the concentrations of these constituents between the impoundment contents and site groundwater.

TR RAI-P&R-14 (j)
Provide revised and additional information on plans for the disposal of liquid wastes.

Background: The NRC needs to determine that liquid effluents generated from the process bleed, process solutions (e.g., backwash, resin transfer waters), wash-down water, well development water, pumping test water, and restoration waters are properly controlled.

j. Additional information is needed regarding contingency plans for dealing with leaks and spills. The NRC staff needs to ensure that facility descriptions include a discussion of design features to contain contamination from spills resulting from normal operations and the likely consequences of any accidents.

The NRC staff needs to ensure that facility descriptions include a discussion of design features to contain contamination from spills resulting from normal operations and the likely consequences of any accidents.

Needed: The applicant needs to address the likelihood of, and measures for, preventing or containing a multiple tank failure such as might occur if one failed tank fell into an adjacent tank. Also provide information on the ability of the sump system to handle the volume of the largest spill from a hazardous materials source.

Response to TR RAI-P&R-14(j) (TR Section 5.7.1.3)
Also refer to Response to ER_RAI PO-3 for more information concerning an accident analysis of a catastrophic tank failure involving the yellowcake thickener, included in NUREG/CR-6733 (Mackin, et al, 2001).

Surface Releases

Potential surface releases may be the result of a tank failure, ruptured pipe, or transportation incident. Failure of a process vessel will be contained within the CPP via berms and directed into a sump (equipped with a level alarm) that will allow the solution to be transported to appropriate tank or disposal system.

Likelihood of multiple tank failures
No reference information could be located that cited numerical probabilities or likelihoods of vessel failures at ISL facilities, whether such failures involve single or multiple tanks. A 1994 thickener accident at the Irigaray ISL facility resulted in about 20 percent of the thickener contents being spilled inside and outside of the processing building (NUREG/CR-6733).

Measures for preventing tank failures

TR Section 4.2.3.2 and the provisions of 40 CFR Part 68, and others, will be followed to prevent tank failures. The primary methods for prevention of tank failure include the following:

- routine inspection
- installation of device to avoid over pressurization or excessive level
- proper engineering design of tanks and supporting structures, foundations, and footings.

Methods of containing tank failures

Both the central processing plant and the satellite facility are equipped with trench drains and sumps, with pumps, to collect spills of process fluids from leaks or tank failures. The facility floors will be sloped toward these trench drains and sumps. Spilled or leaked fluids will be transferred to the waste tanks, from which it can be directed to wastewater treatment and disposal. If a spill occurs in the recovery area, the spilled fluid could also be returned to the process circuit for re-working, or stored temporarily in the central plant pond.

Capacity of the curbed areas.

In addition to the sump system, both the CPP and the satellite facility buildings will be designed with a concrete containment curb around the perimeter of the building. The height of the concrete containment curb will be such that the curbed area will contain a minimum of 1.5 times the volume of the largest tank located in the facility. Any of the spills located within the curbed foundation areas will be considered contained spills. For the CPP, the largest tank is the thickener vessel, of which there are two. It is estimated that, considering the volume of trench drains, sumps and the curbed area of only the elution/precip/dewatering process areas, but excluding the IX, dryer and packaging portions of the central processing plant, a containment curb of less than 3-inches will be sufficient to contain the entire contents of a thickener vessel. The two thickeners are spaced far enough apart to prevent a failed thickener to fall into, and cause the failure of, the other thickener vessel. For other vessels, even in the unlikely event of the failure of multiple tanks, the containment curb will be large enough to contain the contents of multiple vessels.

TR RAI-P&R-14 (k)
Provide revised and additional information on plans for the disposal of liquid wastes.

Background: The NRC needs to determine that liquid effluents generated from the process bleed, process solutions (e.g., backwash, resin transfer waters), wash-down water, well development water, pumping test water, and restoration waters are properly controlled.

k. ***The applicant needs to describe the controls for shut down of the deep well injection system.***

Needed: Provide information as requested.

Response to TR RAI-P&R-14(k)
The reviewer is directed to Section 2.K. "Injection Procedures" of Appendix WR-7 "UIC application, Class V Non-Hazardous Injection Wells (March 2010)" located in the ER_RAI Response package submitted to the NRC in August of 2010.

TR RAI-P&R-15
The applicant has not identified where it will dispose of 11 e. (2) wastes.

Background: Prior to the start of operations, the NRC will need to verify that the applicant has an approved waste disposal agreement for 11 e.(2) byproduct material disposal at an NRC or NRC Agreement State licensed disposal facility (Sections 4.2 and 6.2 of the Technical Report).

Needed: The applicant needs to provide this information now, or the license will have a condition requiring verification of the solid waste disposal agreement prior to the start of operations.

Response: TR RAI-P&R-15
The applicant is not providing an approved waste disposal agreement for 11e. (2) byproduct material disposal with this response. The applicant acknowledges that without an approved 11e. (2) byproduct disposal agreement, the NRC will include a license condition requiring verification of an approved 11e. (2) byproduct disposal agreement at an NRC or NRC Agreement State licensed disposal facility.

TR RAI-P&R-16

Additional discussion of the land clean up program needs to be provided.

Background: The applicant needs to provide land cleanup information including: (1) which areas would be focused on during the surveys (such as well field surfaces, areas around structures in process and storage areas, on-site transportation routes, historical spill areas, retention ponds, and areas near the deep disposal wells); (2) plans for decommissioning nonradiological hazardous constituents as required by 10 CFR Part 40, Appendix A, Criterion 6 (7); and (3) the actual QAPP for radiological monitoring (including decommissioning), rather than just a commitment to include the aspects discussed in Regulatory Guide 8.15.

Response: TR RAI-P&R-16 (TR Section 5.7.9, TR Section 6.2 and TR Section 6.4)

(1) The post-operation (pre-reclamation) radiological survey will consist of an integrated area gamma survey and sampling of soils for confirmation of whether cleanup action is required and to what extent. The areas that will receive particular attention are those that are expected to have higher levels of contamination than surrounding areas, and include diversion ditches, surface impoundment areas, well fields (particularly those areas where spills or leaks may have occurred), process structures, storage areas, on-site transportation routes for contaminated material and equipment. In the case where land application is used for disposal of waste water, the irrigated areas and associated retention structures would also receive particular attention. If the deep disposal well method is used for waste water disposal, the areas around the disposal wells also would receive close attention (TR Section 6.4 "Methodologies for Conducting Post-Reclamation and Decommissioning Radiological Surveys").

(2) Pursuant to 10 CFR Part 40, Appendix A, Criterion 6(7), non-radiological hazardous constituents that pose a potential threat to human health or the environment and that are contained in, or mixed with, 11e.(2) waste materials will be disposed of offsite with the associated 11e.(2) wastes in an approved 11e.(2) disposal facility or in a deep disposal well. If the non-radiological constituents are not associated with 11e.(2) wastes, they will be disposed of at an appropriate and approved off-site waste disposal facility or, if determined not to be waste, released for offsite use (TR Section 6.2 "Plans and Schedules for Reclaiming Disturbed Lands").

(3) The request for the Quality Assurance Program Plan ("actual QAPP") for radiological monitoring (including decommissioning), as written, appears to be in error as the reference, Regulatory Guide 8.15, titled, "Acceptable Programs for Respiratory Protection," is not relevant to the subject being addressed. However, the applicant suspects the intended reference is Regulatory Guide 4.15 (RG 4.15). For the purpose of this response, it is assumed that RG 4.15, titled, "Quality Assurance for Radiological Monitoring Programs (Normal Operations) – Effluent Streams and the Environment," is the intended reference see also TR Section 5.7.9 "Quality Assurance Program". Also see TR sections 4.2 "Liquid Waste" and 6.2 "Plans and Schedules for Reclaiming Disturbed Lands"

Dewey-Burdock Project
Quality Assurance Program Plan – Draft Outline

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Figure TR_RAI_P&R-16

TR RAI-P&R-17

Section 6.3: The applicant needs to provide additional commitments in the section on removal and disposal of structures, waste materials, and equipment.
(1) to make plans for radioactivity measurements on the interior surfaces of pipes, drain lines, and ductwork by including plans to measure at all traps and other access points where contamination is likely to be representative of system-wide contamination.
(2) to assume that all premises, equipment, or scrap likely to be contaminated but that cannot be measured, would be assumed by the applicant to be contaminated in excess of limits and will treated accordingly.

Response: TR RAI-P&R-17 (TR Section 6.3.3.1)

Building Materials, Equipment and Piping to be Released for Unrestricted Use

Powertech (USA) will develop an approved standard operating procedure for release of items to unrestricted use and thoroughly document all items eligible for release to unrestricted use. To the extent possible, releasable items having a salvageable value will be sold on the industrial market. Releasable items having no net salvageable value will be sent to a municipal landfill.

Powertech (USA) commits to prepare plans for performing radioactivity measurements on the interior surfaces of pipes, drain lines, and ductwork, and include them in its decommissioning and decontamination plan (D&D Plan). Such plans will include measurements at all traps and other access points where contamination is likely to be representative of system-wide contamination. Additionally, in its D&D Plan, Powertech (USA) will assume that all premises, equipment, or scrap likely to be contaminated in excess of limits, but that cannot be measured, is contaminated in excess of limits and will be treated accordingly.

II. Radiological Issues

TR RAI-RI-1

Additional information needs to be provided on the authority of the Radiation Safety Officer (RSO).

Background: It is not clear that the RSO has the responsibilities and authority discussed in Regulatory Guide 8.31.

Needed: To be consistent with the responsibilities and authority discussed in Regulatory Guide 8.31, Section 1.2, the applicant needs to provide a commitment that the Mine Manager cannot unilaterally override a decision of the RSO to suspend, postpone, or modify an activity.

Response: TR RAI-RI-1 (TR Section 5.1.5)

The RSO will also have the authority to enforce regulations and administrative policies that affect the program and can raise issues concerning safety to Mine Manager and the Vice President of Environment, Health, and Safety as shown in Figures 5.1-1 and 5.1-2. A mine manager will not possess the authority to unilaterally override the RSO's decision to suspend, postpone or modify an activity. The RSO will possess the authority to enforce regulations and administrative policies that may affect any aspect of the radiological protection program. The RSO will also be a member of the SERP described in Section 5.2.3 and will meet the qualifications outlined in NRC guidance.

TR RAI-RI-2

Additional information on the use of Radiation Work Permits (RWPs) needs to be provided in the application.

Background: The applicant has indicated that RWPs would be reviewed and approved by the RSO or the RSO designee in the absence of the RSO.

Needed: Provide the criteria by which the applicant will determine who is a qualified designee to replace the RSO (e.g., specialized training) in RWP review and approval activities and demonstrate how these criteria are consistent with Regulatory Guide 8.31.

Response: TR RAI-RI-2 and 3 (TR Section 5.2.2)

Non-Routine Activities

Any activities with potential for significant exposure to radioactive material and not documented by existing SOPs will require radiological work permits (RWPs). RWPs are job-specific permits that describe the following:

The details of the job to be performed,
Precautions necessary to maintain radiation exposures ALARA, and
The radiological monitoring and sampling necessary before, during, and following completion of the job.

The RSO or the RSO designee must review and sign off on the RWP before the associated work is to be performed. That work will be executed to the details specified in the RWP. The RSO designee shall be able to describe which locations, operations and jobs are associated with the highest exposures and why exposures may increase or decrease during work execution. See section 5.4 for radiation staff qualifications.

TR RAI-RI-3
Additional information on the operational inspection program needs to be submitted.

Background: The applicant has indicated that the Dewey Burdock RSO, or an RSO designee would conduct a daily visual inspection of all work and storage areas in the facility to determine if standard operating procedures are being followed properly and good radiation practices are being implemented.

Needed: Provide the criteria (e.g., specialized training) by which the applicant will determine who is a qualified designee to replace the RSO in radiation safety inspection activities and expected frequency of inspections performed by the designee.

Response: TR RAI-RI-3 (TR Section 5.4)
Qualifications for Personnel Implementing the Radiation Safety Program

The minimum qualifications for the RSO are:

A bachelor's degree in the physical sciences, industrial hygiene, or engineering from an accredited college or university or an equivalent combination of training and relevant experience in radiation protection at a uranium recovery facility. Two years of relevant experience will generally be considered equivalent to one year of academic study.

At least one year of uranium recovery work experience in applied health physics, radiation protection, industrial hygiene, or similar area. This experience should involve hands-on work with radiation detection and measurement equipment, not strictly administrative work.

At least four weeks of specialized classroom training in health physics.

A thorough knowledge of the health physics instrumentation used in the facility, the chemical and analytical procedures used for radiological sampling and monitoring, methods used to calculate personnel exposure to uranium and its progeny, the uranium recovery process, and the facility hazards and their controls.

The minimum qualifications for a RSO designee will include:

- Training equal to the minimum qualifications of the appointed RSO as specified in Section 2.4 of RG 8.31.
- Must pass with an 80 percent score or better regarding the minimum training of the RSO.

- The level of experience required will be commensurate with the type, form and the anticipated radiation hazards to be encountered while acting as a designee for the appointed RSO.

On-the job training overseen by the lead RSO will provide expertise regarding implementation of site specific radiological safety protocols and any necessary specialized radiation safety training concerning a specific RWP. For more information see section 5.2.2.The minimum qualifications for a Health Physics Technician are one of the following combinations:

- An associate's degree or two or more years of study in the physical sciences, engineering, or a health-related field; at least four weeks of generalized training in radiation health protection applicable to uranium recovery facilities (up to two weeks may be on-the-job training); one year of work experience using sampling and analytical laboratory procedures that involve health physics, industrial hygiene, or industrial safety measures that apply to uranium recovery facility operations.

- A high school diploma; at least three months of specialized training in radiation health protection relevant to uranium recovery facilities (up to one month may be on-the-job training); two years relevant work experience in applied radiation protection.

TR RAI-RI-4 (TR Section 2.8.4 and TR Section 2.9.3.2.1)

Sampling and analysis results

Background: Regulatory Guide 4.14, Section 7.0 (Recording and Reporting Results) recommends, among other things, providing the values of the lower limit of detection (LLD) error estimates and a description of the calculation of the LLD and error along with other quality assurance data. The following are some of the examples the staff has identified that do not appear to conform to these recommendations.

(a) In the Technical Report, no LLD or error values for fish are given in Tables 2.8-23 and 2.8-30 or in the lab report in Appendix 2.8-H.
(b) In Table 2.9-16 and 2.9-17 of the Technical Report, no LLD or error values are given for ground water.
(c) In Table 2.9-5 of the Technical Report, LLD values for soil samples are not provided.
(d) The results for sediment samples in Tables 2.9.8 and 2.9.9 of the Technical Report do not fully address reporting recommendations for LLD, error and quality assurance.
(e) In Table 2.9-12 of the Technical Report, LLD values for the radionuclide concentrations in air are reported. However, the LLD values are not reported on the corresponding laboratory report and NRC staff cannot locate the method of deriving these LLD values in the Technical Report.

TR RAI-RI-4(a-e)

Statement of Clarification:

The tables referred to in the request for additional information such as 2.8-23; 2.8-30; 2.9-16; 2.9-17; 2.9.8; 2.9.9 are inserted as summary tables and were not meant for detailed review of all reporting values contained within an Analytical Report. The Appendices were provided within the application for a more detailed review of specifics regarding analytical results.

Appendix 2.8-H provides the laboratory analytical reports (QA/QC report included) for a variety of fish samples from Energy Laboratories, Inc. For each radionuclide, the error estimate is expressed as "precision (+/-)" immediately underneath the radionuclide result. The LLD for the radionuclide is shown in a separate column as RL (reporting limit) or MDC (minimum detectable concentration). See explanation above.

Appendix 2.9-A (Baseline Radiological Report) provides the laboratory analytical reports from Energy Laboratories, Inc. for air filter particulate matter, soils, vegetation and local food samples. For each radionuclide, the error estimate is expressed as "precision (+/-)" immediately underneath the radionuclide result. The LLD for the radionuclide is shown in a separate column under the RL (reporting limit) or MDC (minimum detectable concentration). See explanation above.

Supplemental Appendix to Section 2.7 provides the laboratory analytical reports from Energy Laboratories, Inc. for groundwater, surface water and sediment samples. For each radionuclide, the error estimate is expressed as "precision (+/-)" immediately underneath the radionuclide result. The LLD for the radionuclide is shown in a separate column as RL (reporting limit) or MDC (minimum detectable concentration). See explanation above for deriving LLD values.

The LLDs reported in Table 2.9-12 of the Technical Report were derived by dividing the reported MDC or RL on the laboratory report in units of activity per filter composite by the total volume of air in milliliters that was sampled for that period. It was assumed for radiological data that the MDC and RL on the laboratory reports were identical (see explanation above). For natural uranium, the mass per filter composite was converted to activity per filter composite by multiplying the mass result from the laboratory by 677 (pCi/mg), the specific activity for natural uranium.

Historical Knowledge:

Since the distribution of Regulatory Guide (RG) 4.14, NUREG-1576, 2004 Multi-Agency Radiological Laboratory Analytical Protocols Manual, (MARLAP) has been released and several analytical laboratories are implementing the guidance and concepts into their analytical programs. This multi-agency guidance was developed by a workgroup that included members representing EPA, DOE, DOD, DHS, and the NRC others include the NIST, USGS, FDA, the commonwealth of Kentucky and the state of California.

The information within Regulatory Guide 4.14 revision 1, 1980, states: "Regulatory Guides are not substitutes for regulations, and compliance with them is not required. Methods and solutions different from those set out in the guides will be acceptable if they provide a basis for the findings requisite to the issuance or continuance of a permit or license by the Commission."

Minimum Detectable Concentration (MDC):

Definition of MDC from MARLAP 2004: Minimum detectable concentration (MDC): The minimum detectable value of the analyte concentration in a sample. ISO refers to the MDC as the minimum detectable value of the net state variable. They define this as the smallest (true) value of the net state variable that gives a specified probability that the value of the response variable will exceed its critical value i.e., that the material analyzed is not blank.

$$MDC = \frac{4.65\sqrt{\frac{CPM_B}{T_S} + \frac{2}{T_S^2}}}{2.22 \times E \times V \times R \times I}$$

Where:

MDC = Lower Limit of Detection (LLD or MDC)

CPM_B = Instrument Background count rate (min^{-1})

T_S	=	Count time (min) for the sample measurement
E	=	Standard efficiency
V	=	Sample volume in liters
R	=	Gravimetric recovery of $BaSO_4$
I	=	Ingrowth factor (see 8.4.4)
2.22	=	Unit conversion factor for pCi to DPM

The MDC functions as the sample specific detection limit (where the calculations have been vetted through Energy Laboratory Inc. (ELI)'s Radiochemistry consultant) where a response above that level is considered to meet the statistical criteria of 'likely to be a true detection' and not a potentially false positive. Where MDC is reported it is specific to the sample and its matrix (ISO, 1995; ANSI N42.23; NUREG-1576, 2004). For more information on detection limit terminology, concepts and principal approaches see NUREG – 4007, 1984.

Lower Limit of Detection (LLD):

Definition from MARLAP 2004: Lower limit of detection (LLD): (1) The smallest concentration of radioactive material in a sample that will yield a net count, above the measurement process (MP) blank, that will be detected with at least 95 percent probability with no greater than a 5 percent probability of falsely concluding that a blank observation represents a real signal (NRC, 1984). (2) An estimated detection limit that is related to the characteristics of the counting instrument (EPA, 1980).

The calculation referred to in several NRC documents for LLD is generally put this way:

$$LLD = \frac{4.66 \times \sigma_b}{2.22 \times E \times M \times R \times I}$$

Where:

LLD	=	Limit of detection as an a priori determination
σ_b	=	Standard deviation of the instrument background count rate (counts-min^{-1})
M	=	The sample weight (g) or volume (L)
E	=	Instrument efficiency for alpha or beta
R	=	Yield for the individual radionuclide as determined by tracer or carrier
I	=	Ingrowth factor
2.22	=	Conversion for dpm to pCi

Uncertainty/Error for a given measurement: (ELI reports it as precision of the analyte concentration).

Definition from Multi-Agency Radiological Laboratory Analytical Protocols Manual, MARLAP, 2004: Uncertainty (of measurement): Parameter, associated with the result of a measurement that characterizes the dispersion of the values that could reasonably be attributed to the measurand (ISO, 1993a).

$$U_{95} = \pm \frac{1.96\sqrt{\frac{CPM_S + CPM_B}{T_S} + \frac{2}{T_S^2}}}{2.22 \times E \times V \times R \times I}$$

Where:

U_{95}	=	95% Confidence interval
1.96	=	z score for 0.975 coverage
CPM_S	=	Sample gross count rate (min^{-1})
CPM_B	=	Instrument Background gross count rate (min^{-1})
T_S	=	Count time (min) for the sample measurement
E	=	Standard efficiency
V	=	Sample volume in liters
R	=	Gravimetric recovery of $BaSO_4$
I	=	Ingrowth factor (see 8.4.4)
2.22	=	Unit conversion factor for pCi to DPM

The error for a given measurement is shown on the analytical report as the analyte precision. It represents the 2 sigma (95%) confidence that the true activity is somewhere within the ± range of the reported value. The RL represents the LLD for a sample where sufficient volume is available and where the matrix presents minimal interference to the methods used for analysis.

RG 4.14 addresses guidelines for reporting sampling and analysis results in section 7, page. 4.14-6. A suggested format is shown in Table 3 of the guide. The analytical results submitted in Appendices via analytical reports provide the analytical information in table format similar to what is recommended in the RG 4.14.

Powertech (USA) Inc. followed Regulatory Guide 4.14 as a guidance document to develop the environmental baseline sampling program, conduct laboratory analysis and to report the analytical results. As stated by NRC in the introduction to Regulatory Guide 4.14, "The programs described in this guide are not requirements." Therefore, some variation from the exact format for presenting analytical results for radionuclides (i.e., error values and LLD values referenced in Regulatory Guide 4.14) resulted due to Energy Laboratories, Inc. (ELI) reporting nomenclature.

The ELI laboratory analytical reports provided in the appendices include error and LLD values the NRC is requesting under the nomenclature of precision (+/-) and RL (reporting limit) or MDC (in cases where a the RL was replaced with a sample specific LLD (minimum detectable concentration or MDC); effectively the MDC is the RL in these cases, such as is the case concerning analytical results of fish species.

TR RAI-RI-5

Reporting format of radiological samples results.

Background: Regulatory Guide 4.14 Section 7.5 states that the term "not detected", "less than the lower limit of detection (LLD)", or similar terms should never be used. However, in Tables 2.8-23, 2.8-30 and in 2.9-19 of the Technical report the sample results are reports as "ND" and "u", etc.

Needed: Consistent with Regulatory Guide 4.14, all radiological data should be reported as a value and its associated error estimate, including values less that the lower limit of detection or less than zero.

Response: TR RAI-RI-5 (TR RAI Attachment RI-5)

A Letter received from Energy Laboratory on 22 October 2010 concerning Powertech (USA)'s data consistency inquiry).

See letter inserted below.

ENERGY LABORATORIES www.energylab.com Analytical Excellence Since 1952

Helena, MT 877-472-0711 • Billings, MT 800-735-4489 • Casper, WY 888-235-0515
Gillette, WY 866-686-7175 • Rapid City, SD 888-672-1225 • College Station, TX 888-690-2218

10/22/2010

Amy L. Thurlkill
E.H.S. Manager; RSO - Corporate
Powertech (USA) Inc.
5575 DTC Parkway Suite # 140
Greenwood Village, CO 80111

Dear Ms. Thurlkill:

Linda Larson, manager of our Rapid City laboratory, and Dave Blaida, radiochemistry supervisor for our Casper laboratory have requested my assistance in evaluating our ability to comply with Powertech's request to reprocess our original analytical data for results from early portions of the Dewey-Burdock project. I understand your goal of providing analytical results from across the project in a fully consistent fashion.

During the course of your project there was a nationwide movement to follow the recommendations of the Multi-Agency Radiological Laboratory Analytical Protocols (MARLAP). One area covered by the MARLAP manual is redefining governmental agencies' expectations from radiological laboratories. MARLAP recommends that radioanalytical data be presented as a numerical result combined with an uncertainty estimate specific to the conditions of the analysis. We were introduced to MARLAP in 2005 at a seminar at the USGS office in Denver and we have since worked under the direction of Dr. Robert Litman to implement the recommended MARLAP changes at Energy Labs. Dr. Litman was one of the authors of the MARLAP manual and is a nationally recognized expert in the field of radiochemistry.

A central element of the MARLAP recommendations is that analytical concentrations always be presented as a numerical result combined with an uncertainty estimate specific to the conditions of the analysis. To evaluate such a result, it is also necessary to have a measure of detectability under the same analytical conditions. This is the minimum detectable concentration, or MDC. The guidance provided in MARLAP that we have now incorporated into our methods discontinues the practice of the detect/non-detect reporting formats that were used for your early data. Consequently we are not able to reprocess the original analytical data as you have requested. Even if it were possible for us to recalculate specific values on the previous data, there would be no reasonable way to make a direct comparison between the analytical results.

Let me reassure you that all results reported to Powertech for this project were generated with attention to the same high quality standards. The inherent differences between the lab procedures designed to produce the "ND at reporting limit X" result format and the procedures designed to produce the "numeric result / uncertainty / MDC" result format currently used by our radiochemistry department simply preclude reprocessing the data in a meaningful fashion.

The decision to make the transition between these reporting formats in our radiochemistry operations was not made lightly. We recognized that the change would necessarily cause discontinuities in some customers' data sets. But this transition was an essential element in a process of continuous improvement.

We regret any inconvenience the discontinuities in analysis reporting formats may cause you. Please understand that these changes were implemented to provide the best available service for Powertech and all our customers as the regulatory community redefines reporting for radiochemical analysis.

Sincerely,

Timothy D. Bailey, Ph.D.
Senior Chemist
Energy Laboratories, Inc.

III. Miscellaneous Issues

TR RAI-MI-1
Provide additional information on chemicals that have the potential to impact radiological safety.

Background: Section 3.2.8. The NRC staff needs to determine whether the hazards associated with the storage and processing of hazardous materials with the potential to impact radiological safety have been sufficiently addressed in the process design for the recovery plant, satellite processing facilities, well fields, and chemical storage facilities.

Needed: Provide information as requested.

TR RAI-MI-1(a)

a. ***The applicant needs to specifically identify specifically those chemicals used in uranium processing that have the potential to impact radiological safety.***

Response: TR RAI-MI-1(a)
The list of chemicals used in uranium processing that have the potential to impact radiological safety are listed in the Table 3.2-1 from the TR RAI response Section 3.2.8.1 submitted in December 2010.

Table 3.2-1: Process-related chemicals and quantities stored on-site

BURDOCK				
Chemical Name	**No. Tanks**	**Unit Storage Capacity**	**Units**	**Consumption Rate ton/yr**
Sodium Chloride (NaCl)	2	20000	gal	2250
Sodium Carbonate (Na_2CO_3) i.e. Soda Ash	1	20000	gal	450
Hydrochloric Acid (HCl, 32%, or Sulfuric Acid ($H_2SO_4$98%)	1	7000	gal	487
Sodium Hydroxide (NaOH 50%)	1	7000	gal	446
Hydrogen Peroxide ($H_2O_2$40%)	1	7000	gal	177
Oxygen (O_2, liquid)	1	11000	gal	979
Carbon Dioxide (CO_2)	1	6000	gal	245
Barium Chloride ($BaCl_2$)	1	275	50kg sacks	7
DEWEY				
Oxygen (O2, liquid)	1	11000	gal	653
Carbon Dioxide	1	6000	gal	163
Barium Chloride	1	138	50-kg sacks	7

TR RAI-MI-1(b)
Provide additional information on chemicals that have the potential to impact radiological safety.

Background: Section 3.2.8. The NRC staff needs to determine whether the hazards associated with the storage and processing of hazardous materials with the potential to impact radiological safety have been sufficiently addressed in the process design for the recovery plant, satellite processing facilities, well fields, and chemical storage facilities.

b. The applicant needs to completely and clearly identify on Figures 3.2-4 and 3.2-5 the storage locations of all chemicals used in uranium processing (enlarge figure to be readable). The locations need to be consistent with the descriptions of chemical use provided in Section 3.2.8 of the application.

Needed: Provide information as requested.

Response: TR RAI-MI-1(b)
Figures 3.2-4 and 3.2-5 are attached and show the locations of chemicals used in uranium processing.

Figure 3.2-4: Central Processing Plant Detail

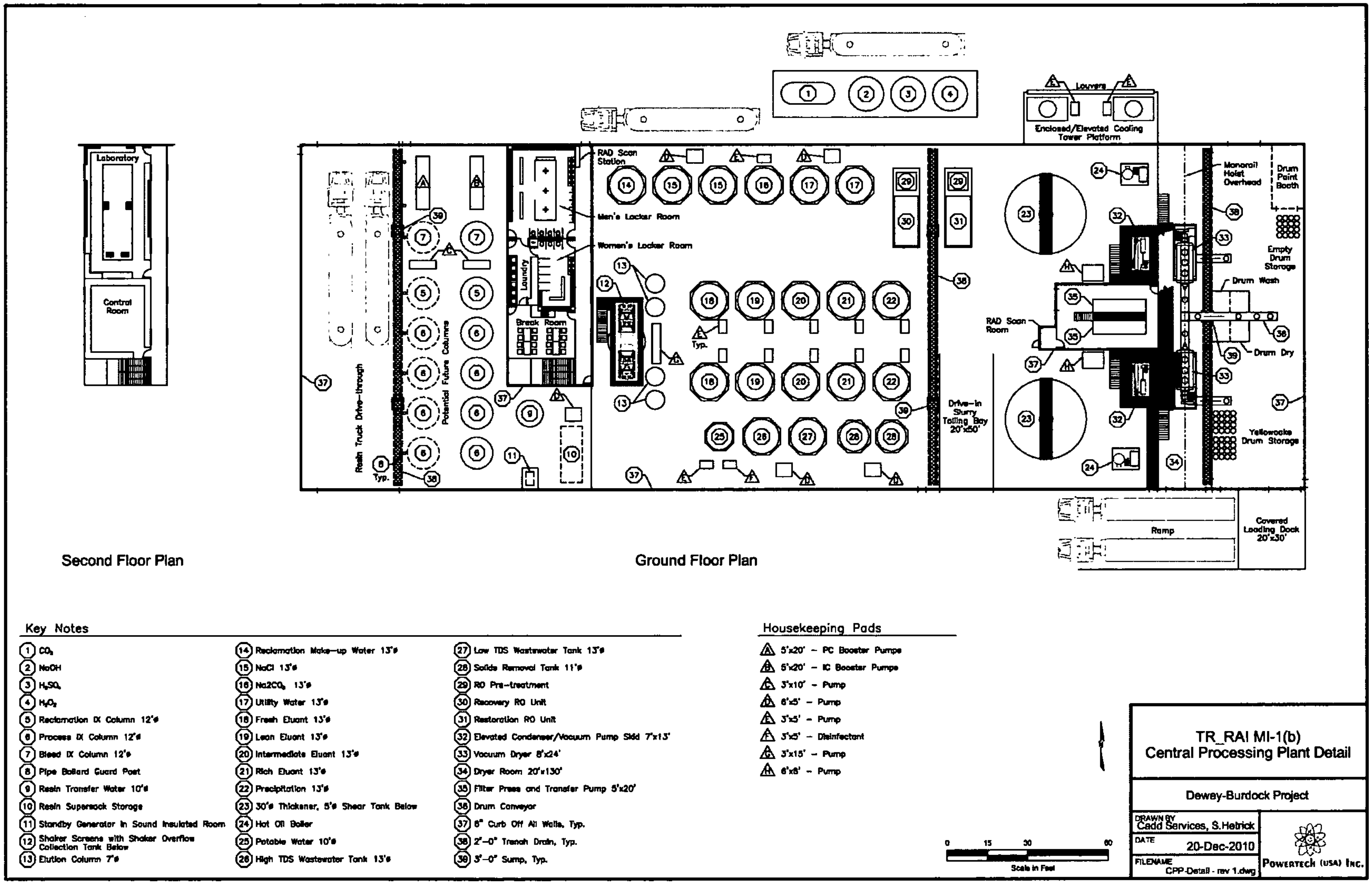
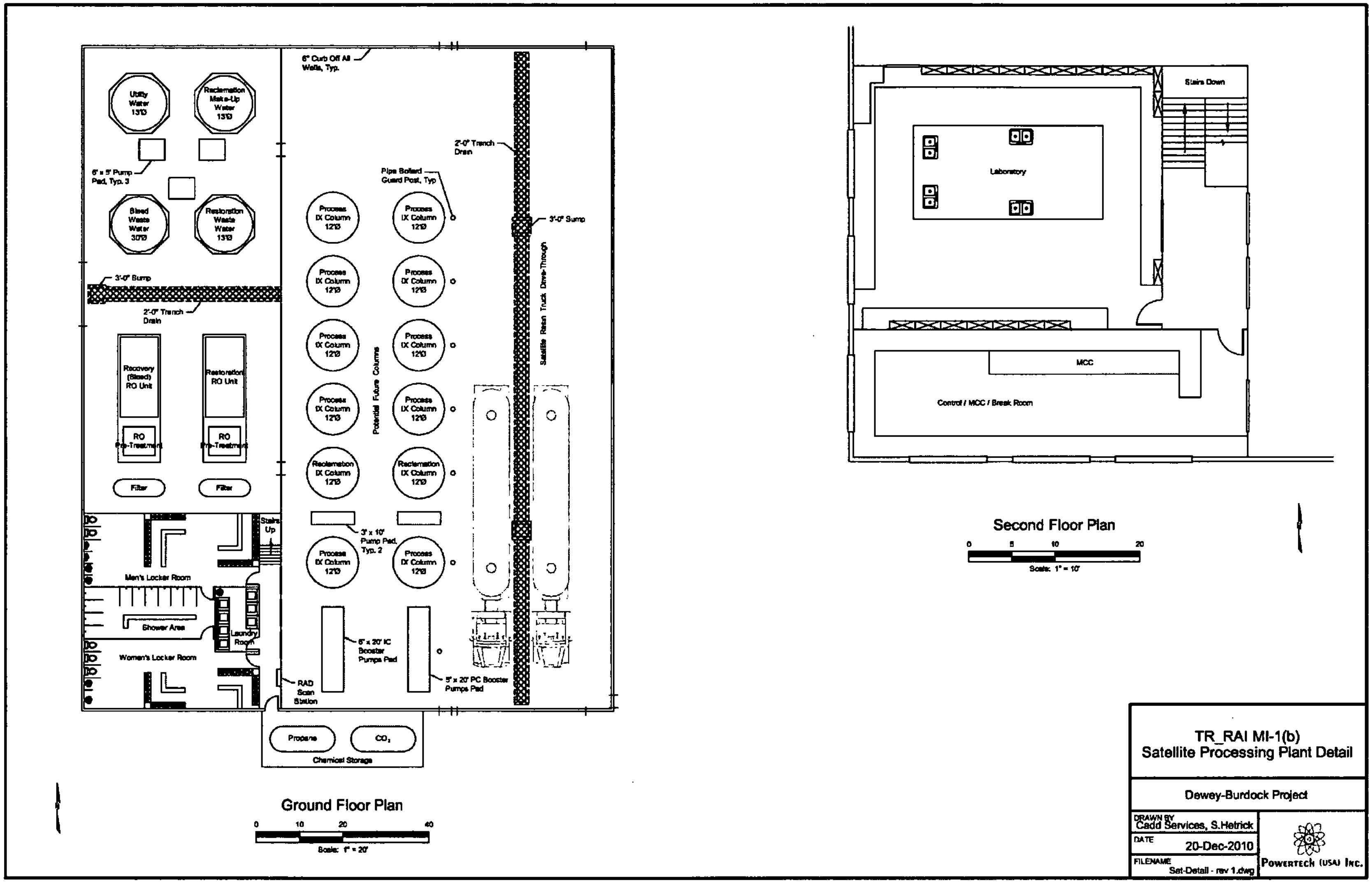


Figure 3.2-5: Satellite Facility Plant Detail



TR RAI-MI-1(c)

Provide additional information on chemicals that have the potential to impact radiological safety.

Background: Section 3.2.8. The NRC staff needs to determine whether the hazards associated with the storage and processing of hazardous materials with the potential to impact radiological safety have been sufficiently addressed in the process design for the recovery plant, satellite processing facilities, well fields, and chemical storage facilities.

c. ***Section 3.2.8.3 on acid storage indicates the acid will be stored outside the CPP, but inconsistently also indicates the tank would be vented through the building roof. The applicant should correct this inconsistency.***

Needed: Provide information as requested.

Response: TR RAI-MI-1(c)

The acid tank is located outside the CPP and is vented to the atmosphere and not through the roof of the CPP.

TR RAI-MI-2

Provide information demonstrating that dryer operations will meet 10 CFR Part 40, Appendix A, Criterion 8.

Background: The NRC staff needs to determine that maintenance and operation of yellowcake dryers, and checking and logging requirements contained in 10 CFR Part 40, Appendix A, Criterion 8, are followed. The applicant indicates that during drying operations, the operator would perform and document inspections of the differential pressure or vacuum every 4 hours, and document readings of the differential gauges for other emission control equipment at least once per shift. 10 CFR Part 40, Appendix A, Criterion 8, requires at least hourly monitoring of yellowcake dryer controls.

Needed: The applicant needs to provide plans to meet the requirements of 10 CFR Part 40, Appendix A, Criterion 8.

Response: TR RAI-MI-2

To ensure that the emission control system is performing within specified operating conditions, instrumentation will be installed that monitor continuously and will signal an audible alarm if the air pressure (i.e. vacuum level) falls below specified levels. The operation of this system is routinely monitored during dryer operations. The operator will perform visual inspections and document inspections of the differential pressure or vacuum every four (4) hours. Additionally, the air pressure differential gauges for other emission control equipment is observed and documented at least once per shift during dryer operations.

TR RAI-MI-3
Provide additional discussion of backup for operating systems.

Background: Section 3.2.12 is insufficient in its discussion of backup systems. The NRC needs to determine that control components of the systems are equipped with backup systems that activate in the event of a failure of the operating system or a common cause failure such as power failure.

Needed: The applicant needs to provide this additional discussion of backup in the event of system or power failure.

Response: TR RAI-MI-3
Loss of power to the project site will cause production wells to stop operating, resulting in shutdown of all production and injection flows. This condition avoids any flow imbalance within the well fields though a well field bleed is not maintained during the power failure. The time span for the aquifer to recover from operational drawdown back to its natural groundwater gradient is typically much longer than the duration of typical power outage. Since the maximum rate at which lixiviant could travel to the monitoring ring would equal the rate which the groundwater returns to its natural gradient, excursions are not likely to occur within the short time period of a power outage.

Backup generators will be installed such that in event of power failure instrumentation will be monitored to confirm conditions in the CPP, SF, and well fields.

Shutdown due to power failure during winter months is not expected to be problematic as well field pipelines are buried sufficiently below the frost line. In addition, heating of the SF and CPP will be maintained by propane or natural gas and will require power to operate.

TR_RAI-MI-4

Additional financial assurance information needs to be provided.

Background: Section 6.6. NRC staff requires certain information to ensure that the proposed surety amount is sufficient to fund all decommissioning activities documented in the license application, that the methods used to establish the surety amount are acceptable, and that the forecast costs are reasonable.

TR_RAI-MI-4(a)

a. ***The applicant has not identified a specific surety mechanism, nor has it made a commitment to one of the mechanisms identified in Criterion 9 of 10 CFR Part 40, Appendix A. This needs to be done prior to operation.***

Needed: Provide information related to financial assurance as requested.

Response: TR RAI-MI-4(a)

In compliance 10 CFR Part 40 Appendix A criteria and NUREG-1569 and 1757, Powertech (USA) commits to provide the required financial surety in the form of an irrevocable letter of credit (ILOC), but reserves its option to combine the ILOC with other surety mechanisms acceptable to the NRC prior to operation.

TR RAI-MI-4(b)
Additional financial assurance information needs to be provided.

Background: Section 6.6. NRC staff requires certain information to ensure that the proposed surety amount is sufficient to fund all decommissioning activities documented in the license application, that the methods used to establish the surety amount are acceptable, and that the forecast costs are reasonable.

b. The applicant has provided decommissioning cost estimates for two options based on 2008 dollars. Costs should be updated to current dollars just prior to licensing.

Needed: Provide information related to financial assurance as requested.

Response: TR RAI-MI-4(b)
The costs presented in the Table 6.6-1 from the TR RAI response submitted in December 2010, reflect prices as of 2009-2010 and costs will be updated just prior to licensing.

Table 6.6-1: Summary of Financial Assurance Amounts

No.		Financial Assurance- Dewey-Burdock Project Description	Details in Table(s):	Disposal Option Disposal wells	Land application
1		Facility Decommissioning			
	A	Salvageable Equipment	9	$ 242,000	$ 242,000
	B	Non-salvageable bldg. & equipment disposal	9,13	$ 670,280	$ 1,046,780
	C	Byproduct disposal	6	$ 483,794	$ 494,535
	D	Restore contaminated areas	9	$ 570,300	$ 709,100
2		O&M- GW restoration and stability			
	A	Method: Groundwater treatment	O&M	$ 885,873	
	B	Method: Groundwater Sweep with Madison Injection	O&M		$ 543,700
3		Well field reclamation			$ -
	A	Well plugging & closure	8, 14	$ 751,300	$ 751,300
	B	Remove surface equipment & reclaim	9	$ 975,050	$ 975,050
4		Radiological Survey and Env. Monitoring	10	$ 832,939	$ 847,039
5		Project Management Costs & Miscellaneous	12	$ 968,700	$ 968,700
6		Labor, 35% overhead+ 10% contactor profit	11	$ 1,337,000	$ 1,337,000
7		Contingency @ 15%		$ 1,157,585	$ 1,187,281
Total Surety amount				$ 8,874,822	$ 9,102,485

TR RAI-MI-4(c)
Additional financial assurance information needs to be provided.

Background: Section 6.6. NRC staff requires certain information to ensure that the proposed surety amount is sufficient to fund all decommissioning activities documented in the license application, that the methods used to establish the surety amount are acceptable, and that the forecast costs are reasonable.

c. ***There needs to be a discussion along with the tables in Appendix 6.6-A that provides explanatory information on the data in the tables, including the time period of the cost estimates, the sources and bases for assumptions, etc. For example, there is an assumption that contaminated waste would be sent to Texas. However, there is no 11e.(2) disposal agreement at this time, so the basis for this assumption is questionable.***

Needed: Provide information related to financial assurance as requested.

Response: TR RAI-MI-4(c)
Detailed cost tables are provided in a revised TR Appendix 6.6-A which is included in this submission.

TR RAI-MI-4(d)

Additional financial assurance information needs to be provided.

Background: Section 6.6. NRC staff requires certain information to ensure that the proposed surety amount is sufficient to fund all decommissioning activities documented in the license application, that the methods used to establish the surety amount are acceptable, and that the forecast costs are reasonable.

d. ***The applicant includes a flare factor of 1.5 in its calculation of restoration costs. In addition ground water restoration costs are based on treatment of 10 pore volumes. Provide justification for the flare facior and for using 10 pore volumes total.***

Needed: Provide information related to financial assurance as requested.

Response: TR RAI-MI-4(d)

Powertech (USA) proposes use of a flare factor of 1.44 and the restoration estimate of 6 pore volumes of groundwater for its financial assurance. Basis for the flare factor is found in TR Appendix 6.6-B "Numerical Modeling of Groundwater Conditions Related to In situ Recovery at the Dewey-Burdock Uranium Project, South Dakota" (Petrotek, 2010).

Pore volume and volume required for restoration

Eleven measurements of ore-zone porosity have been made on cores removed from the Lakota and Fall River formation sands. The average of these porosity measurements is 0.30, which is assumed to be the average porosity of the mineralized sands within the project. The mean thickness of the mineralized zones was determined by down-hole radiologic logging to be 4.6 ft.

The formulas for determining the pore volume, including flare, and the volume of restoration composite (RC) to be withdrawn during aquifer restoration operations are as follows:

Pore volume = (well field pattern area) x (thickness) x (porosity) x (flare factor)

RC volume = (pore volume) x (number of pore volumes for aquifer restoration)

The flare factor and number of pore volumes required for aquifer restoration are both a function of the properties of the particular sandstone formations and ore deposits, as well as the operational factors of aquifer bleed rates, the balancing of pattern flow rates, the use of RO during recovery operations and the timeliness of beginning aquifer restoration operations following cessation of recovery operations (Appendix 6.6-B). The total volume of restoration composite withdrawn during aquifer restoration operations is directly proportional to both the flare factor and the number of pore volumes to be withdrawn; thus, there exists a continuum of paired values of the flare factor and the number of restoration pore volumes that produce the same total volume of restoration composite removed during aquifer restoration operations (HRI, 2001). For the Dewey-Burdock Project, the values of the flare factor and the number of pore volumes removed for aquifer restoration are comparable to those that have been recently approved for other in situ recovery sites and that are consistent with the best practicable technology for aquifer restoration.

The overall (volumetric) flare factor for ISR uranium recovery projects has varied from 1.44 at Irigaray/Christianson Ranch (Reference) to 1.95 at Churchrock/Crownpoint (Reference). The overall well field flare factor for the Dewey-Burdock Project is estimated to be 1.44, which is equal to the flare factor in approved permit applications at ISL facilities located nearby in the State of Wyoming. A detailed discussion is provided in Appendix 6.6-B.

The number of pore volumes, including flare, of groundwater to be removed to affect aquifer restoration is estimated to be 6.0. This figure is consistent with the best practicable technology that includes the following operational practices:

(i) *Daily balancing of injection and extraction flow rates during production. This flow rate balancing is designed to ensure that a proper aquifer bleed is maintained both at the well field level and also within each five-spot pattern within the well field.*

(ii) *Timeliness of beginning restoration operations. For any particular well field, aquifer restoration operations will begin as soon as is reasonably possible following the cessation of recovery operations.*

(iii) *Maintenance of aquifer bleeds. Hydraulic control of well fields through the net withdrawal of the aquifer bleed stream will be continuously maintained from the beginning of recovery operations until the completion of the stability monitoring period following aquifer restoration.*

(iv) *The use of RO technology. The use of RO with the deep disposal well option of wastewater disposal during the recovery operations, will remove dissolved solids concurrent with the recovery of uranium, effectively conducting a portion of the aquifer restoration operations during the recovery phase of operations.*

While the number of pore volumes required for aquifer restoration has historically proven to have been significantly higher for some of the early ISL operations, the methods and timing of restoration likely contributed to these larger numbers as has been documented as follows:

> *.. the average number of PVs extracted and treated/reinjected/or disposed was 13.6 for Irigaray and 12.4 for Christensen. ...Circumstances at both those ISR projects resulted in increased PVs to achieve restoration goals including the following:*
>
> - *Production and restoration were not conducted sequentially, and were plagued with extended periods of shut-in and standby, with delays of up to several years in some cases:"*
> - *Groundwater sweep, the initial phase of restoration, was often largely ineffective and in some cases may have exacerbated the problem: and "*

- *RO was continued in some well fields after it was apparent that little improvement in water quality was occurring.*

Restoration was not performed immediately following the completion of production, and in some cases, there were long periods of inactivity during the production and restoration phases. At Irigaray, production was interrupted for a period of almost six years in MU1 through MU5 [Figure 6.1-A (1)]. Similarly, there was a three-year break in production inMU6 through MU9, when the operation was in standby status. Restoration did not commence at MUI through MU3 until a year after production had ended. At MU4 and MU5, restoration operations did not begin until two years following production Restoration commenced shortly after the end of production at MU6 through MU9. However the project was on standby status between the completion of groundwater sweep and the beginning of the RO phase of production, resulting in a break of one to two years, depending on the MU. Restoration was initiated sooner after the end of production at Christensen Ranch, with the exception of MU3 and MU4. However, there were periods of standby between groundwater sweep and RO treatment/injection of up to a year. These delays between and during production and restoration operations most likely increased the number of PVs required to complete aquifer restoration. (Uranium One, 2009).

For the financial assurance calculations, the pore volume affected in the first year of production is estimated to be 13 million gallons corresponding to an active well field area of 20 acres. The volume of groundwater to be extracted during groundwater restoration is estimated to be 78 million gallons.

TR RAI-MI-4(e)
Additional financial assurance information needs to be provided.

Background: Section 6.6. NRC staff requires certain information to ensure that the proposed surety amount is sufficient to fund all decommissioning activities documented in the license application, that the methods used to establish the surety amount are acceptable, and that the forecast costs are reasonable.

e. The applicant has committed to annually adjusting the surety value. However, additional comments are needed to: (1) automatically extend the surety if the NRC has not approved the proposed revision 30 days prior to the expiration date; (2) revise the surety arrangement within 3 months of NRC approval of any revised closure (decommissioning) plan if the revised cost estimates exceed the amount of the existing financial surety: (3) submit (for NRC review) an updated surety to cover any planned expansion or operational change not included in the annual surety update at least 90 days prior to beginning associated construction; and (4) provide the NRC copies of surety related information submitted to the State of South Dakota and the Environmental Protection Agency, including a copy of the State's surety review or the final surety arrangement.

Needed: Provide information related to financial assurance as requested.

Response: TR RAI-MI-4(e)
In accordance with NRC requirements, an updated Annual Surety Estimate Revision will be submitted each year adjusting the surety instrument to reflect existing operations and those planned for construction or operation in the following year. After review and approval of the Annual Surety Estimate Revision by the NRC, Powertech (USA) will revise the surety instrument to reflect the updated amount. Powertech (USA) agrees to update its decommissioning cost estimate for the selected option in current dollars just prior to licensing.

In addition to adjusting the surety value annually, the applicant agrees to:

1. *automatically extend the surety if the NRC has not approved the proposed revision 30 days prior to the expiration date of the existing surety;*

2. *revise the surety arrangement within 90 days of NRC approval of any revised closure (decommissioning) plan if the revised cost estimate exceeds the amount of the existing financial surety;*

3. *submit for NRC review an updated surety to cover any planned expansion or operational change not included in the annual surety update at least 90 days prior to beginning associated construction; and*

4. *provide the NRC copies of surety related information submitted to the State of South Dakota and/or the U.S. Environmental Protection Agency, including a copy of the State's surety review or the final surety arrangement.*

TR RAI-MI-5

Provide additional information and analyses related to site flooding.

Background: The applicant did not adequately address the potential for flooding of the site from large floods on nearby streams. In accordance with the requirements of 10 CFR Part 40, Appendix A, and the suggested criteria of NUREG-1569, the effects of potential flooding need to be addressed.

Needed: The applicant needs to provide appropriate estimates of peak flood discharges and water levels produced by large floods on Pass Creek, Beaver Creek, and local small drainage areas.

Response: TR RAI-MI-5

Please refer to TR_RAI Appendix MI-5 which is included in this submission for peak flood discharges and water levels produced by large floods on Pass Creek, Beaver Creek, and local small drainage areas.

TR RAI-MI-6

Provide additional information and analyses related to retention pond design and the effects of local intense rainfall and flooding.

Background: The applicant did not provide sufficient information and analyses related to runoff and flooding from local intense rainfall with respect to erosion and the capacity of site retention ponds. In accordance with the requirements of 10 CFR Part 40, Appendix A, and the suggested criteria of NUREG-1569 and Regulatory Guide·3.11, the effects of potential flooding need to be addressed.

Needed: The applicant needs to provide: detailed site drawings showing detailed local topography and pond construction features: peak flood calculations; peak water level and velocity calculations; and erosion protection design features, as applicable.

Response: TR RAI-MI-6

Please refer to TR_RAI Appendix MI-5 which is included in this submission for detailed site drawings.

Detailed site drawings showing detailed local topography and pond construction features as well as erosion protection design features are included in the document "Pond and Land Application Technical Specifications and QA/QC Plan" which is included in Appendix 3-A of TR_RAI Response Dec 2010.

Peak Flows of Beaver Creek, Pass Creek and Other Small Drainages

The hydrologic analysis of Beaver Creek is provided in Section 2.7.1.4.2. Peak flows for various recurrence intervals are provided in Tables 2.7-1 through 2.7-4. Water levels resulting from the floodplain analysis are provided in the attached Appendix C, Tables 1 and 2 (HEC-RAS Beaver Creek output table from RESPEC). The hydrologic analysis of Pass Creek is provided in Section 2.7.1.4.3 of the TR. Peak flows for the 100 yr and estimated PMF event are provided in Table 2.7-18. Water levels resulting from the floodplain analysis are provided in Appendix C Table 3 and 4 (HEC-RAS Pass Creek output table from RESPEC).

Powertech has completed additional hydrologic and floodplain analysis of 12 small channels that are tributaries to Beaver and Pass Creeks. All of these channels are ephemeral. They have no base flow and do not contain flowing water except immediately following rain events.

Two tributary subbasins (9 and 10) of Beaver Creek were analyzed for peak flows and water surface profiles resulting from the 100-year 24-hour storm. Subbasins 10 and 9 are the upper and lower subbasins of a single channel that is tributary to Beaver Creek. These subbasins are shown on Figure 1 (Appendix A), and Table 1 gives the areas and 100-year peak flows for each of these subbasins.

A total of 10 tributary subbasins of Pass Creek (1, 2, 3, 4, 5, 6, 7, 8, 13, and 14) were analyzed for peak flows and water surface profiles. These subbasins are shown on Figure 1, and the areas and peak flows are shown in Table 1.

Peak flows and runoff hydrographs were calculated for these subbasins using the U.S. Army Corps of Engineers HEC-1 Flood Hydrograph model and the U.S. Soil Conservation Service (SCS) unit hydrograph methodology. A runoff curve number of 63 was used, consistent with the curve number values used in the hydrologic analysis of the Pass Creek and Beaver Creek watersheds that is presented in Section 2.7 of the TR. This curve number is based on the Soil Survey Geographic (SSURGO) Database, county land use data, and a field inspection of the area. The SCS lag equation was used to calculate the time of concentration for each subbasin. This equation is:

$$t_c = \frac{100L^{0.8}[(1000/CN)-9]^{0.7}}{1900S^{0.5}}$$

where:
L = hydraulic length of watershed (longest flow path), ft
CN = SCS runoff curve number
S = average watershed slope, %
t_c = time of concentration in minutes

The time of concentration is defined as the time it takes water to flow from the hydraulically most remote point in a basin to the basin outlet. The HEC-1 model uses the lag time (in hours) as an input parameter to compute the runoff hydrograph, where lag time is calculated as 0.6 x t_c and is defined as the time from the center of mass of rainfall to the peak of the unit hydrograph. A Type II 24-hour precipitation distribution at 30-minute intervals and the 24-hour precipitation value for the 100-year return period was used in the HEC-1 modelling to calculate the peak flows. The 100-year 24-hour precipitation value was estimated using 28 years of daily precipitation data from the nearest available meteorological station at Edgemont, South Dakota, which is approximately 13 miles southeast of the project site at an elevation of 3,460 feet above mean sea level. A statistical analysis was performed on the daily precipitation data using the Type I Extremal (Gumbel) distribution to determine the 24-hour precipitation value with a 100-year return period, which was 3.83 inches. The HEC-1 model output is given in Appendix B.

Table 1
Dewey-Burdock Subbasin Areas and 100-Year Peak Flows

Tributary To	Subbasin No.	Area (square miles)	100-Year 24-Hour Peak Flow (cfs)
Pass Creek	1	0.4793	77
Pass Creek	2	0.2625	42
Pass Creek	3	0.5347	61
Pass Creek	4	0.6754	104
Pass Creek	5	0.5479	98
Pass Creek	6	0.4348	31
Pass Creek	7	0.3891	50
Pass Creek	8	0.9785	181
Beaver Creek	9	0.6626	92
Beaver Creek	10	0.6411	122
Pass Creek	13	0.1538	20
Pass Creek	14	0.1936	33

Water surface profiles for the 100-year peak flows were modeled using the U.S. Army Corps of Engineers HEC-RAS model version 4.1. Tables 2 through 9 provide the HEC-RAS model results for each subbasin at selected stations along the alignment of the associated channel. The results shown in the tables include the channel station, peak flow, minimum channel elevation, water surface elevation, critical water surface elevation, energy gradeline elevation, energy gradeline slope, channel velocity, cross-sectional flow area, top width of flow, and Froude number. The water surface elevation determines the extent of flooding during the peak flow. The stationing along each channel, along with the floodplain area associated with the 100-year peak flow, is shown on Figures 2 through 9.

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Table 2
HEC-RAS Model Results for Subbasin 1

HEC-RAS Plan:

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Basin 1 Alignmen	7073.54	PF 1	39.00	3689.98	3690.37	3690.27	3690.42	0.019708	1.82	21.38	73.95	0.60
Basin 1 Alignmen	6900	PF 1	39.00	3687.88	3688.36		3688.39	0.007722	1.33	29.38	81.09	0.39
Basin 1 Alignmen	6600	PF 1	39.00	3683.59	3683.94		3684.00	0.037455	2.08	18.73	86.03	0.79
Basin 1 Alignmen	6300	PF 1	39.00	3677.96	3678.47		3678.51	0.010793	1.58	24.75	67.85	0.46
Basin 1 Alignmen	6000	PF 1	39.00	3671.98	3672.50	3672.47	3672.65	0.045404	3.11	12.53	36.33	0.93
Basin 1 Alignmen	5700	PF 1	39.00	3666.73	3667.56	3667.29	3667.60	0.008617	1.69	23.13	48.37	0.43
Basin 1 Alignmen	5400	PF 1	39.00	3661.97	3662.27	3662.26	3662.37	0.052000	2.56	15.23	65.59	0.94
Basin 1 Alignmen	5100	PF 1	39.00	3657.84	3658.27	3658.08	3658.28	0.006130	0.92	42.33	169.87	0.33
Basin 1 Alignmen	4800	PF 1	39.00	3653.60	3653.84	3653.84	3653.92	0.067588	2.24	17.42	111.73	1.00
Basin 1 Alignmen	4500	PF 1	39.00	3649.31	3649.84	3649.61	3649.86	0.005157	1.06	36.83	105.35	0.32
Basin 1 Alignmen	4200	PF 1	77.00	3643.99	3644.65	3644.64	3644.84	0.046940	3.50	21.97	54.70	0.97
Basin 1 Alignmen	3900	PF 1	77.00	3640.92	3641.69	3641.42	3641.71	0.004352	1.15	67.03	149.23	0.30
Basin 1 Alignmen	3600	PF 1	77.00	3637.98	3638.36	3638.36	3638.49	0.058230	2.79	27.61	113.85	1.00
Basin 1 Alignmen	3300	PF 1	77.00	3634.70	3635.65	3635.10	3635.66	0.001014	0.66	116.69	200.00	0.15
Basin 1 Alignmen	3000	PF 1	77.00	3634.00	3634.55	3634.55	3634.69	0.058317	3.03	25.37	92.25	1.02
Basin 1 Alignmen	2700	PF 1	77.00	3628.48	3630.18	3629.29	3630.19	0.001312	1.01	76.54	84.64	0.19
Basin 1 Alignmen	2400	PF 1	77.00	3627.98	3628.79	3628.79	3629.02	0.047753	3.87	19.89	43.15	1.01
Basin 1 Alignmen	2100	PF 1	77.00	3624.49	3626.24	3625.48	3626.27	0.002733	1.23	62.78	89.34	0.26
Basin 1 Alignmen	1800	PF 1	77.00	3623.78	3624.68		3624.75	0.012404	2.08	36.99	74.12	0.52
Basin 1 Alignmen	1500	PF 1	77.00	3617.91	3619.68		3619.98	0.020841	4.41	17.47	16.29	0.75
Basin 1 Alignmen	1200	PF 1	77.00	3614.17	3616.85		3616.95	0.005767	2.61	29.50	23.00	0.41
Basin 1 Alignmen	900	PF 1	77.00	3612.00	3614.72		3614.81	0.009049	2.42	31.81	39.27	0.47
Basin 1 Alignmen	600	PF 1	77.00	3612.00	3613.54		3613.58	0.002295	1.49	51.78	48.32	0.25
Basin 1 Alignmen	300	PF 1	77.00	3611.77	3612.79	3612.26	3612.82	0.002819	1.35	57.07	71.97	0.27
Basin 1 Alignmen	0	PF 1	77.00	3609.95	3610.38	3610.38	3610.56	0.053844	3.38	22.76	66.20	1.02

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Table 3

HEC-RAS Model Results for Subbasin 2

HEC-RAS Plan: Plan 02 River: Basin 2 Alignmen Reach: Basin 2 Alignmen Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Basin 2 Alignmen	6937.8	PF 1	42.00	3750.06	3750.67	3750.42	3750.70	0.007092	1.40	30.08	72.20	0.38
Basin 2 Alignmen	6900	PF 1	42.00	3749.61	3749.98	3749.98	3750.11	0.056676	2.85	14.73	57.56	0.99
Basin 2 Alignmen	6600	PF 1	42.00	3740.37	3741.03	3740.90	3741.10	0.018227	2.13	19.71	50.87	0.60
Basin 2 Alignmen	6300	PF 1	42.00	3731.78	3732.21	3732.21	3732.36	0.053688	3.05	13.75	46.54	0.99
Basin 2 Alignmen	6000	PF 1	42.00	3724.12	3724.72		3724.77	0.014585	1.81	23.23	64.97	0.53
Basin 2 Alignmen	5700	PF 1	42.00	3717.97	3718.46		3718.57	0.031399	2.72	15.42	41.46	0.79
Basin 2 Alignmen	5400	PF 1	42.00	3709.95	3710.53		3710.63	0.022553	2.56	16.43	37.89	0.68
Basin 2 Alignmen	5100	PF 1	42.00	3703.08	3703.71		3703.80	0.022968	2.42	17.32	43.85	0.68
Basin 2 Alignmen	4800	PF 1	42.00	3697.69	3698.61	3698.39	3698.69	0.013179	2.17	19.38	38.23	0.54
Basin 2 Alignmen	4500	PF 1	42.00	3692.00	3692.67		3692.76	0.032811	2.41	17.45	58.34	0.78
Basin 2 Alignmen	4200	PF 1	42.00	3686.37	3687.02		3687.06	0.012313	1.60	26.26	77.74	0.48
Basin 2 Alignmen	3900	PF 1	42.00	3681.89	3682.29		3682.34	0.020836	1.86	22.60	79.25	0.61
Basin 2 Alignmen	3600	PF 1	42.00	3675.91	3676.68	3676.51	3676.76	0.016667	2.34	17.97	37.75	0.60
Basin 2 Alignmen	3300	PF 1	42.00	3672.69	3673.37	3673.14	3673.41	0.007936	1.46	28.71	69.86	0.40
Basin 2 Alignmen	3000	PF 1	42.00	3667.99	3668.43	3668.42	3668.57	0.048241	3.03	13.85	43.70	0.95
Basin 2 Alignmen	2700	PF 1	42.00	3663.94	3664.50		3664.52	0.006158	1.15	36.61	106.06	0.34
Basin 2 Alignmen	2400	PF 1	42.00	3659.98	3660.47	3660.45	3660.55	0.046614	2.17	19.36	98.48	0.86
Basin 2 Alignmen	2100	PF 1	42.00	3654.33	3655.54	3655.09	3655.58	0.008397	1.68	24.93	51.15	0.43
Basin 2 Alignmen	1800	PF 1	42.00	3649.78	3650.27	3650.27	3650.37	0.054852	2.53	16.63	76.01	0.95
Basin 2 Alignmen	1500	PF 1	42.00	3644.53	3645.50	3645.14	3645.53	0.005528	1.48	28.28	51.30	0.35
Basin 2 Alignmen	1200	PF 1	42.00	3641.93	3642.23		3642.28	0.030392	1.74	24.17	124.11	0.69
Basin 2 Alignmen	900	PF 1	42.00	3638.97	3639.48	3639.27	3639.49	0.004403	0.97	43.31	125.35	0.29
Basin 2 Alignmen	600	PF 1	42.00	3635.99	3636.25	3636.23	3636.32	0.051446	2.19	19.17	103.45	0.90
Basin 2 Alignmen	300	PF 1	42.00	3633.97	3634.41		3634.41	0.002313	0.70	60.22	176.27	0.21
Basin 2 Alignmen	0	PF 1	42.00	3632.00	3632.33	3632.33	3632.45	0.060515	2.78	15.10	64.07	1.01

Table 4

HEC-RAS Model Results for Subbasin 3

HEC-RAS Plan: Plan 01 River: Basin 3 Alignmen Reach: Basin 3 Alignmen Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Basin 3 Alignmen	9228.02	PF 1	61.00	3801.12	3802.31	3802.24	3802.55	0.033598	3.89	15.67	24.73	0.86
Basin 3 Alignmen	9000	PF 1	61.00	3793.80	3794.32	3794.27	3794.44	0.037378	2.85	21.41	61.32	0.85
Basin 3 Alignmen	8700	PF 1	61.00	3783.93	3784.73	3784.63	3784.90	0.027410	3.26	18.71	34.61	0.78
Basin 3 Alignmen	8400	PF 1	61.00	3773.06	3773.66	3773.66	3773.85	0.052103	3.44	17.74	49.12	1.01
Basin 3 Alignmen	8100	PF 1	61.00	3764.29	3765.07	3764.90	3765.16	0.016985	2.40	25.39	51.92	0.61
Basin 3 Alignmen	7800	PF 1	61.00	3756.62	3757.20	3757.17	3757.30	0.045742	2.56	23.81	92.99	0.89
Basin 3 Alignmen	7500	PF 1	61.00	3749.98	3751.12	3750.83	3751.20	0.011403	2.26	27.02	44.98	0.51
Basin 3 Alignmen	7200	PF 1	61.00	3745.94	3746.58		3746.69	0.020786	2.65	23.04	47.38	0.67
Basin 3 Alignmen	6900	PF 1	61.00	3741.97	3742.50	3742.31	3742.54	0.009762	1.58	38.60	97.77	0.44
Basin 3 Alignmen	6600	PF 1	61.00	3737.33	3737.78		3737.86	0.028717	2.24	27.19	91.44	0.73
Basin 3 Alignmen	6300	PF 1	61.00	3725.94	3727.16	3727.16	3727.55	0.041620	5.01	12.18	15.98	1.01
Basin 3 Alignmen	6000	PF 1	61.00	3719.93	3721.82	3721.11	3721.90	0.005030	2.21	27.59	25.35	0.37
Basin 3 Alignmen	5700	PF 1	61.00	3717.77	3718.38	3718.35	3718.50	0.044668	2.84	21.48	70.61	0.91
Basin 3 Alignmen	5400	PF 1	61.00	3709.96	3710.81		3710.90	0.016292	2.32	26.27	54.63	0.59
Basin 3 Alignmen	5100	PF 1	61.00	3706.32	3707.30		3707.36	0.008860	1.95	31.32	53.85	0.45
Basin 3 Alignmen	4800	PF 1	61.00	3701.95	3702.54	3702.49	3702.68	0.034452	2.95	20.69	52.92	0.83
Basin 3 Alignmen	4500	PF 1	61.00	3696.76	3697.84		3697.88	0.009112	1.79	34.12	68.15	0.45
Basin 3 Alignmen	4200	PF 1	61.00	3691.90	3692.91	3692.85	3693.12	0.034272	3.63	16.82	31.35	0.87
Basin 3 Alignmen	3900	PF 1	61.00	3688.00	3689.39		3689.44	0.006116	1.89	32.25	43.78	0.39
Basin 3 Alignmen	3600	PF 1	61.00	3683.98	3685.20	3685.20	3685.55	0.042843	4.71	12.94	19.12	1.01
Basin 3 Alignmen	3300	PF 1	61.00	3679.98	3681.92	3681.20	3681.98	0.004440	2.01	30.33	29.35	0.35
Basin 3 Alignmen	3000	PF 1	61.00	3677.84	3678.59	3678.59	3678.83	0.047391	3.98	15.34	31.77	1.01
Basin 3 Alignmen	2700	PF 1	61.00	3673.81	3674.70	3674.41	3674.73	0.005729	1.40	43.46	87.78	0.35
Basin 3 Alignmen	2400	PF 1	61.00	3671.93	3672.54		3672.59	0.009096	1.82	33.43	64.63	0.45
Basin 3 Alignmen	2100	PF 1	61.00	3669.94	3670.67		3670.70	0.004628	1.34	45.35	83.54	0.32
Basin 3 Alignmen	1800	PF 1	61.00	3667.73	3668.74		3668.78	0.009495	1.62	37.63	89.78	0.44
Basin 3 Alignmen	1500	PF 1	61.00	3665.89	3666.33		3666.35	0.006914	1.18	51.66	156.36	0.36
Basin 3 Alignmen	1200	PF 1	61.00	3661.73	3662.75		3662.89	0.022602	3.02	20.20	36.23	0.71
Basin 3 Alignmen	900	PF 1	61.00	3657.84	3659.20	3658.67	3659.25	0.007471	1.73	35.26	63.59	0.41
Basin 3 Alignmen	600	PF 1	61.00	3653.80	3654.29	3654.29	3654.45	0.055146	3.21	18.99	60.67	1.01
Basin 3 Alignmen	300	PF 1	61.00	3650.00	3652.34	3651.35	3652.39	0.002459	1.73	35.21	27.20	0.27
Basin 3 Alignmen	0	PF 1	61.00	3649.83	3650.20	3650.20	3650.34	0.059093	2.89	20.42	76.80	1.02

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Table 5

HEC-RAS Model Results for Subbasin 4

HEC-RAS Plan: Plan 01 River: Basin 4 Alignmen Reach: Basin 4 Alignmen Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Basin 4 Alignmen	7235.89	PF 1	104.00	3847.31	3849.25	3848.91	3849.40	0.014269	3.17	32.86	37.04	0.59
Basin 4 Alignmen	7200	PF 1	104.00	3846.46	3848.13	3848.13	3848.55	0.043395	5.20	20.00	24.26	1.01
Basin 4 Alignmen	6900	PF 1	104.00	3831.93	3832.76	3832.86	3833.20	0.061270	5.31	19.57	31.79	1.19
Basin 4 Alignmen	6600	PF 1	104.00	3818.80	3819.41	3819.34	3819.53	0.029175	2.77	37.48	92.70	0.77
Basin 4 Alignmen	6300	PF 1	104.00	3807.75	3808.49	3808.49	3808.77	0.045040	4.23	24.58	44.67	1.01
Basin 4 Alignmen	6000	PF 1	104.00	3797.91	3799.12	3798.86	3799.26	0.015178	2.99	34.73	46.85	0.61
Basin 4 Alignmen	5700	PF 1	104.00	3790.76	3791.61	3791.61	3791.88	0.046339	4.12	25.27	48.92	1.01
Basin 4 Alignmen	5400	PF 1	104.00	3781.51	3782.53	3782.36	3782.68	0.020294	3.08	33.76	54.35	0.69
Basin 4 Alignmen	5100	PF 1	104.00	3774.73	3775.61		3775.77	0.026350	3.23	32.24	58.90	0.77
Basin 4 Alignmen	4800	PF 1	104.00	3764.49	3765.48	3765.48	3765.80	0.043064	4.57	22.77	35.65	1.01
Basin 4 Alignmen	4500	PF 1	104.00	3759.40	3760.36	3760.10	3760.40	0.007819	1.73	59.96	111.75	0.42
Basin 4 Alignmen	4200	PF 1	104.00	3755.68	3756.25	3756.18	3756.36	0.028438	2.69	38.68	98.38	0.76
Basin 4 Alignmen	3900	PF 1	104.00	3749.89	3750.96	3750.68	3751.04	0.012088	2.26	46.03	80.03	0.52
Basin 4 Alignmen	3600	PF 1	104.00	3745.09	3746.04	3745.88	3746.16	0.022983	2.84	36.61	73.11	0.71
Basin 4 Alignmen	3300	PF 1	104.00	3739.93	3740.54		3740.62	0.015148	2.35	44.22	85.70	0.58
Basin 4 Alignmen	3000	PF 1	104.00	3735.98	3737.22	3736.78	3737.32	0.008344	2.54	40.92	45.01	0.47
Basin 4 Alignmen	2700	PF 1	104.00	3731.76	3732.39	3732.36	3732.59	0.040058	3.59	28.99	61.85	0.92
Basin 4 Alignmen	2400	PF 1	104.00	3727.12	3728.44		3728.50	0.006698	2.05	50.78	65.52	0.41
Basin 4 Alignmen	2100	PF 1	104.00	3724.00	3725.46		3725.61	0.015004	3.04	34.20	44.68	0.61
Basin 4 Alignmen	1800	PF 1	104.00	3720.68	3721.95		3722.05	0.009527	2.61	39.79	46.41	0.50
Basin 4 Alignmen	1500	PF 1	104.00	3717.83	3718.85		3718.95	0.011233	2.63	39.54	51.69	0.53
Basin 4 Alignmen	1200	PF 1	104.00	3715.74	3716.63		3716.68	0.005395	1.75	59.48	82.87	0.36
Basin 4 Alignmen	900	PF 1	104.00	3712.09	3712.80	3712.80	3713.01	0.049171	3.70	28.11	66.80	1.01
Basin 4 Alignmen	600	PF 1	104.00	3703.93	3705.05	3704.75	3705.21	0.013648	3.25	31.99	35.09	0.60
Basin 4 Alignmen	300	PF 1	104.00	3701.71	3703.18	3702.53	3703.23	0.003790	1.80	57.66	58.79	0.32
Basin 4 Alignmen	0	PF 1	104.00	3699.68	3700.21	3700.21	3700.39	0.052036	3.42	30.40	84.81	1.01

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Table 6

HEC-RAS Model Results for Subbasins 5, 13, and 14

HEC-RAS Plan: Plan 01 River: Basin 5-13 Align Reach: Basin 5-13 Align Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Basin 5-13 Align	17055.05	PF 1	49.00	3925.97	3926.20	3926.15	3926.21	0.019699	1.03	47.60	387.94	0.52
Basin 5-13 Align	17000	PF 1	49.00	3923.93	3924.33	3924.33	3924.43	0.061192	2.60	18.83	89.04	1.00
Basin 5-13 Align	16500	PF 1	49.00	3861.67	3862.06	3862.32	3863.11	0.474741	8.22	5.96	23.44	2.87
Basin 5-13 Align	16000	PF 1	49.00	3837.70	3838.44	3838.44	3838.69	0.046918	4.03	12.15	24.40	1.01
Basin 5-13 Align	15500	PF 1	49.00	3820.70	3822.15	3821.82	3822.30	0.013472	3.07	15.95	18.70	0.59
Basin 5-13 Align	15000	PF 1	49.00	3809.63	3810.14	3810.14	3810.30	0.054076	3.27	15.00	46.09	1.01
Basin 5-13 Align	14500	PF 1	49.00	3793.98	3795.33	3794.88	3795.40	0.006727	2.14	22.92	27.71	0.41
Basin 5-13 Align	14000	PF 1	49.00	3787.99	3788.94		3789.17	0.030245	3.81	12.86	20.19	0.84
Basin 5-13 Align	13500	PF 1	98.00	3778.92	3779.96	3779.73	3780.07	0.014659	2.66	36.79	57.68	0.59
Basin 5-13 Align	13000	PF 1	98.00	3766.63	3767.36	3767.36	3767.56	0.051916	3.59	27.29	70.63	1.02
Basin 5-13 Align	12500	PF 1	98.00	3753.92	3754.67	3754.41	3754.75	0.010958	2.36	41.52	62.73	0.51
Basin 5-13 Align	12000	PF 1	98.00	3743.70	3744.15	3744.15	3744.30	0.054338	3.13	31.29	102.95	1.00
Basin 5-13 Align	11500	PF 1	98.00	3734.04	3734.67	3734.48	3734.69	0.008068	1.31	75.07	219.46	0.39
Basin 5-13 Align	11000	PF 1	98.00	3724.66	3725.86	3725.86	3725.98	0.061937	2.76	35.56	155.12	1.01
Basin 5-13 Align	10500	PF 1	98.00	3713.85	3714.79	3714.47	3714.86	0.007733	2.05	47.81	68.74	0.43
Basin 5-13 Align	10000	PF 1	98.00	3705.91	3707.00	3707.00	3707.40	0.039463	5.11	19.17	23.59	1.00
Basin 5-13 Align	9500	PF 1	195.00	3699.97	3701.88	3701.25	3701.95	0.005553	2.18	89.59	91.53	0.39
Basin 5-13 Align	9000	PF 1	195.00	3697.35	3698.44	3698.13	3698.51	0.008733	2.02	96.46	155.29	0.45
Basin 5-13 Align	8500	PF 1	195.00	3692.53	3693.32	3693.15	3693.38	0.012176	1.92	101.36	224.77	0.50
Basin 5-13 Align	8000	PF 1	195.00	3688.00	3688.52		3688.56	0.007825	1.54	126.30	280.07	0.41
Basin 5-13 Align	7500	PF 1	195.00	3679.40	3680.07	3680.07	3680.25	0.056117	3.38	57.61	172.18	1.03
Basin 5-13 Align	7000	PF 1	195.00	3669.99	3673.20	3671.81	3673.30	0.005113	2.53	77.07	58.38	0.39
Basin 5-13 Align	6500	PF 1	195.00	3665.97	3669.72		3670.00	0.008680	4.26	45.79	22.49	0.53
Basin 5-13 Align	6000	PF 1	195.00	3662.02	3665.83		3665.94	0.007453	2.61	74.82	71.90	0.45
Basin 5-13 Align	5500	PF 1	195.00	3659.89	3662.73	3661.70	3662.76	0.005374	1.51	129.39	224.20	0.35
Basin 5-13 Align	5000	PF 1	195.00	3655.60	3656.57	3656.57	3656.94	0.041190	4.88	39.98	54.82	1.01
Basin 5-13 Align	4500	PF 1	273.00	3651.86	3653.66	3652.73	3653.70	0.002475	1.67	163.96	137.08	0.27
Basin 5-13 Align	4000	PF 1	273.00	3647.93	3650.15	3650.15	3650.36	0.051246	3.69	73.93	181.44	1.02
Basin 5-13 Align	3500	PF 1	273.00	3645.78	3647.21	3646.57	3647.23	0.002245	1.18	231.80	301.76	0.24
Basin 5-13 Align	3000	PF 1	273.00	3641.99	3644.28	3644.21	3644.39	0.033742	2.69	101.44	292.28	0.81
Basin 5-13 Align	2500	PF 1	273.00	3637.92	3640.67		3640.72	0.003098	1.81	150.92	128.52	0.29
Basin 5-13 Align	2000	PF 1	273.00	3635.96	3638.79	3638.34	3638.83	0.004699	1.69	161.42	212.59	0.34
Basin 5-13 Align	1500	PF 1	273.00	3634.00	3636.57	3636.17	3636.61	0.004201	1.52	179.52	255.10	0.32
Basin 5-13 Align	1000	PF 1	326.00	3630.77	3632.39		3632.55	0.017724	3.18	102.65	141.07	0.66
Basin 5-13 Align	500	PF 1	326.00	3628.88	3630.31		3630.33	0.001926	1.22	266.26	292.71	0.23
Basin 5-13 Align	0	PF 1	326.00	3626.25	3627.34	3627.34	3627.66	0.044020	4.52	72.11	116.77	1.01

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Table 7
HEC-RAS Model Results for Subbasins 6 and 7

HEC-RAS Plan: Plan 01 River: Basin 6-7 Alignm Reach: Basin 6-7 Alignm Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Basin 6-7 Alignm	15450.95	PF 1	35.00	3774.99	3775.34	3775.34	3775.42	0.070179	2.25	15.56	101.55	1.01
Basin 6-7 Alignm	15300	PF 1	35.00	3762.15	3762.61	3762.69	3762.85	0.100217	3.88	9.02	33.56	1.32
Basin 6-7 Alignm	15000	PF 1	35.00	3749.89	3750.45	3750.27	3750.49	0.010612	1.50	23.40	68.53	0.45
Basin 6-7 Alignm	14700	PF 1	35.00	3743.65	3744.11	3744.11	3744.25	0.057553	3.00	11.68	42.85	1.01
Basin 6-7 Alignm	14400	PF 1	35.00	3734.78	3735.41	3735.23	3735.47	0.012830	1.85	18.87	46.13	0.51
Basin 6-7 Alignm	14100	PF 1	35.00	3727.87	3728.22	3728.22	3728.34	0.057753	2.83	12.35	49.43	1.00
Basin 6-7 Alignm	13800	PF 1	35.00	3719.92	3720.88	3720.62	3720.93	0.010434	1.86	18.81	39.15	0.47
Basin 6-7 Alignm	13500	PF 1	35.00	3715.86	3716.14		3716.18	0.026800	1.47	23.83	143.51	0.64
Basin 6-7 Alignm	13200	PF 1	35.00	3711.20	3711.97		3712.01	0.008457	1.60	21.88	48.82	0.42
Basin 6-7 Alignm	12900	PF 1	35.00	3706.66	3707.30	3707.22	3707.43	0.035049	3.00	11.68	29.49	0.84
Basin 6-7 Alignm	12600	PF 1	35.00	3703.91	3704.37		3704.38	0.004681	1.00	35.17	102.72	0.30
Basin 6-7 Alignm	12300	PF 1	35.00	3701.90	3702.22		3702.24	0.012199	1.20	29.19	132.16	0.45
Basin 6-7 Alignm	12000	PF 1	35.00	3697.96	3698.33		3698.35	0.013836	1.30	26.99	119.16	0.48
Basin 6-7 Alignm	11700	PF 1	35.00	3694.61	3695.11		3695.13	0.008541	1.18	29.67	105.39	0.39
Basin 6-7 Alignm	11400	PF 1	35.00	3689.87	3690.29		3690.37	0.038882	2.32	15.10	60.66	0.82
Basin 6-7 Alignm	11100	PF 1	35.00	3685.97	3686.71	3686.40	3686.73	0.005824	1.08	32.35	98.18	0.33
Basin 6-7 Alignm	10800	PF 1	35.00	3682.05	3682.45	3682.45	3682.52	0.069032	2.15	16.26	111.90	1.00
Basin 6-7 Alignm	10500	PF 1	35.00	3675.97	3676.60	3676.30	3676.62	0.004661	1.14	30.63	72.39	0.31
Basin 6-7 Alignm	10200	PF 1	35.00	3674.00	3674.43		3674.47	0.012409	1.74	20.14	52.89	0.50
Basin 6-7 Alignm	9900	PF 1	35.00	3670.15	3670.95		3671.01	0.010742	1.91	18.37	37.71	0.48
Basin 6-7 Alignm	9600	PF 1	50.00	3665.98	3667.04	3666.80	3667.14	0.014768	2.58	19.40	32.09	0.58
Basin 6-7 Alignm	9300	PF 1	50.00	3663.63	3664.48		3664.50	0.005768	1.17	42.79	113.94	0.34
Basin 6-7 Alignm	9000	PF 1	50.00	3661.67	3662.34		3662.37	0.008888	1.22	40.89	141.51	0.40
Basin 6-7 Alignm	8700	PF 1	50.00	3659.94	3660.84		3660.86	0.003218	1.21	41.26	67.64	0.27
Basin 6-7 Alignm	8400	PF 1	50.00	3658.00	3659.28		3659.32	0.009327	1.59	31.48	76.41	0.44
Basin 6-7 Alignm	8100	PF 1	50.00	3655.97	3657.35		3657.39	0.004743	1.61	31.03	44.27	0.34
Basin 6-7 Alignm	7800	PF 1	50.00	3654.00	3655.38		3655.49	0.008892	2.61	19.17	21.08	0.48
Basin 6-7 Alignm	7500	PF 1	50.00	3651.88	3653.81		3653.85	0.003627	1.79	27.99	27.73	0.31
Basin 6-7 Alignm	7200	PF 1	50.00	3650.00	3652.28		3652.36	0.007301	2.22	22.49	26.95	0.43
Basin 6-7 Alignm	6900	PF 1	50.00	3650.00	3650.38		3650.40	0.005712	1.04	47.89	150.84	0.33
Basin 6-7 Alignm	6600	PF 1	70.00	3648.05	3648.86		3648.89	0.004639	1.50	46.57	72.71	0.33
Basin 6-7 Alignm	6300	PF 1	70.00	3645.86	3647.50		3647.55	0.004312	1.71	40.95	49.85	0.33
Basin 6-7 Alignm	6000	PF 1	70.00	3644.00	3646.18		3646.21	0.004616	1.25	56.18	115.56	0.31
Basin 6-7 Alignm	5700	PF 1	70.00	3643.82	3644.53		3644.57	0.006596	1.52	45.98	91.76	0.38
Basin 6-7 Alignm	5400	PF 1	70.00	3641.86	3642.47		3642.51	0.007138	1.45	48.22	109.65	0.39
Basin 6-7 Alignm	5100	PF 1	70.00	3638.41	3639.20		3639.29	0.017793	2.48	28.24	57.05	0.62
Basin 6-7 Alignm	4800	PF 1	70.00	3632.82	3634.39	3633.96	3634.46	0.014647	2.12	32.97	72.47	0.55
Basin 6-7 Alignm	4500	PF 1	70.00	3629.76	3630.65		3630.73	0.010679	2.28	30.76	48.14	0.50
Basin 6-7 Alignm	4200	PF 1	70.00	3628.00	3629.29		3629.31	0.002589	1.26	55.76	73.64	0.25
Basin 6-7 Alignm	3900	PF 1	70.00	3627.99	3628.72		3628.73	0.001513	0.86	81.70	127.39	0.19
Basin 6-7 Alignm	3600	PF 1	70.00	3627.24	3628.19		3628.20	0.002077	0.95	73.67	124.86	0.22

Table 7 (Continued)
HEC-RAS Model Results for Subbasins 6 and 7

HEC-RAS Plan: Plan 01 River: Basin 6-7 Alignm Reach: Basin 6-7 Alignm Profile: PF 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Basin 6-7 Alignm	3300	PF 1	70.00	3625.72	3626.29	3626.29	3626.43	0.054666	3.06	22.87	78.21	1.00
Basin 6-7 Alignm	3000	PF 1	70.00	3620.00	3622.73	3621.66	3622.80	0.004202	2.13	32.94	27.63	0.34
Basin 6-7 Alignm	2700	PF 1	70.00	3619.93	3621.35		3621.43	0.005072	2.23	31.38	28.69	0.38
Basin 6-7 Alignm	2400	PF 1	70.00	3617.98	3619.40		3619.48	0.008561	2.34	29.94	38.07	0.46
Basin 6-7 Alignm	2100	PF 1	70.00	3613.97	3615.92	3615.54	3616.15	0.014794	3.86	18.13	15.87	0.64
Basin 6-7 Alignm	1800	PF 1	70.00	3611.98	3613.28		3613.36	0.006227	2.23	31.39	33.67	0.41
Basin 6-7 Alignm	1500	PF 1	428.00	3609.99	3612.18		3612.27	0.003348	2.37	180.47	110.58	0.33
Basin 6-7 Alignm	1200	PF 1	428.00	3606.00	3611.08		3611.22	0.003623	2.95	145.03	67.17	0.35
Basin 6-7 Alignm	900	PF 1	428.00	3605.90	3610.30		3610.35	0.002250	1.67	255.83	195.43	0.26
Basin 6-7 Alignm	600	PF 1	428.00	3603.94	3609.10		3609.29	0.006125	3.44	124.56	68.17	0.45
Basin 6-7 Alignm	300	PF 1	428.00	3603.79	3607.22	3606.70	3607.32	0.006907	2.61	163.76	148.88	0.44
Basin 6-7 Alignm	0	PF 1	428.00	3599.86	3602.61	3602.61	3603.33	0.033546	6.79	63.07	44.85	1.01

Table 8
HEC-RAS Model Results for Subbasin 8

HEC-RAS Plan: Plan 01 River: Basin 8 Alignmen Reach: Basin 8 Alignmen Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Basin 8 Alignmen	6900	PF 1	45.00	3777.90	3778.66	3778.36	3778.71	0.007543	1.76	25.63	45.49	0.41
Basin 8 Alignmen	6883.4	PF 1	45.00	3777.73	3778.48		3778.55	0.012173	2.02	22.23	45.68	0.51
Basin 8 Alignmen	6600	PF 1	45.00	3772.51	3773.49	3773.36	3773.65	0.026270	3.29	13.67	23.20	0.76
Basin 8 Alignmen	6300	PF 1	45.00	3767.88	3768.37		3768.42	0.012299	1.80	24.99	61.84	0.50
Basin 8 Alignmen	6000	PF 1	45.00	3763.89	3764.30	3764.19	3764.35	0.015055	1.74	25.83	78.19	0.53
Basin 8 Alignmen	5700	PF 1	45.00	3755.36	3756.76	3756.76	3757.16	0.043422	5.04	8.93	11.71	1.02
Basin 8 Alignmen	5400	PF 1	45.00	3747.96	3749.62	3749.11	3749.73	0.008511	2.70	16.68	16.68	0.48
Basin 8 Alignmen	5100	PF 1	45.00	3743.91	3744.38	3744.38	3744.58	0.050737	3.61	12.45	31.29	1.01
Basin 8 Alignmen	4800	PF 1	45.00	3739.99	3741.09	3740.46	3741.11	0.002488	1.35	33.35	38.24	0.25
Basin 8 Alignmen	4500	PF 1	90.00	3737.76	3738.59		3738.75	0.020743	3.18	28.33	44.19	0.70
Basin 8 Alignmen	4200	PF 1	90.00	3733.98	3734.96	3734.60	3735.03	0.008132	2.14	42.09	58.94	0.45
Basin 8 Alignmen	3900	PF 1	90.00	3729.24	3729.78	3729.78	3729.93	0.055176	3.05	29.53	102.38	1.00
Basin 8 Alignmen	3600	PF 1	90.00	3724.00	3725.13	3724.42	3725.15	0.001112	0.98	91.44	92.08	0.17
Basin 8 Alignmen	3300	PF 1	90.00	3724.00	3724.30		3724.34	0.013643	1.55	57.93	193.12	0.50
Basin 8 Alignmen	3000	PF 1	181.00	3714.72	3715.49	3715.49	3715.71	0.047720	3.79	47.73	106.91	1.00
Basin 8 Alignmen	2700	PF 1	181.00	3710.24	3711.36	3710.93	3711.42	0.005121	1.84	98.36	121.23	0.36
Basin 8 Alignmen	2400	PF 1	181.00	3707.07	3707.68	3707.68	3707.88	0.050376	3.54	51.20	132.67	1.00
Basin 8 Alignmen	2100	PF 1	181.00	3699.93	3701.34	3700.90	3701.49	0.009968	3.05	59.29	56.23	0.52
Basin 8 Alignmen	1800	PF 1	181.00	3695.78	3697.07		3697.36	0.019983	4.27	42.40	41.15	0.74
Basin 8 Alignmen	1500	PF 1	181.00	3691.77	3693.01		3693.15	0.010225	3.00	60.37	60.40	0.53
Basin 8 Alignmen	1200	PF 1	181.00	3687.65	3688.79		3688.98	0.019740	3.55	50.95	64.82	0.71
Basin 8 Alignmen	900	PF 1	181.00	3686.00	3687.77		3687.81	0.001536	1.48	122.37	85.31	0.22
Basin 8 Alignmen	600	PF 1	181.00	3685.83	3687.06		3687.11	0.003913	1.80	100.47	105.21	0.32
Basin 8 Alignmen	300	PF 1	181.00	3683.91	3684.68	3684.52	3684.84	0.019867	3.23	55.97	82.40	0.69
Basin 8 Alignmen	0	PF 1	181.00	3674.00	3676.37	3676.37	3677.00	0.035346	6.39	28.30	22.58	1.01

Table 9
HEC-RAS Model Results for Subbasins 9 and 10

HEC-RAS Plan: Plan 01 River: Basin 9-10 Align Reach: Basin 9-10 Align Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Basin 9-10 Align	13404.94	PF 1	61.00	3923.38	3924.43	3924.43	3924.75	0.044618	4.53	13.46	21.81	1.02
Basin 9-10 Align	13200	PF 1	61.00	3905.83	3906.79	3907.19	3908.09	0.188802	9.14	6.68	10.98	2.06
Basin 9-10 Align	12900	PF 1	61.00	3865.99	3867.05	3867.27	3867.79	0.099758	6.89	8.85	13.85	1.52
Basin 9-10 Align	12600	PF 1	61.00	3849.88	3850.92	3850.92	3851.27	0.042823	4.72	12.93	19.07	1.01
Basin 9-10 Align	12300	PF 1	61.00	3829.98	3831.32	3831.62	3832.31	0.101559	8.02	7.61	9.27	1.56
Basin 9-10 Align	12000	PF 1	61.00	3815.54	3816.25	3816.22	3816.48	0.038415	3.79	16.09	30.53	0.92
Basin 9-10 Align	11700	PF 1	61.00	3802.83	3803.85	3803.85	3804.18	0.043701	4.58	13.33	20.94	1.01
Basin 9-10 Align	11400	PF 1	61.00	3793.08	3793.64	3793.57	3793.73	0.027088	2.42	25.19	72.29	0.72
Basin 9-10 Align	11100	PF 1	61.00	3781.96	3782.42	3782.42	3782.56	0.054383	3.07	19.85	67.19	1.00
Basin 9-10 Align	10800	PF 1	61.00	3766.01	3766.88	3766.77	3767.03	0.027470	3.12	19.57	38.85	0.77
Basin 9-10 Align	10500	PF 1	61.00	3755.08	3755.61	3755.61	3755.75	0.054462	3.04	20.06	69.08	0.99
Basin 9-10 Align	10200	PF 1	61.00	3743.36	3744.31	3744.31	3744.60	0.045592	4.32	14.12	25.05	1.01
Basin 9-10 Align	9900	PF 1	61.00	3733.88	3734.67	3734.43	3734.76	0.012194	2.37	25.74	41.86	0.53
Basin 9-10 Align	9600	PF 1	122.00	3725.77	3726.39	3726.39	3726.61	0.047515	3.79	32.21	72.01	1.00
Basin 9-10 Align	9300	PF 1	122.00	3715.89	3717.28	3716.91	3717.43	0.012025	3.08	39.55	42.78	0.57
Basin 9-10 Align	9000	PF 1	122.00	3709.64	3710.93	3710.93	3711.31	0.041330	4.97	24.55	32.78	1.01
Basin 9-10 Align	8700	PF 1	122.00	3701.92	3703.69	3703.21	3703.81	0.011870	2.80	43.52	53.85	0.55
Basin 9-10 Align	8400	PF 1	122.00	3695.99	3697.96	3697.88	3698.38	0.030368	5.25	23.25	22.43	0.91
Basin 9-10 Align	8100	PF 1	122.00	3693.88	3694.70		3694.75	0.006168	1.79	68.08	101.15	0.38
Basin 9-10 Align	7800	PF 1	122.00	3690.03	3690.49	3690.49	3690.69	0.049685	3.57	34.18	86.38	1.00
Basin 9-10 Align	7500	PF 1	122.00	3683.98	3684.77	3684.44	3684.83	0.007085	1.88	64.99	99.92	0.41
Basin 9-10 Align	7200	PF 1	122.00	3680.00	3680.66	3680.61	3680.76	0.035486	2.59	47.03	149.00	0.81
Basin 9-10 Align	6900	PF 1	122.00	3675.91	3676.83		3676.88	0.006577	1.82	67.10	102.32	0.40
Basin 9-10 Align	6600	PF 1	122.00	3671.78	3672.37	3672.37	3672.56	0.052236	3.51	34.74	93.39	1.01
Basin 9-10 Align	6300	PF 1	122.00	3659.86	3662.42	3661.57	3662.60	0.006759	3.33	36.68	22.29	0.46
Basin 9-10 Align	6000	PF 1	122.00	3656.92	3660.04		3660.25	0.009144	3.71	32.85	21.08	0.52
Basin 9-10 Align	5700	PF 1	122.00	3653.97	3657.02		3657.27	0.010865	3.98	30.62	20.08	0.57
Basin 9-10 Align	5400	PF 1	122.00	3651.02	3654.25		3654.45	0.008102	3.58	34.12	21.10	0.50
Basin 9-10 Align	5100	PF 1	122.00	3648.08	3650.96		3651.26	0.014455	4.42	27.58	19.17	0.65
Basin 9-10 Align	4800	PF 1	122.00	3645.13	3648.44		3648.59	0.005879	3.11	39.29	23.77	0.43
Basin 9-10 Align	4500	PF 1	122.00	3642.19	3644.49	3644.44	3645.02	0.033954	5.87	20.77	18.09	0.97
Basin 9-10 Align	4200	PF 1	168.00	3637.94	3639.83		3640.03	0.010889	3.63	46.22	36.13	0.57
Basin 9-10 Align	3900	PF 1	168.00	3633.97	3635.98	3635.63	3636.21	0.015155	3.86	43.50	39.84	0.65
Basin 9-10 Align	3600	PF 1	168.00	3628.62	3630.01	3629.88	3630.32	0.026353	4.48	37.47	41.70	0.83
Basin 9-10 Align	3300	PF 1	168.00	3623.99	3625.92		3626.06	0.008661	2.94	57.15	51.91	0.49
Basin 9-10 Align	3000	PF 1	168.00	3619.89	3621.50	3621.35	3621.91	0.024914	5.17	32.53	27.81	0.84
Basin 9-10 Align	2700	PF 1	168.00	3615.88	3617.61		3617.75	0.008564	3.03	55.37	47.49	0.50
Basin 9-10 Align	2400	PF 1	168.00	3611.98	3613.78		3614.06	0.019048	4.21	39.95	38.24	0.73
Basin 9-10 Align	2100	PF 1	196.00	3609.99	3612.59		3612.64	0.002172	1.89	103.72	64.68	0.26

POWERTECH (USA) INC.

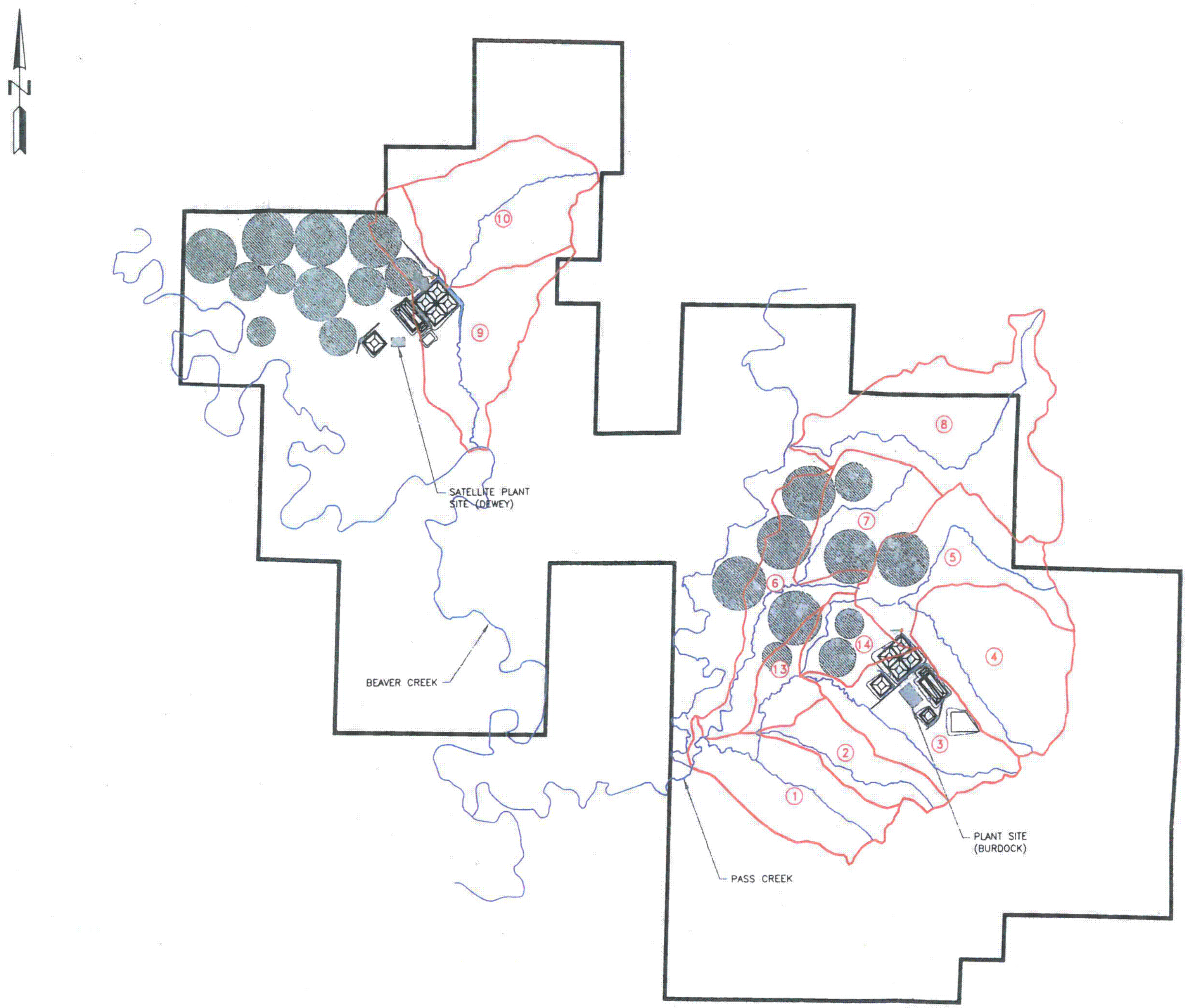
Table 9 (Continued)
HEC-RAS Model Results for Subbasins 9 and 10

HEC-RAS Plan: Plan 01 River: Basin 9-10 Align Reach: Basin 9-10 Align Profile: PF 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Basin 9-10 Align	1800	PF 1	196.00	3609.30	3610.45	3610.45	3610.91	0.038416	5.42	36.18	40.12	1.01
Basin 9-10 Align	1500	PF 1	196.00	3602.04	3604.59	3604.02	3604.85	0.010761	4.10	47.83	30.62	0.58
Basin 9-10 Align	1200	PF 1	196.00	3599.97	3602.12		3602.26	0.006930	3.03	64.75	47.43	0.46
Basin 9-10 Align	900	PF 1	196.00	3597.75	3599.57		3599.72	0.010521	3.11	63.04	60.81	0.54
Basin 9-10 Align	600	PF 1	196.00	3594.67	3596.34	3596.03	3596.45	0.011194	2.62	74.74	97.68	0.53
Basin 9-10 Align	300	PF 1	196.00	3589.81	3592.12	3591.75	3592.43	0.016157	4.46	43.92	33.60	0.69
Basin 9-10 Align	0	PF 1	196.00	3584.00	3584.52	3584.52	3584.77	0.046078	3.99	49.09	99.05	1.00

Appendix A

Subbasin Figures



LEGEND:

EXISTING GROUND SURFACE CONTOUR AND ELEVATION, FEET

PERMIT BOUNDARY

WATERSHED BOUNDARIES

EPHEMERAL CHANNELS

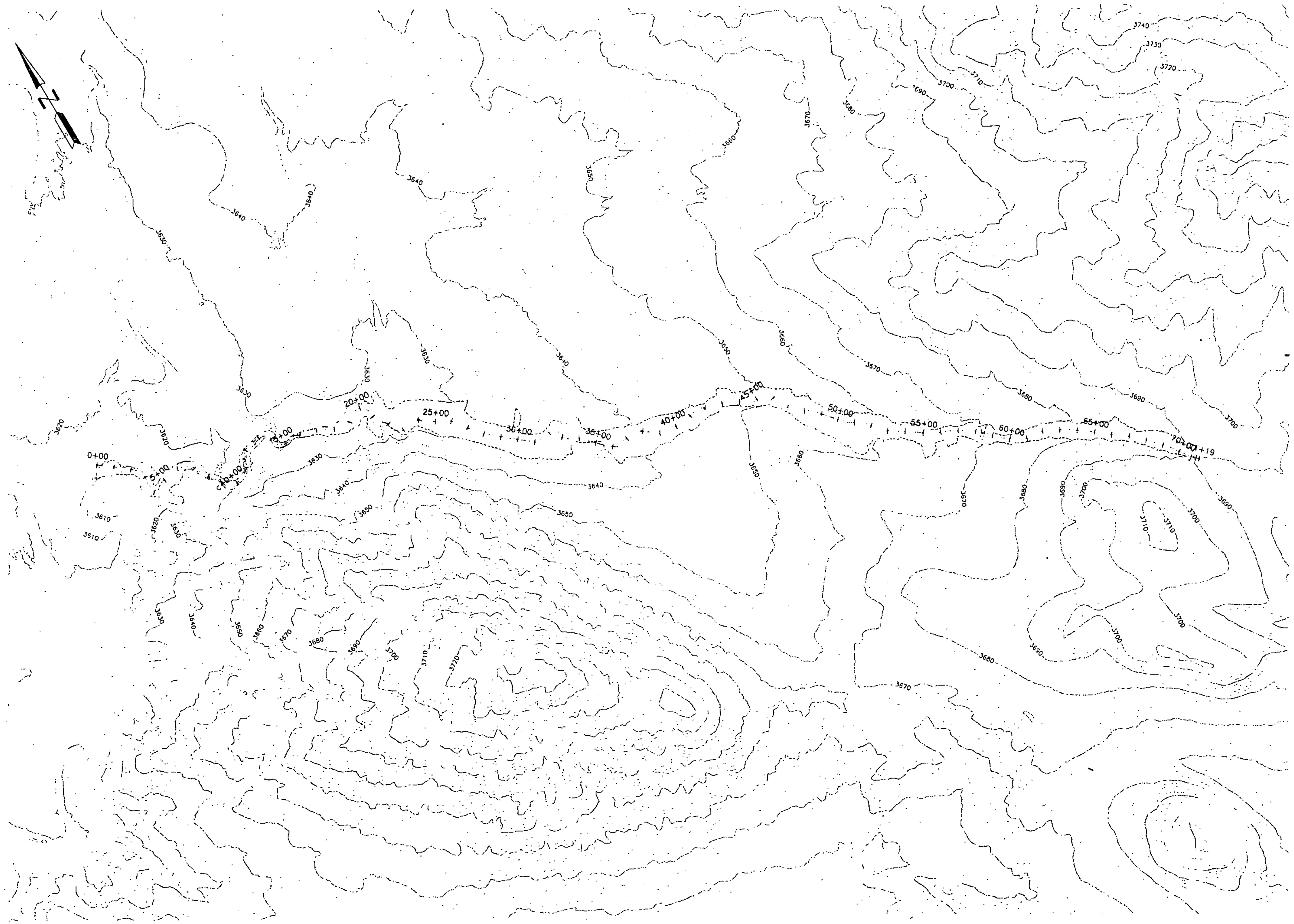
LAND APPLICATION AREAS

PLAN

2000 0 2000 4000 FEET

1" = 2000' AT FULL SIZE (ANSI D)
1" = 4000' AT HALF SIZE (ANSI B)

CONSULTANT	REVISIONS					POWERTECH (USA) INC.
	#	DRAWN	CHECKED	APPROVED	DATE	FIGURE 1 MINOR SUBBASINS AND CHANNELS
REF						
CHECK SCALES — If this bar does not measure 1 inch this map is not at its original scale	PLOT DATE 15-Sep-2010	DATE 25-Aug-2010	PROJECT DEWEY-BURDOCK PROJECT			1
	DRAWN SH	CHECKED JD	COORDS			
Arch D 24" x 36"	SCALE 1" = 2000'	FILENAME g:\102\00279.13\cad\design\civil 3d\102.00279.13 small drainage basins.dwg				1 OF 10



LEGEND:

3550 — EXISTING GROUND SURFACE CONTOUR AND ELEVATION, FEET

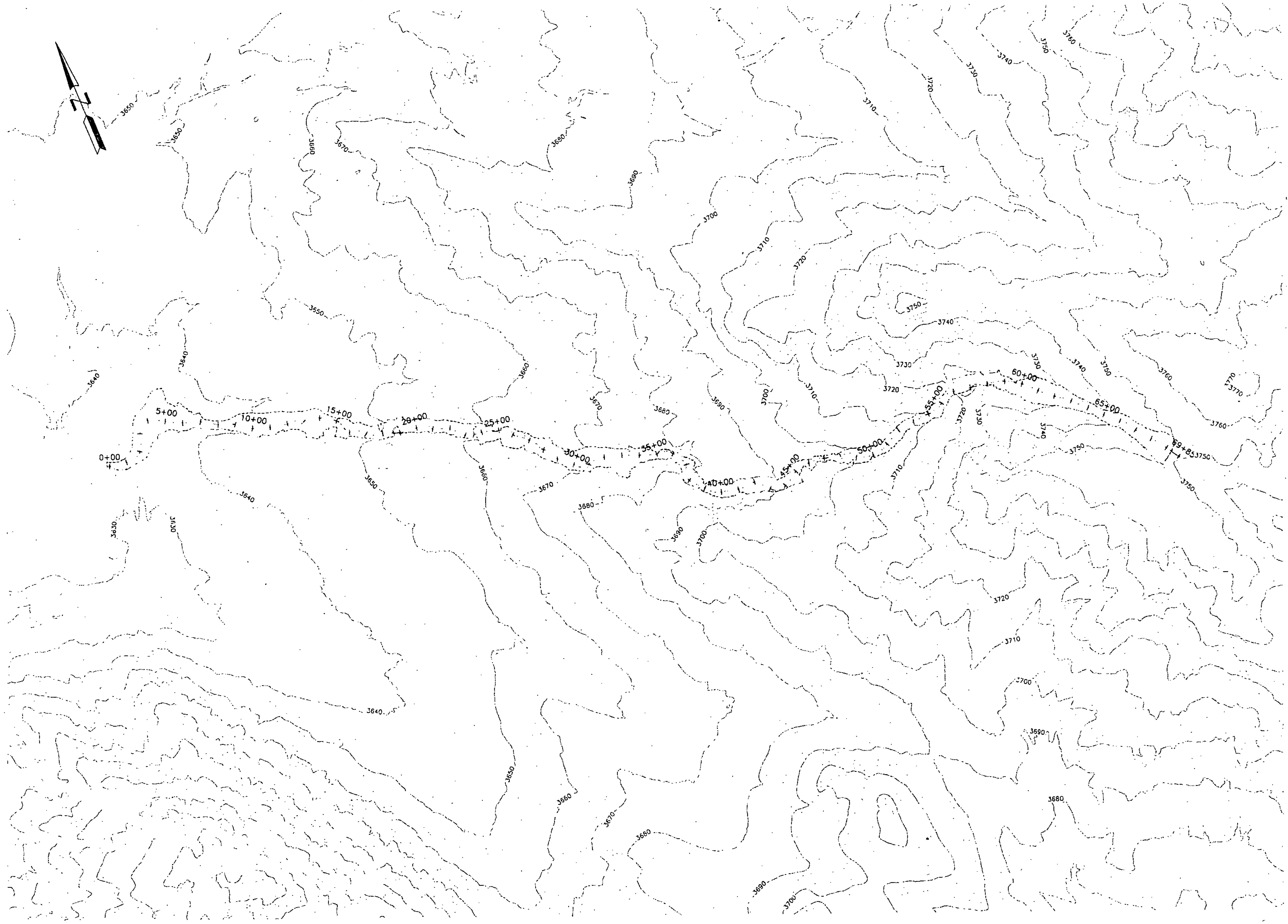
FLOODPLAIN LIMITS

PLAN

300 0 300 600 FEET

1" = 300' AT FULL SIZE (ANSI D)
1" = 600' AT HALF SIZE (ANSI B)

CONSULTANT	REVISIONS	
REF	# DRAWN CHECKED APPROVED DATE	POWERTECH (USA) INC.
CHECK SCALES If this bar does not measure 1 inch the map is not at its original scale		FIGURE 2 100-YR FLOODPLAIN BOUNDARY SUBBASIN 1
Arch D 24" x 36"	PLOT DATE 27-Aug-2010 / DATE 25-Aug-2010	PROJECT DEWEY-BURDOCK PROJECT / 2
	DRAWN SH / CHECKED JD	COORDS
	SCALE 1" = 300' / FILENAME g:\102\00279.13\cad\design\civil 3d\102.00279.13 basin 01 hec ras.dwg	2 of 10



LEGEND:

3550 — EXISTING GROUND SURFACE CONTOUR AND ELEVATION, FEET

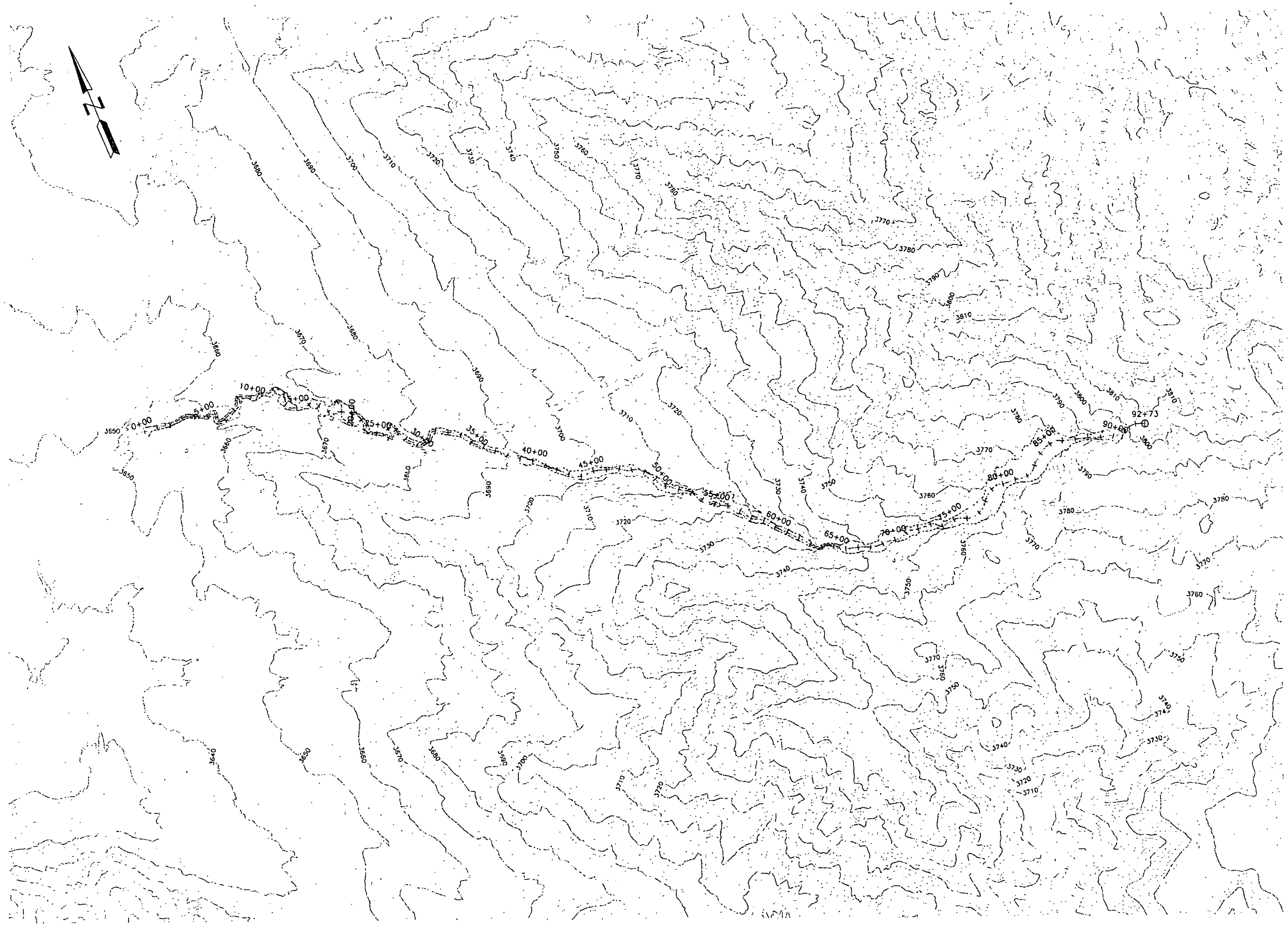
FLOODPLAIN LIMITS

PLAN

300 0 300 600 FEET

1" = 300' AT FULL SIZE (ANSI D)
1" = 600' AT HALF SIZE (ANSI B)

CONSULTANT	REVISIONS					POWERTECH (USA) INC.
	#	DRAWN	CHECKED	APPROVED	DATE	FIGURE 3 100-YR FLOODPLAIN BOUNDARY SUBBASIN 2
REF						
CHECK SCALES — If the bar does not measure 1 inch this map is not at its original scale	PLOT DATE 27-Aug-2010	DATE 25-Aug-2010	PROJECT DEWEY-BURDOCK PROJECT			3
	DRAWN SH	CHECKED JD	COORDS			
Arch D 24" x 36"	SCALE 1" = 300'	FILENAME g:\102\00279.13\cad\design\civil 3d\102.00279.13 basin 02 hec ras.dwg				3 OF 10



PLAN

400 0 400 800 FEET
1" = 400' AT FULL SIZE (ANSI D)
1" = 800' AT HALF SIZE (ANSI B)

LEGEND:

3550 — EXISTING GROUND SURFACE CONTOUR AND ELEVATION, FEET

FLOODPLAIN LIMITS

CONSULTANT	REVISIONS				
	#	DRAWN	CHECKED	APPROVED	DATE

REF

CHECK SCALES

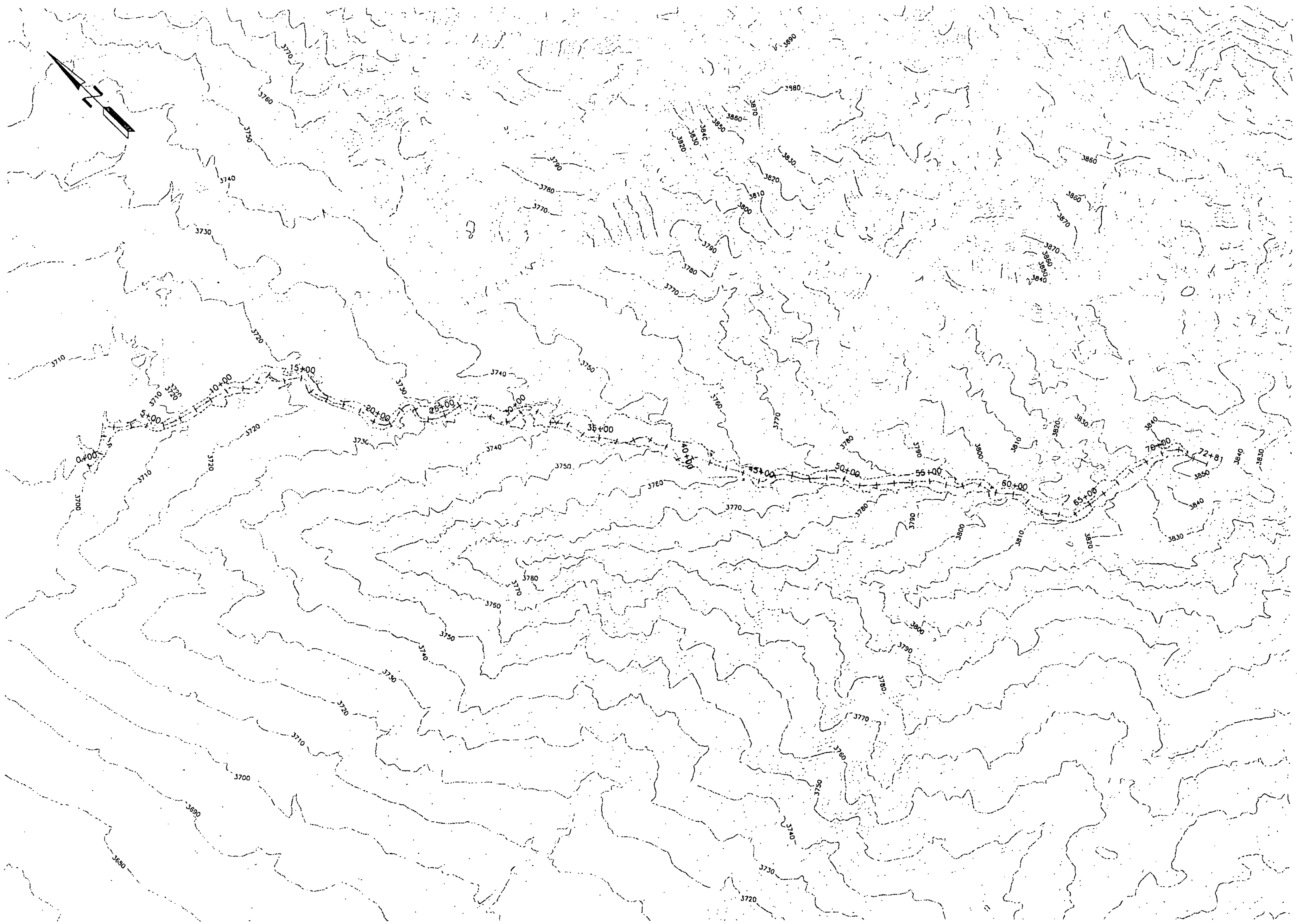
If this bar does not measure 1 inch this map is not at its original scale

Arch D 24" x 36"

POWERTECH (USA) INC.

FIGURE 4
100-YR FLOODPLAIN BOUNDARY
SUBBASIN 3

PLOT DATE 27-Aug-2010	DATE 25-Aug-2010	PROJECT DEWEY-BURDOCK PROJECT	4
DRAWN SH	CHECKED JD	COORDS	
SCALE 1" = 400'	FILENAME g:\102\00279.13\cad\design\civil 3d\102.00279.13 basin 03 hec ras.dwg		4 OF 10



PLAN

300 0 300 600 FEET
1" = 300' AT FULL SIZE (ANSI D)
1" = 600' AT HALF SIZE (ANSI B)

LEGEND:

3550 EXISTING GROUND SURFACE CONTOUR AND ELEVATION, FEET

FLOODPLAIN LIMITS

REVISIONS				
#	DRAWN	CHECKED	APPROVED	DATE

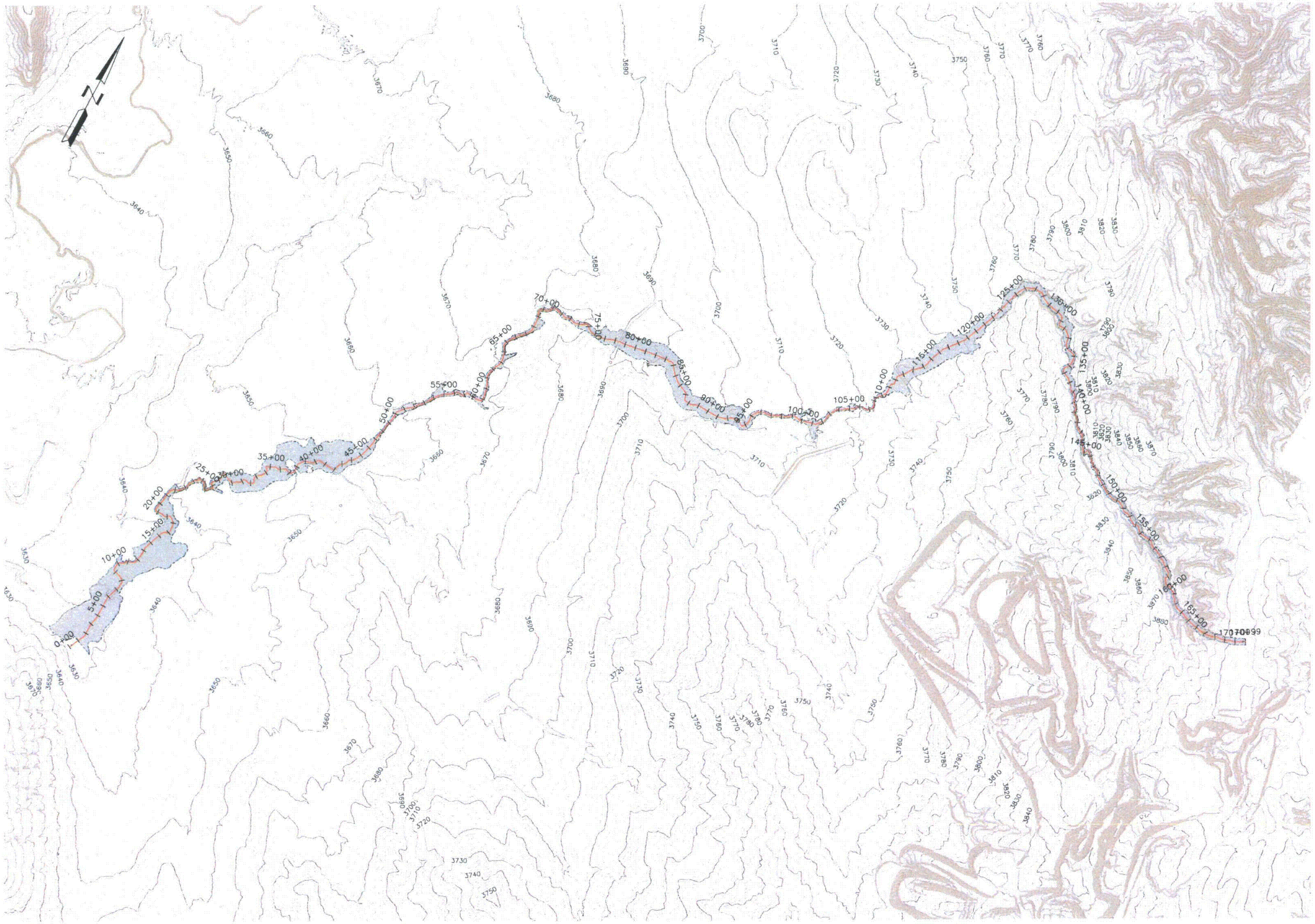
POWERTECH (USA) INC.

FIGURE 5
100-YR FLOODPLAIN BOUNDARY
SUBBASIN 4

PLOT DATE	27-Aug-2010	DATE	25-Aug-2010	PROJECT	DEWEY-BURDOCK PROJECT
DRAWN	SH	CHECKED	JD	COORDS	
SCALE	1" = 300'	FILENAME	g:\102\00279.13\cad\design\civil 3d\102.00279.13 basin 04 hec ras.dwg		

5

5 of 10



LEGEND:

3550 — EXISTING GROUND SURFACE CONTOUR AND ELEVATION, FEET

FLOODPLAIN LIMITS

PLAN

500 0 500 1000 FEET

1" = 500' AT FULL SIZE (ANSI D)
1" = 1000' AT HALF SIZE (ANSI B)

CONSULTANT	REVISIONS					POWERTECH (USA) INC.
	#	DRAWN	CHECKED	APPROVED	DATE	FIGURE 6 100-YR FLOODPLAIN BOUNDARY SUBBASINS 5, 13 AND 14
REF						
CHECK SCALES. If this bar does not measure 1 inch this map is not at its original scale	PLOT DATE 27-Aug-2010	DATE 25-Aug-2010	PROJECT DEWEY-BURDOCK PROJECT			6
	DRAWN SH	CHECKED JD	COORDS			
ANSI D 24" x 36"	SCALE 1" = 500'	FILENAME g:\102\00279.13\cad\design\civil 3d\102.00279.13 basin 05-13 hec ras.dwg				6 OF 10

LEGEND:

3550 — EXISTING GROUND SURFACE CONTOUR AND ELEVATION, FEET

FLOODPLAIN LIMITS

PLAN

500 0 500 1000 FEET

1" = 500' AT FULL SIZE (ANSI D)
1" = 1000' AT HALF SIZE (ANSI B)

CONSULTANT	REVISIONS					
	#	DRAWN	CHECKED	APPROVED	DATE	
REF						
CHECK SCALES If this bar does not measure 1 inch this map is not at its original scale	PLOT DATE 27-Aug-2010	DATE 25-Aug-2010	PROJECT DEWEY-BURDOCK PROJECT			
	DRAWN SH	CHECKED JD	COORDS			
Arch D 24" x 36"	SCALE 1" = 500'	FILENAME g:\102\00279.13\cad\design\civil 3d\102.00279.13 basin 06-07 hec ras.dwg				

POWERTECH (USA) INC.

FIGURE 7
100-YR FLOODPLAIN BOUNDARY
SUBBASINS 6 AND 7

7

7 OF 10

LEGEND:

- 3550 — EXISTING GROUND SURFACE CONTOUR AND ELEVATION, FEET
- FLOODPLAIN LIMITS

PLAN

300 0 300 600 FEET

1" = 300' AT FULL SIZE (ANSI D)
1" = 600' AT HALF SIZE (ANSI B)

CONSULTANT	REVISIONS				
	#	DRAWN	CHECKED	APPROVED	DATE

REF

CHECK SCALES
If this bar does not measure 1 inch this map is not at its original scale
Arch D 24" x 36"

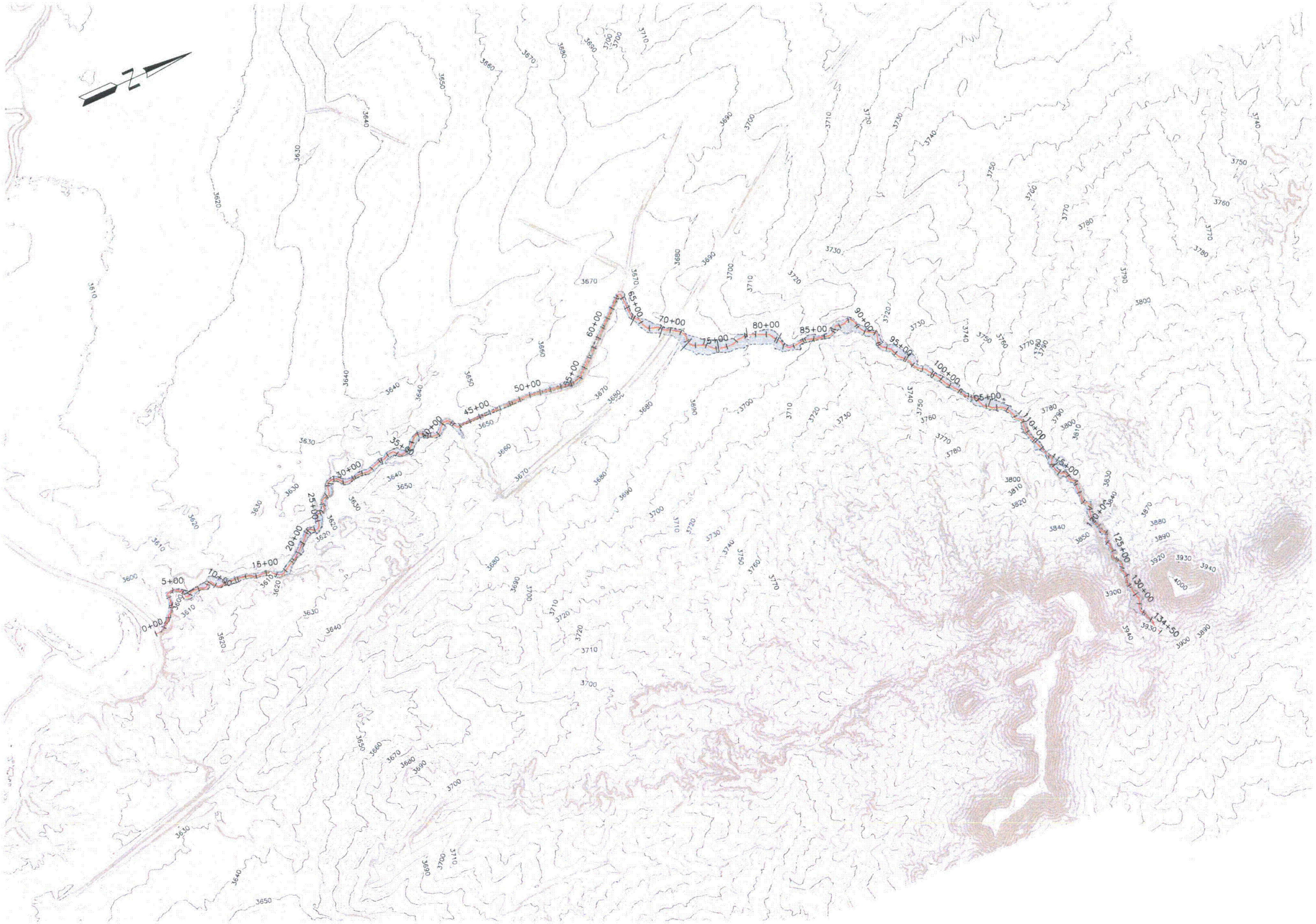
POWERTECH (USA) INC.

FIGURE 8
100-YR FLOODPLAIN BOUNDARY
SUBBASIN 8

PLOT DATE	27-Aug-2010	DATE	25-Aug-2010	PROJECT	DEWEY-BURDOCK PROJECT
DRAWN	SH	CHECKED	JD	COORDS	
SCALE	1" = 300'	FILENAME	g:\102\00279.13\cad\design\civil 3d\102.00279.13 basin 08 hec ras.dwg		

8

8 OF 10



LEGEND:

3550 — EXISTING GROUND SURFACE CONTOUR AND ELEVATION, FEET

FLOODPLAIN LIMITS

PLAN

500 0 500 1000 FEET

1" = 500' AT FULL SIZE (ANSI D)
1" = 1000' AT HALF SIZE (ANSI B)

CONSULTANT

REF

CHECK SCALES

If this bar does not measure 1 inch this map is not at its original scale

Arch D 24" x 36"

REVISIONS				
#	DRAWN	CHECKED	APPROVED	DATE

PLOT DATE 27-Aug-2010 | DATE 25-Aug-2010
DRAWN SH | CHECKED JD
SCALE 1" = 500' | FILENAME g:\102\00279.13\cad\design\civil 3d\102.00279.13 basin 09-10 hec ras.dwg

POWERTECH (USA) INC.

FIGURE 9
100-YR FLOODPLAIN BOUNDARY
SUBBASINS 9 AND 10

PROJECT DEWEY-BURDOCK PROJECT

COORDS

9

9 OF 10

POWERTECH (USA) INC.

Appendix B

HEC-1 Model Outputs

B-1 HEC-1 Output for Burdock
B-2 HEC-1 Output for Dewey

POWERTECH (USA) INC.

Appendix B-1

HEC-1 Output for Burdock

```
*****************************************                    ***************************************
*                                       *                    *                                     *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                    *   U.S. ARMY CORPS OF ENGINEERS      *
*              JUN   1998               *                    *   HYDROLOGIC ENGINEERING CENTER     *
*            VERSION 4.1                *                    *         609 SECOND STREET           *
*                                       *                    *     DAVIS, CALIFORNIA 95616         *
*  RUN DATE   06AUG10  TIME  16:42:45   *                    *         (916) 756-1104              *
*                                       *                    *                                     *
*****************************************                    ***************************************
```

```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X               X
XXXXXXX  XXXX     X        XXXXX  X
X     X  X        X               X
X     X  X        X     X         X
X     X  XXXXXXX   XXXXX         XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  1           ID  DEWEY-BURDOCK PROJECT DV102\279.13
  2           ID  24-HR PEAK FLOWS FOR PASS CREEK TRIBUTARY WATERSHEDS (Burdock Area)
  3           ID  PRECIPITATION INPUT: 24-HOUR TYPE II DISTRIBUTION AT 30-MINUTE INTERVALS
  4           ID  24-HR 100-YR PRECIP VALUE = 3.83 inches
  5           ID  USES SCS UNIT HYDROGRAPH METHOD
  6           ID  tc = (100*L^0.8*[(1000/CN)-9]^0.7)/1900*S^0.5
  7           ID  L=longest flow path; S=channel slope; CN=curve number
  8           ID  TLAG=0.6*tc
  9           ID  SUBBASINS B-1,B-2,B-3,B-4,B-5,B-6,B-7,B-8 SHOWN ON AUTOCAD FILE
 10           ID  DV102\279.13\CAD\Design\JRD-EG.dwg
              *DIAGRAM
 11           JR    PREC    3.83
 12           IT      15                      100
 13           IN      30
 14           IO       5

 15           KK     B-8
 16           KM  RUNOFF FROM SUBBASIN B-8
 17           BA  0.9785
 18           PB       1
 19           PC       0  0.0053  0.0108  0.0164  0.0223  0.0284  0.0347  0.0414  0.0483  0.0555
 20           PC  0.0632  0.0712  0.0797  0.0887  0.0984  0.1089  0.1203  0.1328  0.1467  0.1625
 21           PC  0.1808  0.2042  0.2351  0.2833  0.6632  0.7351  0.7724  0.7989  0.8197   0.838
 22           PC  0.8538  0.8676  0.8801  0.8914  0.9019  0.9115  0.9206  0.9291  0.9371  0.9446
 23           PC  0.9519  0.9588  0.9653  0.9717  0.9777  0.9836  0.9892  0.9947       1
 24           LS              63
 25           UD    0.65
              *

 26           KK     B-5
 27           KM  RUNOFF FROM SUBBASIN B-5
 28           BA   0.548
 29           LS              63
 30           UD    0.73
              *

 31           KK     B-4
 32           KM  RUNOFF FROM SUBBASIN B-4
 33           BA   0.675
 34           LS              63
 35           UD    0.94
              *

 36           KK     P-1
 37           KM  COMBINE HYDROGRAPHS--SUBBASINS B-5, B-4
 38           HC       2
              *

 39           KK   P1>P2
 40           KM  ROUTE P-1 HYDROGRAPH TO P-2
 41           RK    5000    0.01    0.05            TRAP       5       2
              *
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 42           KK     B-3
 43           KM  RUNOFF FROM SUBBASIN B-3
 44           BA   0.535
 45           LS                 63
 46           UD    1.51
              *

 47           KK    B-14
 48           KM  RUNOFF FROM SUBBASIN B-14
 49           BA   0.194
 50           LS                 63
 51           UD    0.78
              *

 52           KK     P-2
 53           KM  COMBINE HYDROGRAPHS--HYDROGRPAHS P-1, B-3, B-14
 54           HC       3
              *

 55           KK   P2>P3
 56           KM  ROUTE P-2 HYDROGRAPH TO P-3
 57           RK    3300   0.005    0.05            TRAP      10       2
              *

 58           KK     B-2
 59           KM  RUNOFF FROM SUBBASIN B-2
 60           BA  0.2625
 61           LS                 63
 62           UD    0.88
              *

 63           KK    B-13
 64           KM  RUNOFF FROM SUBBASIN B-13
 65           BA   0.154
 66           LS                 63
 67           UD    1.21
              *

 68           KK     P-3
 69           KM  COMBINE HYDROGRAPHS--P-3, B-2, B-13
 70           HC       3
              *

 71           KK   P3>P4
 72           KM  ROUTE P-3 HYDROGRAPH TO P-4
 73           RK    4659   0.006    0.05            TRAP      10       2
              *

 74           KK     B-7
 75           KM  RUNOFF--SUBBASIN B-7
 76           BA   0.389
 77           LS                 63
 78           UD    1.26
              *
```

```
LINE            ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  79            KK  B-7>P4
  80            KM  ROUTE B-7 HYDROGRAPH TO P-4
  81            RK    9200   0.006    0.05            TRAP      10        2
                *

  82            KK     B-6
  83            KM  RUNOFF--SUBBASIN B-6
  84            BA   0.435
  85            LS               63
  86            UD    3.05
                *

  87            KK     B-1
  88            KM  RUNOFF--SUBBASIN B-1
  89            BA   0.479
  90            LS               63
  91            UD    0.86
                *

  92            KK     P-4
  93            KM  COMBINE HYDROGRAPHS--SUBBASINS P-3, B-7, B-6, B-1
  94            HC       4
                *
  95            ZZ
```

```
               SCHEMATIC DIAGRAM OF STREAM NETWORK
INPUT
 LINE     (V) ROUTING            (--->) DIVERSION OR PUMP FLOW

  NO.     (.) CONNECTOR          (<---) RETURN OF DIVERTED OR PUMPED FLOW

   15    B-8
           .
           .
    6      .         B-5
           .          .
           .          .
   31      .          .          B-4
           .          .           .
           .          .           .
   36      .         P-1...........
           .          V
           .          V
   39      .        P1>P2
           .          .
           .          .
   42      .          .          B-3
           .          .           .
           .          .           .
   47      .          .           .         B-14
           .          .           .           .
           .          .           .           .
   52      .         P-2.......................
           .          V
           .          V
   55      .        P2>P3
           .          .
           .          .
   58      .          .          B-2
           .          .           .
           .          .           .
   63      .          .           .         B-13
           .          .           .           .
           .          .           .           .
   68      .         P-3.......................
           .          V
           .          V
   71      .        P3>P4
           .          .
           .          .
   74      .          .          B-7
           .          .           V
           .          .           V
   79      .          .       B-7>P4
           .          .           .
           .          .           .
           .          .           .         B-6
           .          .           .           .
           .          .           .           .
   87      .          .           .           .          B-1
           .          .           .           .           .
           .          .           .           .           .
   92      .         P-4...................................

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
```

```
*****************************************                              ***************************************
*                                       *                              *                                     *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                              *   U.S. ARMY CORPS OF ENGINEERS      *
*              JUN   1998               *                              *   HYDROLOGIC ENGINEERING CENTER     *
*            VERSION 4.1                *                              *         609 SECOND STREET           *
*                                       *                              *      DAVIS, CALIFORNIA 95616        *
*  RUN DATE   06AUG10  TIME  16:42:45   *                              *          (916) 756-1104             *
*                                       *                              *                                     *
*****************************************                              ***************************************


                          DEWEY-BURDOCK PROJECT DV102\279.13
                          24-HR PEAK FLOWS FOR PASS CREEK TRIBUTARY WATERSHEDS (Burdock Area)
                          PRECIPITATION INPUT: 24-HOUR TYPE II DISTRIBUTION AT 30-MINUTE INTERVALS
                          24-HR 100-YR PRECIP VALUE = 3.83 inches
                          USES SCS UNIT HYDROGRAPH METHOD
                          tc = (100*L^0.8*[(1000/CN)-9]^0.7)/1900*S^0.5
                          L=longest flow path; S=channel slope; CN=curve number
                          TLAG=0.6*tc
                          SUBBASINS B-1,B-2,B-3,B-4,B-5,B-6,B-7,B-8 SHOWN ON AUTOCAD FILE
                          DV102\279.13\CAD\Design\JRD-EG.dwg

  14 IO         OUTPUT CONTROL VARIABLES
                      IPRNT          5  PRINT CONTROL
                      IPLOT          0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

    IT          HYDROGRAPH TIME DATA
                       NMIN         15  MINUTES IN COMPUTATION INTERVAL
                      IDATE      1   0  STARTING DATE
                      ITIME       0000  STARTING TIME
                         NQ        100  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE      2   0  ENDING DATE
                     NDTIME       0045  ENDING TIME
                      ICENT         19  CENTURY MARK

                COMPUTATION INTERVAL     .25 HOURS
                     TOTAL TIME BASE   24.75 HOURS

          ENGLISH UNITS
               DRAINAGE AREA          SQUARE MILES
               PRECIPITATION DEPTH    INCHES
               LENGTH, ELEVATION      FEET
               FLOW                   CUBIC FEET PER SECOND
               STORAGE VOLUME         ACRE-FEET
               SURFACE AREA           ACRES
               TEMPERATURE            DEGREES FAHRENHEIT

    JP          MULTI-PLAN OPTION
                      NPLAN          1  NUMBER OF PLANS

    JR          MULTI-RATIO OPTION
                    RATIOS OF PRECIPITATION
                  3.83
```

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1 3.83
HYDROGRAPH AT	B-8	.98	1	FLOW	181.
				TIME	12.75
HYDROGRAPH AT	B-5	.55	1	FLOW	98.
				TIME	12.75
HYDROGRAPH AT	B-4	.68	1	FLOW	104.
				TIME	13.00
2 COMBINED AT	P-1	1.22	1	FLOW	195.
				TIME	12.75
ROUTED TO	P1>P2	1.22	1	FLOW	194.
				TIME	13.00
HYDROGRAPH AT	B-3	.54	1	FLOW	61.
				TIME	13.75
HYDROGRAPH AT	B-14	.19	1	FLOW	33.
				TIME	12.75
3 COMBINED AT	P-2	1.95	1	FLOW	273.
				TIME	13.00
ROUTED TO	P2>P3	1.95	1	FLOW	268.
				TIME	13.25
HYDROGRAPH AT	B-2	.26	1	FLOW	42.
				TIME	13.00
HYDROGRAPH AT	B-13	.15	1	FLOW	20.
				TIME	13.25
3 COMBINED AT	P-3	2.37	1	FLOW	326.
				TIME	13.25
ROUTED TO	P3>P4	2.37	1	FLOW	324.
				TIME	13.25
HYDROGRAPH AT	B-7	.39	1	FLOW	50.
				TIME	13.25
ROUTED TO	B-7>P4	.39	1	FLOW	49.
				TIME	14.00
HYDROGRAPH AT	B-6	.44	1	FLOW	31.
				TIME	15.50
HYDROGRAPH AT	B-1	.48	1	FLOW	77.
				TIME	13.00
4 COMBINED AT	P-4	3.67	1	FLOW	428.
				TIME	13.25

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	DT (INTERPOLATED TO COMPUTATION INTERVAL)	PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
FOR PLAN = 1 RATIO= 3.83									
P1>P2	MANE	4.33	194.95	775.13	.81	15.00	194.13	780.00	.81

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5327E+02 EXCESS= .0000E+00 OUTFLOW= .5287E+02 BASIN STORAGE= .4165E+00 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 3.83									
P2>P3	MANE	3.43	271.90	788.19	.80	15.00	268.48	795.00	.80

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8392E+02 EXCESS= .0000E+00 OUTFLOW= .8324E+02 BASIN STORAGE= .6310E+00 PERCENT ERROR= .1

FOR PLAN = 1 RATIO= 3.83									
P3>P4	MANE	4.20	325.47	800.53	.79	15.00	323.70	795.00	.79

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1011E+03 EXCESS= .0000E+00 OUTFLOW= .1002E+03 BASIN STORAGE= .9793E+00 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 3.83									
B-7>P4	MANE	14.61	49.60	831.77	.78	15.00	48.77	840.00	.77

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1672E+02 EXCESS= .0000E+00 OUTFLOW= .1626E+02 BASIN STORAGE= .5538E+00 PERCENT ERROR= -.6

*** NORMAL END OF HEC-1 ***

POWERTECH (USA) INC.

Appendix B-2

HEC-1 Output for Dewey

```
FLOOD HYDROGRAPH PACKAGE  (HEC-1)    *                                                                  *                                    *
         JUN   1998                  *                                                                  *   U.S. ARMY CORPS OF ENGINEERS     *
       VERSION 4.1                   *                                                                  *   HYDROLOGIC ENGINEERING CENTER    *
                                     *                                                                  *         609 SECOND STREET          *
RUN DATE   14SEP10  TIME  09:54:36   *                                                                  *      DAVIS, CALIFORNIA 95616       *
                                     *                                                                  *           (916) 756-1104           *
**************************************                                                                  **************************************


                                       X     X  XXXXXXX   XXXXX           X
                                       X     X  X        X     X         XX
                                       X     X  X        X                X
                                       XXXXXXX  XXXX     X         XXXXX  X
                                       X     X  X        X                X
                                       X     X  X        X     X          X
                                       X     X  XXXXXXX   XXXXX          XXX


         THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

         THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
         THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
         NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
         DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
         KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM
```

```
ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

ID  DEWEY-BURDOCK PROJECT DV102\279.13
ID  24-HR PEAK FLOWS FOR BEAVER CREEK TRIBUTARY WATERSHEDS
ID  PRECIPITATION INPUT: 24-HOUR TYPE II DISTRIBUTION AT 30-MINUTE INTERVALS
ID  24-HR 100-YR PRECIP VALUE = 3.83 inches
ID  USES SCS UNIT HYDROGRAPH METHOD
ID  tc = (100*L^0.8*[(1000/CN)-9]^0.7)/1900*S^0.5
ID  L=longest flow path; S=watershed slope; CN=curve number
ID  TLAG=0.6*tc
ID  SUBBASINS B-9,B-10 SHOWN ON AUTOCAD FILE
ID  DV102\279.13\CAD\Design\JRD-EG-2.dwg
*DIAGRAM
JR    PREC    3.83
IT      15                   100
IN      30
IO       5

KK    B-10
KM  RUNOFF FROM SUBBASIN B-10
BA  0.6411
PB       1
PC       0  0.0053  0.0108  0.0164  0.0223  0.0284  0.0347  0.0414  0.0483  0.0555
PC  0.0632  0.0712  0.0797  0.0887  0.0984  0.1089  0.1203  0.1328  0.1467  0.1625
PC  0.1808  0.2042  0.2351  0.2833  0.6632  0.7351  0.7724  0.7989  0.8197   0.838
PC  0.8538  0.8676  0.8801  0.8914  0.9019  0.9115  0.9206  0.9291  0.9371  0.9446
PC  0.9519  0.9588  0.9653  0.9717  0.9777  0.9836  0.9892  0.9947       1
LS              63
UD    0.63
*

KK     B-9
KM  RUNOFF FROM SUBBASIN B-9
BA  0.6626
LS              63
UD    1.11
*

KK     P-1
KM  COMBINE HYDROGRAPHS--SUBBASINS B-9, B-10
HC       2
*
ZZ
```

```
             SCHEMATIC DIAGRAM OF STREAM NETWORK
'UT
NE       (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

O.       (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

15         B-10
             .
             .
2            .          B-9
             .            .
             .            .
31          P-1............

*) RUNOFF ALSO COMPUTED AT THIS LOCATION
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FLOOD HYDROGRAPH PACKAGE  (HEC-1)    *                                         *                                          *
         JUN   1998                  *                                         *    U.S. ARMY CORPS OF ENGINEERS          *
       VERSION 4.1                   *                                         *    HYDROLOGIC ENGINEERING CENTER         *
                                     *                                         *          609 SECOND STREET               *
RUN DATE   14SEP10  TIME  09:54:36   *                                         *       DAVIS, CALIFORNIA 95616            *
                                     *                                         *           (916) 756-1104                 *
                                     *                                         *                                          *
**************************************                                         ********************************************


                         DEWEY-BURDOCK PROJECT DV102\279.13
                         24-HR PEAK FLOWS FOR BEAVER CREEK TRIBUTARY WATERSHEDS
                         PRECIPITATION INPUT: 24-HOUR TYPE II DISTRIBUTION AT 30-MINUTE INTERVALS
                         24-HR 100-YR PRECIP VALUE = 3.83 inches.
                         USES SCS UNIT HYDROGRAPH METHOD
                         tc = (100*L^0.8*[(1000/CN)-9]^0.7)/1900*S^0.5
                         L=longest flow path; S=watershed slope; CN=curve number
                         TLAG=0.6*tc
                         SUBBASINS B-9,B-10 SHOWN ON AUTOCAD FILE
                         DV102\279.13\CAD\Design\JRD-EG-2.dwg

4 IO          OUTPUT CONTROL VARIABLES
                   IPRNT          5  PRINT CONTROL
                   IPLOT          0  PLOT CONTROL
                   QSCAL          0.  HYDROGRAPH PLOT SCALE

  IT          HYDROGRAPH TIME DATA
                    NMIN         15  MINUTES IN COMPUTATION INTERVAL
                   IDATE     1    0  STARTING DATE
                   ITIME       0000  STARTING TIME
                      NQ        100  NUMBER OF HYDROGRAPH ORDINATES
                  NDDATE     2    0  ENDING DATE
                  NDTIME       0045  ENDING TIME
                   ICENT         19  CENTURY MARK

               COMPUTATION INTERVAL    .25 HOURS
                    TOTAL TIME BASE  24.75 HOURS

        ENGLISH UNITS
             DRAINAGE AREA         SQUARE MILES
             PRECIPITATION DEPTH   INCHES
             LENGTH, ELEVATION     FEET
             FLOW                  CUBIC FEET PER SECOND
             STORAGE VOLUME        ACRE-FEET
             SURFACE AREA          ACRES
             TEMPERATURE           DEGREES FAHRENHEIT

              MULTI-PLAN OPTION
                   NPLAN          1  NUMBER OF PLANS

  JR          MULTI-RATIO OPTION
                  RATIOS OF PRECIPITATION
                 3.83
```

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

.RATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1 3.83
PH AT	B-10	.64	1	FLOW	122.
				TIME	12.50
ROGRAPH AT	B-9	.66	1	FLOW	92.
				TIME	13.25
COMBINED AT	P-1	1.30	1	FLOW	196.
				TIME	12.75

NORMAL END OF HEC-1 ***

POWERTECH (USA) INC.

Appendix C

POWERTECH (USA) INC.

Table 1
Beaver Creek HEC-RAS Standard Table 1 Output, 100yr

Beaver Creek HEC-RAS Standard Table 1 Output, 100yr

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Upstream	58181	PF3 (100yr)	7990	3609.19	3624.16	3618.12	3624.22	0.000341	2.80	5642.96	1434.24	0.16
Upstream	57088	PF3 (100yr)	7990	3608.37	3623.31	3620.21	3623.53	0.001285	4.64	2619.00	1821.76	0.29
Upstream	56177	PF3 (100yr)	7990	3607.23	3621.72	3615.86	3622.21	0.001825	5.85	1751.52	909.21	0.35
Upstream	55949.*	PF3 (100yr)	7990	3607.07	3621.34	3615.13	3621.80	0.001733	5.43	1471.94	498.91	0.34
Upstream	55721.*	PF3 (100yr)	7990	3606.90	3621.06	3614.68	3621.42	0.001371	4.83	1683.26	402.66	0.30
Upstream	55493	PF3 (100yr)	7990	3606.74	3620.82	3614.26	3621.11	0.001181	4.37	1924.07	340.86	0.28
Upstream	55212.9*	PF3 (100yr)	7990	3606.56	3620.44	3614.21	3620.76	0.001309	4.60	1819.80	340.34	0.29
Upstream	54932.8*	PF3 (100yr)	7990	3606.37	3620.00	3614.17	3620.37	0.001483	4.87	1721.02	355.20	0.31
Upstream	54652.7*	PF3 (100yr)	7990	3606.19	3619.50	3614.15	3619.92	0.001727	5.20	1637.97	401.07	0.34
Upstream	54372.6*	PF3 (100yr)	7990	3606.01	3618.92	3614.14	3619.39	0.002059	5.57	1609.49	520.75	0.36
Upstream	54092.5*	PF3 (100yr)	7990	3605.82	3618.25	3614.14	3618.77	0.002454	5.93	1644.10	571.28	0.40
Upstream	53812.4*	PF3 (100yr)	7990	3605.64	3617.49	3614.17	3618.04	0.002958	6.32	1707.26	762.67	0.43
Upstream	53532.3*	PF3 (100yr)	7990	3605.45	3616.60	3614.24	3617.19	0.003651	6.72	1839.80	1075.75	0.47
Upstream	53252.2*	PF3 (100yr)	7990	3605.27	3615.64	3615.23	3616.20	0.004368	6.94	2150.02	1547.70	0.51
Upstream	52972.1*	PF3 (100yr)	7990	3605.09	3614.44	3614.40	3615.00	0.006149	7.50	2245.08	1874.49	0.59
Upstream	52692.0*	PF3 (100yr)	7990	3604.90	3614.28		3614.35	0.001341	3.57	4853.48	2428.86	0.28
Upstream	52412	PF3 (100yr)	7990	3604.72	3614.23	3612.14	3614.24	0.000296	1.73	8315.50	2628.06	0.13
Upstream	51024	PF3 (100yr)	7990	3603.51	3614.02	3612.62	3614.03	0.000246	1.70	9151.83	3003.73	0.12
Upstream	48653	PF3 (100yr)	7990	3601.69	3613.21	3611.73	3613.33	0.001270	3.95	3826.74	1422.59	0.28
Upstream	46694	PF3 (100yr)	7990	3599.90	3612.03	3605.97	3612.12	0.000423	2.76	5372.21	2157.02	0.17
Upstream	45774.*	PF3 (100yr)	7990	3599.08	3611.18	3605.47	3611.50	0.001126	4.53	1808.53	275.71	0.28
Upstream	44854.*	PF3 (100yr)	7990	3598.26	3609.92	3605.05	3610.31	0.001493	5.12	1756.35	302.43	0.32
Upstream	43934.*	PF3 (100yr)	7990	3597.44	3608.65	3604.87	3608.96	0.001420	5.03	2082.32	693.84	0.31
Upstream	43014	PF3 (100yr)	7990	3596.62	3607.92	3602.55	3608.04	0.000688	3.64	3170.13	1531.13	0.22
Upstream	42315.2*	PF3 (100yr)	7990	3596.19	3607.30	3602.88	3607.49	0.001120	4.47	2918.26	1672.10	0.27
Upstream	41616.5*	PF3 (100yr)	7990	3595.75	3606.37	3603.26	3606.63	0.001625	5.06	2605.83	1793.11	0.33
Upstream	40917.7*	PF3 (100yr)	7990	3595.31	3606.21	3603.52	3606.23	0.000264	2.02	7055.67	1699.87	0.13
Upstream	40219	PF3 (100yr)	7990	3594.88	3606.11	3602.77	3606.12	0.000128	1.40	8681.09	1567.26	0.09
Upstream	38921.2*	PF3 (100yr)	7990	3593.67	3605.94		3606.00	0.000321	2.67	5427.64	1418.60	0.17
Upstream	37623.4*	PF3 (100yr)	7990	3592.46	3605.22		3605.50	0.000913	4.59	2637.77	969.91	0.28
Upstream	36325.6*	PF3 (100yr)	7990	3591.24	3603.90	3598.52	3604.28	0.001105	4.96	1753.28	379.76	0.31
Upstream	35027.8*	PF3 (100yr)	7990	3590.03	3602.61	3596.81	3602.94	0.000964	4.64	1755.75	1042.10	0.29
Upstream	33730	PF3 (100yr)	7990	3588.82	3601.57	3595.16	3601.84	0.000735	4.16	1962.41	2211.18	0.25
Upstream	32982.8*	PF3 (100yr)	7990	3588.32	3601.00	3594.82	3601.28	0.000760	4.22	1964.19	2196.47	0.26
Upstream	32235.6*	PF3 (100yr)	7990	3587.82	3600.54	3594.48	3600.75	0.000639	3.89	2786.74	1738.45	0.24
Upstream	31488.5*	PF3 (100yr)	7990	3587.33	3600.03	3594.08	3600.27	0.000694	4.06	2496.42	1279.62	0.25
Upstream	30741.3*	PF3 (100yr)	7990	3586.83	3599.54	3593.77	3599.77	0.000682	4.03	2391.27	553.76	0.24
Upstream	29994.1*	PF3 (100yr)	7990	3586.33	3599.08	3593.41	3599.29	0.000631	3.90	2500.00	485.28	0.23
Upstream	29247	PF3 (100yr)	7990	3585.83	3598.68	3593.04	3598.87	0.000571	3.74	2623.21	462.78	0.22
Upstream	25145	PF3 (100yr)	7990	3582.34	3593.60	3590.39	3594.36	0.002872	6.99	1159.11	962.78	0.48
Upstream	24462.3*	PF3 (100yr)	7990	3581.37	3591.80	3588.67	3592.45	0.002641	6.47	1248.16	704.32	0.46
Upstream	23779.6*	PF3 (100yr)	7990	3580.39	3590.33	3586.91	3590.83	0.002041	5.70	1424.54	429.16	0.40
Upstream	23097	PF3 (100yr)	7990	3579.42	3589.41	3585.08	3589.73	0.001193	4.60	1793.94	322.69	0.31
Upstream	17942	PF3 (100yr)	7990	3574.41	3584.98		3585.15	0.000689	3.37	2464.41	424.85	0.23
Upstream	17058.*	PF3 (100yr)	7990	3573.03	3584.33		3584.52	0.000735	3.57	2463.29	490.69	0.24
Upstream	16174.*	PF3 (100yr)	7990	3571.65	3583.60	3578.51	3583.82	0.000848	3.92	2384.29	570.51	0.26
Upstream	15290.*	PF3 (100yr)	7990	3570.26	3582.44	3577.32	3582.85	0.001445	5.11	1562.98	562.28	0.34
Upstream	14406	PF3 (100yr)	7990	3568.88	3580.49	3576.25	3581.23	0.002292	6.89	1160.21	409.70	0.44
Upstream	13867.5*	PF3 (100yr)	7990	3568.38	3579.36	3575.49	3579.96	0.002268	6.20	1289.54	452.61	0.42
Upstream	13329.*	PF3 (100yr)	7990	3567.89	3578.08	3574.95	3578.61	0.002696	5.85	1374.94	620.04	0.45
Upstream	12790.5*	PF3 (100yr)	7990	3567.40	3576.85	3574.59	3577.20	0.002453	5.00	1910.29	703.89	0.42
Upstream	12252	PF3 (100yr)	7990	3566.90	3575.97	3573.89	3576.18	0.001551	4.00	2450.16	767.48	0.33
Upstream	11584.2*	PF3 (100yr)	7990	3565.96	3574.94		3575.18	0.002151	4.41	2341.23	813.74	0.38
Upstream	10916.5*	PF3 (100yr)	7990	3565.02	3573.72		3573.97	0.002936	4.83	2264.23	839.13	0.44
Upstream	10248.7*	PF3 (100yr)	7990	3564.09	3572.53	3571.93	3572.76	0.002948	4.93	2395.79	900.79	0.44
Upstream	9581	PF3 (100yr)	7990	3563.15	3571.93	3571.93	3572.03	0.001563	3.72	3617.23	1460.41	0.32
Upstream	4694	PF3 (100yr)	7990	3557.81	3569.33		3569.41	0.000261	2.52	4673.86	990.28	0.15
Upstream	2411	PF3 (100yr)	7990	3556.07	3568.73		3568.80	0.000298	2.78	4229.81	682.13	0.16
Upstream	0	PF3 (100yr)	7990	3554.27	3568.03	3563.05	3568.13	0.000421	3.11	3845.10	775.69	0.19

POWERTECH (USA) INC.

Table 2
Beaver Creek HEC-RAS Standard Table 1 Output, 1000yr

Beaver Creek HEC-RAS Standard Table 1 Output, 1000yr

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Upstream	58181	PF1 (1000yr)	23000	3609.19	3627.32	3622.60	3627.43	0.000516	4.13	10487.95	1663.40	0.20
Upstream	57088	PF1 (1000yr)	23000	3608.37	3626.75	3623.08	3626.83	0.000528	3.78	12957.09	2956.44	0.20
Upstream	56177	PF1 (1000yr)	23000	3607.23	3626.23	3623.60	3626.36	0.000760	4.07	11910.89	3403.15	0.23
Upstream	55949.*	PF1 (1000yr)	23000	3607.07	3626.02	3621.18	3626.21	0.000851	4.67	10669.89	3332.54	0.25
Upstream	55721.*	PF1 (1000yr)	23000	3606.90	3625.85	3620.11	3626.05	0.000761	4.68	10036.10	2771.90	0.24
Upstream	55493	PF1 (1000yr)	23000	3606.74	3624.99	3619.52	3625.76	0.001891	7.39	3816.11	2755.24	0.38
Upstream	55212.9*	PF1 (1000yr)	23000	3606.56	3624.34	3619.68	3625.20	0.002211	7.87	3752.35	2249.11	0.41
Upstream	54932.8*	PF1 (1000yr)	23000	3606.37	3623.63	3619.82	3624.56	0.002560	8.30	3785.84	1791.15	0.44
Upstream	54652.7*	PF1 (1000yr)	23000	3606.19	3622.70	3620.22	3623.80	0.003236	9.03	3798.23	1563.44	0.49
Upstream	54372.6*	PF1 (1000yr)	23000	3606.01	3621.77	3620.15	3622.90	0.003786	9.43	4010.85	1592.26	0.52
Upstream	54092.5*	PF1 (1000yr)	23000	3605.82	3620.63	3620.15	3621.83	0.004804	10.08	4138.05	1666.68	0.58
Upstream	53812.4*	PF1 (1000yr)	23000	3605.64	3619.53	3619.53	3620.59	0.005368	10.09	4461.61	1821.33	0.61
Upstream	53532.3*	PF1 (1000yr)	23000	3605.45	3618.53	3618.31	3619.28	0.004966	9.24	5131.88	1977.93	0.58
Upstream	53252.2*	PF1 (1000yr)	23000	3605.27	3618.26	3616.98	3618.52	0.002163	6.15	7508.71	2167.69	0.38
Upstream	52972.1*	PF1 (1000yr)	23000	3605.09	3618.15	3615.64	3618.24	0.000880	4.00	10634.43	2360.15	0.24
Upstream	52692.0*	PF1 (1000yr)	23000	3604.90	3618.09		3618.14	0.000384	2.71	14366.35	2554.04	0.16
Upstream	52412	PF1 (1000yr)	23000	3604.72	3618.07	3612.71	3618.10	0.000183	1.92	18640.50	2746.01	0.11
Upstream	51024	PF1 (1000yr)	23000	3603.51	3617.96	3612.93	3617.98	0.000140	1.72	21129.67	3079.31	0.10
Upstream	48653	PF1 (1000yr)	23000	3601.69	3617.55	3613.18	3617.65	0.000556	3.72	10329.75	1583.36	0.20
Upstream	46694	PF1 (1000yr)	23000	3599.90	3617.17	3610.33	3617.20	0.000147	2.24	18647.00	2708.44	0.11
Upstream	45774.*	PF1 (1000yr)	23000	3599.08	3616.52	3610.07	3616.90	0.000937	5.75	7665.49	2276.01	0.27
Upstream	44854.*	PF1 (1000yr)	23000	3598.26	3614.72	3609.98	3615.62	0.002076	8.22	3580.35	905.85	0.40
Upstream	43934.*	PF1 (1000yr)	23000	3597.44	3612.66	3608.53	3613.51	0.002597	8.70	4009.11	1582.34	0.44
Upstream	43014	PF1 (1000yr)	23000	3596.62	3610.97	3605.65	3611.40	0.001906	7.18	5389.39	2799.50	0.38
Upstream	42315.2*	PF1 (1000yr)	23000	3596.19	3610.69	3605.99	3610.76	0.000506	3.63	13128.83	2712.72	0.19
Upstream	41616.5*	PF1 (1000yr)	23000	3595.75	3610.43	3606.46	3610.49	0.000402	3.19	13849.68	2541.19	0.17
Upstream	40917.7*	PF1 (1000yr)	23000	3595.31	3610.26	3604.32	3610.31	0.000246	2.47	14561.23	2294.16	0.13
Upstream	40219	PF1 (1000yr)	23000	3594.88	3610.15	3602.86	3610.19	0.000174	2.07	15713.50	2068.40	0.11
Upstream	38921.2*	PF1 (1000yr)	23000	3593.67	3609.98		3610.06	0.000296	3.22	11243.30	1463.70	0.17
Upstream	37623.4*	PF1 (1000yr)	23000	3592.46	3609.51		3609.74	0.000668	5.09	7803.67	1341.23	0.26
Upstream	36325.6*	PF1 (1000yr)	23000	3591.24	3608.09	3603.28	3608.79	0.001456	7.49	4709.31	2312.35	0.38
Upstream	35027.8*	PF1 (1000yr)	23000	3590.03	3604.03	3601.69	3605.97	0.004582	11.26	2172.64	1727.02	0.64
Upstream	33730	PF1 (1000yr)	23000	3588.82	3604.72	3599.99	3604.77	0.000200	2.68	15356.41	2543.19	0.14
Upstream	32982.8*	PF1 (1000yr)	23000	3588.32	3604.59	3599.56	3604.66	0.000249	3.06	13912.51	2447.32	0.16
Upstream	32235.6*	PF1 (1000yr)	23000	3587.82	3604.41	3600.42	3604.50	0.000316	3.52	12434.66	2347.65	0.18
Upstream	31488.5*	PF1 (1000yr)	23000	3587.33	3604.15	3599.03	3604.30	0.000415	4.08	10878.60	2241.26	0.20
Upstream	30741.3*	PF1 (1000yr)	23000	3586.83	3603.78	3598.60	3604.00	0.000574	4.84	9166.80	2118.46	0.24
Upstream	29994.1*	PF1 (1000yr)	23000	3586.33	3603.14	3597.97	3603.54	0.000890	6.00	7105.28	1941.45	0.30
Upstream	29247	PF1 (1000yr)	23000	3585.83	3602.18	3597.30	3602.81	0.001312	7.11	4757.57	1283.07	0.36
Upstream	25145	PF1 (1000yr)	23000	3582.34	3596.21	3594.38	3596.63	0.001918	6.90	5628.20	1255.16	0.41
Upstream	24462.3*	PF1 (1000yr)	23000	3581.37	3595.35	3593.20	3595.84	0.001754	6.93	5545.70	1280.97	0.40
Upstream	23779.6*	PF1 (1000yr)	23000	3580.39	3594.56	3592.06	3595.06	0.001458	6.67	5604.20	1319.61	0.37
Upstream	23097	PF1 (1000yr)	23000	3579.42	3593.97	3589.01	3594.39	0.001011	5.92	6357.94	1683.33	0.31
Upstream	17942	PF1 (1000yr)	23000	3574.41	3589.32		3589.78	0.000959	5.55	4431.01	477.96	0.30
Upstream	17058.*	PF1 (1000yr)	23000	3573.03	3588.46		3588.91	0.001023	5.72	4699.98	587.41	0.31
Upstream	16174.*	PF1 (1000yr)	23000	3571.65	3587.51	3583.16	3587.97	0.001144	6.01	4906.32	712.10	0.33
Upstream	15290.*	PF1 (1000yr)	23000	3570.26	3586.36	3582.31	3586.87	0.001424	6.56	4934.33	852.46	0.36
Upstream	14406	PF1 (1000yr)	23000	3568.88	3583.99	3582.13	3584.99	0.003535	9.28	3769.84	1138.14	0.55
Upstream	13867.5*	PF1 (1000yr)	23000	3568.38	3582.43	3580.64	3583.34	0.003328	8.65	3807.73	924.96	0.53
Upstream	13329.*	PF1 (1000yr)	23000	3567.89	3580.98	3579.39	3581.77	0.003068	8.00	3963.08	931.79	0.51
Upstream	12790.5*	PF1 (1000yr)	23000	3567.40	3579.73	3577.73	3580.37	0.002608	7.18	4293.35	937.91	0.47
Upstream	12252	PF1 (1000yr)	23000	3566.90	3578.79	3576.07	3579.25	0.001929	6.16	4885.88	1082.73	0.40
Upstream	11584.2*	PF1 (1000yr)	23000	3565.96	3577.71		3578.18	0.002339	6.49	4906.56	1060.10	0.44
Upstream	10916.5*	PF1 (1000yr)	23000	3565.02	3576.73		3577.11	0.002410	6.34	5498.55	1349.77	0.44
Upstream	10248.7*	PF1 (1000yr)	23000	3564.09	3576.22	3572.92	3576.41	0.001376	4.83	7376.06	1653.60	0.33
Upstream	9581	PF1 (1000yr)	23000	3563.15	3576.07	3571.92	3576.15	0.000565	3.21	10784.32	2030.03	0.21
Upstream	4694	PF1 (1000yr)	23000	3557.81	3575.13		3575.22	0.000196	3.08	11024.34	1155.24	0.14
Upstream	2411	PF1 (1000yr)	23000	3556.07	3574.58		3574.69	0.000337	3.88	12403.28	2377.84	0.18
Upstream	0	PF1 (1000yr)	23000	3554.27	3573.85	3566.46	3574.00	0.000421	4.31	9940.67	1772.78	0.21

POWERTECH (USA) INC.

Table 3
Pass Creek HEC-RAS Standard Table 1 Output, 100yr

Beaver Creek HEC-RAS Standard Table 1 Output, 100yr

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
reach1	27180	100yr_high	5616	3690.11	3698.89	3697.97	3700.23	0.008945	9.81	681.47	329.95	0.67
reach1	27000	100yr_high	5616	3689.26	3698.28	3695.64	3698.94	0.004253	6.53	877.89	381.55	0.46
reach1	26858	100yr_high	5616	3689.64	3697.99	3694.70	3698.41	0.002528	5.33	1160.86	482.73	0.36
reach1	26391	100yr_high	5616	3689.13	3697.01	3694.04	3697.31	0.002176	4.60	1410.50	459.32	0.33
reach1	26063	100yr_high	5616	3689.78	3695.15	3694.15	3695.99	0.009651	7.39	785.59	487.10	0.65
reach1	25600	100yr_high	5616	3689.92	3693.62	3692.04	3693.77	0.002693	3.32	1949.83	772.57	0.33
reach1	25338	100yr_high	5616	3688.65	3691.66	3691.66	3692.36	0.027766	8.36	976.33	778.34	0.99
reach1	25091	100yr_high	5616	3678.43	3685.34	3685.17	3687.17	0.020425	10.87	516.84	125.11	0.94
reach1	24903	100yr_high	5616	3679.45	3686.11		3686.20	0.000987	2.97	2691.20	730.27	0.22
reach1	24761	100yr_high	5616	3679.86	3685.97		3686.07	0.000863	2.54	2451.50	650.91	0.20
reach1	24401	100yr_high	5616	3679.97	3685.62		3685.72	0.001237	2.74	2361.62	707.99	0.23
reach1	24035	100yr_high	5616	3678.07	3684.64		3684.97	0.004323	5.40	1735.72	1010.59	0.44
reach1	23738	100yr_high	5616	3675.90	3681.81	3681.81	3682.70	0.019712	8.53	942.44	665.93	0.88
reach1	23374	100yr_high	5616	3668.81	3675.89	3674.79	3676.88	0.010834	7.98	704.17	169.04	0.69
reach1	23143	100yr_high	5616	3668.71	3675.48		3675.64	0.002551	4.60	2102.62	724.25	0.35
reach1	22970	100yr_high	5616	3668.66	3675.40		3675.44	0.000593	2.24	3993.62	1089.90	0.17
reach1	22693	100yr_high	5616	3669.07	3675.29		3675.35	0.001033	2.77	3218.47	991.25	0.22
reach1	22220	100yr_high	5616	3669.74	3674.84		3674.96	0.001976	3.42	2361.42	852.26	0.30
reach1	21755	100yr_high	5616	3667.69	3673.90		3674.12	0.004048	5.18	1923.50	896.89	0.43
reach1	21458	100yr_high	5616	3666.34	3672.19	3671.63	3672.76	0.007719	7.02	1317.71	826.53	0.59
reach1	20876	100yr_high	5616	3663.27	3666.89		3667.57	0.013011	6.70	877.73	371.43	0.71
reach1	20486	100yr_high	5616	3659.85	3666.34		3666.47	0.001093	3.09	2215.28	523.25	0.23
reach1	20239	100yr_high	5616	3658.90	3665.74		3666.06	0.003300	5.29	1462.32	414.53	0.40
reach1	20077	100yr_high	5616	3658.59	3665.45	3662.89	3665.63	0.002161	4.49	1837.57	450.93	0.33
reach1	19817	100yr_high	5616	3657.76	3664.79		3665.09	0.004412	5.74	1423.79	524.43	0.45
reach1	19576	100yr_high	5616	3656.93	3664.20	3663.15	3664.41	0.003375	4.94	1957.12	790.02	0.39
reach1	19246	100yr_high	5616	3655.74	3663.34		3663.59	0.003325	5.13	1824.13	739.45	0.40
reach1	18934	100yr_high	5616	3654.90	3660.55	3660.55	3661.80	0.017118	9.39	736.50	368.77	0.85
reach1	18423	100yr_high	5616	3649.59	3656.84		3657.30	0.003844	5.41	1056.98	235.84	0.42
reach1	17966	100yr_high	5616	3647.91	3655.75		3655.99	0.002247	4.87	1951.07	728.62	0.34
reach1	17660	100yr_high	5616	3646.82	3655.13	3653.13	3655.34	0.001989	4.51	2118.12	802.52	0.32
reach1	17232	100yr_high	5616	3645.08	3654.45		3654.62	0.001770	4.29	2316.34	809.63	0.30

Powertech (USA) Inc.

Table 3 (continued)

Pass Creek HEC-RAS Standard Table 1 Output, 100yr

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
reach1	16897	100yr_high	5616	3643.55	3652.59	3652.59	3653.56	0.010095	8.68	979.03	573.28	0.68
reach1	16379	100yr_high	5616	3641.00	3646.97		3647.84	0.007786	7.48	769.40	178.55	0.60
reach1	16127	100yr_high	5616	3638.77	3646.89	3642.69	3647.06	0.001095	3.48	1973.83	466.52	0.24
reach1	15802	100yr_high	5616	3639.10	3646.14	3643.94	3646.53	0.003510	5.56	1280.11	318.38	0.41
reach1	15348	100yr_high	5616	3638.21	3644.71		3645.04	0.004572	5.27	1528.23	666.77	0.45
reach1	14698	100yr_high	5616	3636.33	3643.81		3643.90	0.001383	3.27	3016.82	1178.96	0.26
reach1	14392	100yr_high	5616	3635.66	3643.50		3643.58	0.001341	3.23	3141.97	1233.86	0.25
reach1	13935	100yr_high	5616	3634.37	3641.77	3641.65	3642.53	0.011634	7.95	1080.80	1385.18	0.71
reach1	13364	100yr_high	5616	3632.04	3637.01		3637.63	0.007743	6.41	916.10	277.60	0.58
reach1	12851	100yr_high	5616	3628.45	3636.32	3632.32	3636.47	0.001005	3.22	2023.33	423.16	0.23
reach1	11965	100yr_high	5616	3628.50	3633.49		3634.35	0.015935	8.08	858.96	396.92	0.80
reach1	11238	100yr_high	5616	3624.20	3629.31		3629.58	0.004033	4.73	1543.03	580.72	0.42
reach1	10152	100yr_high	5616	3618.54	3628.07	3623.04	3628.21	0.000709	3.14	2068.91	370.42	0.20
reach1	9760	100yr_high	5616	3619.92	3627.45	3624.26	3627.76	0.002155	4.47	1294.45	258.50	0.33
reach1	9463	100yr_high	5616	3617.34	3624.54	3624.54	3626.23	0.016201	11.10	623.25	199.19	0.87
reach1	9032	100yr_high	5616	3613.98	3621.26	3621.08	3621.77	0.007288	7.35	1243.60	656.80	0.58
reach1	8710	100yr_high	5616	3611.82	3616.90	3616.66	3618.23	0.018282	9.39	655.62	671.68	0.87
reach1	7942	100yr_high	5616	3608.25	3615.59	3612.48	3615.74	0.001294	3.63	2014.29	422.43	0.26
reach1	7341	100yr_high	5616	3606.29	3612.68	3612.68	3614.02	0.014646	10.08	744.09	303.25	0.82
reach1	6898	100yr_high	5616	3604.23	3612.37	3611.27	3612.41	0.000446	1.92	3745.86	800.77	0.15
reach1	6537	100yr_high	5616	3602.32	3609.87	3609.87	3611.73	0.015604	11.22	574.06	310.46	0.86
reach1	5995	100yr_high	5616	3596.49	3605.38	3600.28	3605.41	0.000219	1.73	4435.16	790.80	0.11
reach1	5147	100yr_high	5616	3597.05	3604.56		3604.95	0.003716	5.32	1284.04	400.49	0.42
reach1	4685	100yr_high	5616	3594.50	3602.43		3603.09	0.004678	6.52	881.94	178.61	0.48
reach1	4202	100yr_high	5616	3592.53	3601.43		3601.72	0.001724	4.38	1436.82	329.20	0.30
reach1	3312	100yr_high	5616	3588.06	3600.63	3593.80	3600.79	0.000656	3.25	1803.89	453.73	0.19
reach1	3145	100yr_high	5616	3587.25	3600.69		3600.72	0.000111	1.63	4821.88	693.49	0.08
reach1	3106	100yr_high	5616	3587.07	3600.68	3591.25	3600.71	0.000093	1.53	5088.15	667.28	0.08
reach1	3089	100yr_high	5616	3586.99	3599.13	3594.56	3600.56	0.003793	9.62	584.04	584.76	0.49
reach1	3079		Bridge									
reach1	3044	100yr_high	5616	3586.74	3596.15	3596.15	3599.93	0.019062	15.60	360.06	495.28	1.01
reach1	2979	100yr_high	5616	3586.32	3596.33	3591.97	3596.58	0.001279	4.10	1553.31	428.41	0.26
reach1	2949	100yr_high	5616	3586.14	3596.02	3592.39	3596.50	0.002578	5.57	1013.46	222.29	0.37

POWERTECH (USA) INC.

Table 3 (continued)
Pass Creek HEC-RAS Standard Table 1 Output, 100yr

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
reach1	2924		Bridge									
reach1	2885	100yr_high	5616	3585.85	3594.98		3595.97	0.007062	7.98	703.32	121.47	0.58
reach1	2827	100yr_high	5616	3585.51	3594.80	3592.23	3595.55	0.005033	6.94	815.05	143.47	0.50
reach1	2447	100yr_high	5616	3583.25	3591.46	3590.30	3592.88	0.010247	9.70	622.57	146.96	0.71
reach1	2035	100yr_high	5616	3581.22	3587.78		3588.82	0.009328	8.20	696.70	160.52	0.66
reach1	1733	100yr_high	5616	3580.08	3588.15		3588.20	0.000371	2.21	3241.10	559.97	0.14
reach1	1262	100yr_high	5616	3579.14	3588.03		3588.07	0.000434	2.39	3657.56	712.98	0.15
reach1	1121	100yr_high	5616	3578.89	3588.00		3588.03	0.000308	2.03	4224.04	757.03	0.13
reach1	754	100yr_high	5616	3578.10	3587.92		3587.96	0.000306	2.10	3963.02	708.61	0.13
reach1	557	100yr_high	5616	3577.75	3587.86		3587.91	0.000386	2.45	3747.67	708.29	0.15
reach1	201	100yr_high	5616	3576.90	3587.76	3582.91	3587.82	0.000340	2.41	3771.72	736.64	0.14

POWERTECH (USA) INC.

Table 4
Pass Creek HEC-RAS Standard Table 1 Output, 50% ESTPMF

Beaver Creek HEC-RAS Standard Table 1 Output, 50% ESTPMF

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
reach1	27180	ESTPMF_high	32872	3690.11	3705.16	3701.06	3705.45	0.002168	7.54	10264.23	2324.32	0.37
reach1	27000	ESTPMF_high	32872	3689.26	3704.94	3702.62	3705.15	0.001231	5.71	11937.92	2330.79	0.28
reach1	26858	ESTPMF_high	32872	3689.64	3704.80	3701.79	3704.99	0.001003	5.34	12848.09	2442.74	0.26
reach1	26391	ESTPMF_high	32872	3689.13	3701.02	3700.00	3703.73	0.011012	14.51	2948.92	1668.29	0.81
reach1	26063	ESTPMF_high	32872	3689.78	3699.91	3699.91	3700.96	0.006973	10.55	5146.33	1670.54	0.63
reach1	25600	ESTPMF_high	32872	3689.92	3697.02	3695.20	3697.86	0.006170	8.18	5020.02	1402.92	0.56
reach1	25338	ESTPMF_high	32872	3688.65	3695.78	3694.61	3696.39	0.008612	8.84	5799.11	2029.25	0.65
reach1	25091	ESTPMF_high	32872	3678.43	3693.17	3693.17	3694.87	0.007642	12.67	4866.87	1895.63	0.68
reach1	24903	ESTPMF_high	32872	3679.45	3690.66		3691.22	0.003269	8.01	7367.12	1714.54	0.44
reach1	24761	ESTPMF_high	32872	3679.86	3690.29		3690.80	0.002471	6.46	7308.24	1713.39	0.38
reach1	24401	ESTPMF_high	32872	3679.97	3689.18		3689.84	0.004063	7.45	6370.91	1753.66	0.47
reach1	24035	ESTPMF_high	32872	3678.07	3687.02		3687.80	0.009917	10.80	6909.85	3065.11	0.72
reach1	23738	ESTPMF_high	32872	3675.90	3684.76		3685.31	0.009420	9.32	7085.66	2821.04	0.68
reach1	23374	ESTPMF_high	32872	3668.81	3681.71	3681.71	3682.70	0.006455	10.36	6722.55	2670.64	0.60
reach1	23143	ESTPMF_high	32872	3668.71	3679.82		3680.21	0.004366	8.92	8794.66	2625.92	0.50
reach1	22970	ESTPMF_high	32872	3668.66	3679.61		3679.76	0.001687	5.52	12046.13	2686.37	0.31
reach1	22693	ESTPMF_high	32872	3669.07	3679.37		3679.56	0.002187	5.92	10736.38	2449.70	0.35
reach1	22220	ESTPMF_high	32872	3669.74	3678.56		3678.92	0.003464	6.92	8138.40	1888.95	0.43
reach1	21755	ESTPMF_high	32872	3667.69	3677.37		3677.85	0.005552	8.86	7136.49	1835.13	0.55
reach1	21458	ESTPMF_high	32872	3666.34	3675.14		3676.17	0.011334	11.97	5300.19	1654.13	0.78
reach1	20876	ESTPMF_high	32872	3663.27	3673.03		3673.65	0.003626	7.69	7148.40	1925.65	0.45
reach1	20486	ESTPMF_high	32872	3659.85	3672.37		3672.81	0.001961	6.75	9027.72	2174.26	0.35
reach1	20239	ESTPMF_high	32872	3658.90	3671.17		3672.14	0.005552	10.86	5940.45	1877.32	0.58
reach1	20077	ESTPMF_high	32872	3658.59	3670.26	3667.41	3671.38	0.006910	11.95	4488.18	1611.04	0.64
reach1	19817	ESTPMF_high	32872	3657.76	3669.77		3670.31	0.004507	9.21	6513.25	1383.93	0.51
reach1	19576	ESTPMF_high	32872	3656.93	3669.11	3666.08	3669.62	0.004300	8.88	6922.63	1528.03	0.50
reach1	19246	ESTPMF_high	32872	3655.74	3668.08		3668.67	0.004648	9.35	7081.01	1826.10	0.52
reach1	18934	ESTPMF_high	32872	3654.90	3666.18		3667.36	0.007928	11.76	5343.43	1647.02	0.68
reach1	18423	ESTPMF_high	32872	3649.59	3662.23	3662.23	3664.06	0.007330	12.12	4397.76	1354.60	0.66
reach1	17966	ESTPMF_high	32872	3647.91	3660.82		3661.15	0.002313	7.28	9500.95	2431.79	0.38
reach1	17660	ESTPMF_high	32872	3646.82	3659.96	3657.30	3660.37	0.002790	7.81	8466.21	2070.94	0.41
reach1	17232	ESTPMF_high	32872	3645.08	3658.88		3659.30	0.003263	8.26	7870.75	1658.34	0.44
reach1	16897	ESTPMF_high	32872	3643.55	3657.59		3658.33	0.005711	10.35	6234.98	1501.57	0.58
reach1	16379	ESTPMF_high	32872	3641.00	3654.21	3654.21	3656.11	0.006744	12.81	4463.15	1185.11	0.65

Table 4 (continued)
Pass Creek HEC-RAS Standard Table 1 Output, 50% ESTPMF

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
reach1	16127	ESTPMF_high	32872	3638.77	3653.87	3648.68	3654.32	0.001579	6.68	8140.90	1313.62	0.32
reach1	15802	ESTPMF_high	32872	3639.10	3650.40	3649.75	3653.22	0.014513	16.22	3561.55	1036.36	0.92
reach1	15348	ESTPMF_high	32872	3638.21	3648.60		3649.46	0.006749	9.86	5409.58	1264.00	0.61
reach1	14698	ESTPMF_high	32872	3636.33	3647.16		3647.56	0.003473	7.26	7198.95	1311.90	0.44
reach1	14392	ESTPMF_high	32872	3635.66	3646.12		3646.61	0.005382	8.52	6746.73	1709.47	0.54
reach1	13935	ESTPMF_high	32872	3634.37	3645.17	3643.45	3645.49	0.004114	7.12	8172.95	2015.43	0.47
reach1	13364	ESTPMF_high	32872	3632.04	3643.91		3644.44	0.002883	7.27	7821.22	1925.46	0.41
reach1	12851	ESTPMF_high	32872	3628.45	3642.86	3637.75	3643.52	0.002129	7.48	6293.97	1822.57	0.37
reach1	11965	ESTPMF_high	32872	3628.50	3637.79	3637.79	3640.17	0.016970	14.79	3126.57	711.24	0.95
reach1	11238	ESTPMF_high	32872	3624.20	3636.29		3636.59	0.001602	5.86	8729.32	1307.13	0.31
reach1	10152	ESTPMF_high	32872	3618.54	3635.43	3629.17	3635.76	0.001011	5.81	9474.89	1337.71	0.26
reach1	9760	ESTPMF_high	32872	3619.92	3634.68	3630.75	3635.31	0.002151	7.63	6969.20	1294.86	0.37
reach1	9463	ESTPMF_high	32872	3617.34	3633.05	3633.05	3634.34	0.005729	12.74	5419.42	1533.84	0.61
reach1	9032	ESTPMF_high	32872	3613.98	3624.73	3624.04	3626.05	0.012005	13.41	4236.12	956.52	0.81
reach1	8710	ESTPMF_high	32872	3611.82	3624.12	3619.78	3624.50	0.001981	6.46	7656.90	1163.02	0.35
reach1	7942	ESTPMF_high	32872	3608.25	3622.43	3617.05	3623.21	0.002809	8.74	5344.38	1198.82	0.43
reach1	7341	ESTPMF_high	32872	3606.29	3617.91	3617.91	3620.38	0.014258	16.36	3226.51	676.34	0.91
reach1	6898	ESTPMF_high	32872	3604.23	3617.27	3612.29	3617.53	0.001431	5.29	8718.04	1145.00	0.29
reach1	6537	ESTPMF_high	32872	3602.32	3614.46	3614.46	3616.24	0.012152	15.01	4034.74	911.41	0.84
reach1	5995	ESTPMF_high	32872	3596.49	3614.52	3604.08	3614.65	0.000344	3.64	11952.09	861.23	0.16
reach1	5147	ESTPMF_high	32872	3597.05	3613.61		3614.18	0.001898	7.34	6917.05	1002.18	0.35
reach1	4685	ESTPMF_high	32872	3594.50	3611.22		3612.99	0.004563	11.93	4296.62	859.61	0.55
reach1	4202	ESTPMF_high	32872	3592.53	3611.71		3611.97	0.000748	5.36	10477.76	1347.90	0.23
reach1	3312	ESTPMF_high	32872	3588.06	3611.37	3601.86	3611.61	0.000529	4.95	10799.62	1283.18	0.20
reach1	3145	ESTPMF_high	32872	3587.25	3611.40		3611.52	0.000225	3.57	14977.35	1440.01	0.13
reach1	3106	ESTPMF_high	32872	3587.07	3611.38	3596.99	3611.51	0.000221	3.57	13992.91	1402.15	0.13
reach1	3089	ESTPMF_high	32872	3586.99	3610.57	3607.98	3611.43	0.002247	8.87	6158.96	949.91	0.39
reach1	3079		Bridge									
reach1	3044	ESTPMF_high	32872	3586.74	3609.14	3609.14	3610.84	0.033062	12.77	3220.08	913.01	1.18
reach1	2979	ESTPMF_high	32872	3586.32	3610.06	3599.36	3610.15	0.000211	3.31	16136.78	1274.20	0.13
reach1	2949	ESTPMF_high	32872	3586.14	3607.56	3600.72	3609.91	0.003505	12.34	2686.45	1148.42	0.50
reach1	2924		Bridge									
reach1	2885	ESTPMF_high	32872	3585.85	3602.18	3602.18	3608.06	0.016528	19.45	1690.00	738.00	1.00
reach1	2827	ESTPMF_high	32872	3585.51	3601.36	3601.36	3605.97	0.013248	17.65	2060.42	748.34	0.90
reach1	2447	ESTPMF_high	32872	3583.25	3598.59		3599.74	0.005366	11.44	4837.28	778.91	0.58

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Table 4 (continued)
Pass Creek HEC-RAS Standard Table 1 Output, 50% ESTPMF

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
reach1	2035	ESTPMF_high	32872	3581.22	3597.91		3598.71	0.002473	8.95	5929.81	799.93	0.41
reach1	1733	ESTPMF_high	32872	3580.08	3598.17		3598.32	0.000379	3.91	12402.06	1125.98	0.16
reach1	1262	ESTPMF_high	32872	3579.14	3598.07		3598.21	0.000424	4.13	11347.06	805.60	0.17
reach1	1121	ESTPMF_high	32872	3578.89	3598.04		3598.16	0.000354	3.78	12376.85	881.85	0.16
reach1	754	ESTPMF_high	32872	3578.10	3597.95		3598.08	0.000370	3.94	12439.02	991.00	0.16
reach1	557	ESTPMF_high	32872	3577.75	3597.90		3598.02	0.000386	4.09	13170.87	1119.70	0.17
reach1	201	ESTPMF_high	32872	3576.90	3597.83	3587.18	3597.94	0.000340	3.94	14160.80	1269.65	0.16

Meteorology 2.5

TR RAI-2.5-1

Regulatory Guide 3.63 recommends comparing a concurrent period ofmeteorological data from a National Weather Service (NWS) station with the longterm meteorological data from that NWS station. The NWS station selected for this comparison should be in a similar geographical and topographical location and bereasonably close (preferably within 50 miles) to the site. Regarding the long-term representativeness of the data collected onsite, please address the following issues.

TR RAI-2.5-1(a)

a. ***In Section 2.5 of the Technical Report (TR), the applicant compared weather data from the NWS site at Chadron, Nebraska. Consistent with Regulatory Guides 3.63, 3.46 and NUREG-1569, Acceptance Criterion 2.5.3(3), explain why the applicant chose the NWS site at Chadron, Nebraska, over other potential NWS sites as a representative location for the purpose of comparing meteorological data.***

Response: TR RAI-2.5-1(a)

The Chadron, Nebraska, National Weather Site (NWS) provides the most representative data for the Dewey-Burdock project area due to its proximity (approximately 62 miles to the southeast of the PAA) and availability of long-term weather parameters (wind speed, temperature, precipitation). The nearest NWS site with the same parameters available is located near Rapid City, South Dakota (approximately 58 miles northeast). This site was not selected because Rapid City is located on the eastern slope of the Black Hills and the project area is located on the western slope. Weather fronts often move from west to east, which could cause significant differences in local climate, especially precipitation. For these reasons the Chadron, NE, NWS location was selected.

TR RAI-2.5-1(b)

Regulatory Guide 3.63 recommends comparing a concurrent period ofmeteorological data from a National Weather Service (NWS) station with the longterm meteorological data from that NWS station. The NWS station selected for this comparison should be in a similar geographical and topographical location and be reasonably close (preferably within 50 miles) to the site. Regarding the long-term representativeness of the data collected onsite, please address the following issues.

b. ***On page 2-58 of the TR, the applicant states that the years 1978-2007 were used for comparison of the NWS site data. On page 2-59 of the TR, the applicant states that January 1,1978 to July 17, 2008 were used for long-term meteorological comparison. Please clarify what years were used for determining long-term representativeness of meteorological conditions.***

Response: TR RAI-2.5-1(b)

For the regional overview, the correct dates are specified in paragraph 1, Section 2.5.2 of the TR (page 2-59). The dates (1978–2007) on page 2-58 were misstated. The sentence in the third paragraph on page 2-58 of Section 2.5.1 of the TR should read:

To determine whether this period of data collection (July 18, 2007, to July 17, 2008) was representative of long-term meteorological conditions, weather data from the nearest National Weather Service (NWS) site at Chadron, Nebraska, for the same period was compared to data collected at the site from years 2007 and 2008.

TR RAI-2.5-1(c)

Regulatory Guide 3.63 recommends comparing a concurrent period of meteorological data from a National Weather Service (NWS) station with the longterm meteorological data from that NWS station. The NWS station selected for this comparison should be in a similar geographical and topographical location and be reasonably close (preferably within 50 miles) to the site. Regarding the long-term representativeness of the data collected onsite, please address the following issues.

c. NRC staff notes that the applicant has provided an analysis of meteorological data from the NWS site in Chadron for temperature and wind speed, but not wind direction. Consistent with Regulatory Guides 3.63, 3.46 and NUREG1569, Acceptance Criterion 2.5.3(3), demonstrate that the wind direction data obtained onsite are representative of the long-term meteorological conditions in the site vicinity.

Response: TR RAI-2.5-1(c)

Wind direction data from the NWS Chadron, NE and the Oral, SD stations were determined not to represent site specific wind patterns due to an orographical effect of the Black Hills.

Due to geographic differences and the associated orographic effects, it is believed the Chadron, NE nor the Oral, South Dakota sites represent the long-term conditions at the Dewey-Burdock site located in the southwestern Black Hills.

The data collected on site show that during the collection period (July 18, 2007, to July 17, 2008), the winds prevailed predominantly from the northwest to southeast except during summer months, see TR Figures 2.5-22 and 2.5-23and Figures 4-6 and 4-7 in Oswald, 2008. The nearest weather station with long-term wind speed and direction data (Oral, SD) indicate the predominant wind direction is from the southwest and northeast direction, see Figure 3-14 in Oswald, 2008.

There is no NWS or other meteorological site with available wind speed and direction data that would demonstrate the wind direction data on site are representative of the long-term meteorological conditions in the site vicinity.

TR RAI-2.5-2

Regulatory Guide 3.63 recommends the basic reduced wind direction, wind speed, and atmospheric stability data should be averaged over a period of 1 hour. At least 15 consecutive minutes of continuous data during each hour should be used to represent a 1-hour average data. Please demonstrate that this data is consistent with the recommendations in Regulatory Guide 3.63 or provide justification for an alternate methodology.

Response: TR RAI-2.5-2

Methods for collecting wind speed

A weather station was installed in coordination with the South Dakota State Climatology office at approximately the center of the PAA, in accordance with NUREG-1569, in July 2007. Parameters sampled at the site included wind speed and wind direction at three and 10-meter heights (9.8 and 32.8 feet). Data were analyzed at each site by time of day, month, and season of the year. The seasons for this analysis are defined as: winter (December, January, February), spring (March, April, May), summer (June, July, August), and fall (September, October, November). Wind speed and wind direction data were collected throughout the entire collection period (July 18, 2007, to July 17, 2008) once a minute every minute for the entire data collection period. The hourly average is an average of the 60 one-minute data points for that hour. This exceeds recommendations found in paragraph 3, Section C-1 of Reg. Guide 3.63, which recommends at least 15 consecutive minutes of continuous data each hour to represent 1-hour average data. Table 2.5-6 lists the model number and specifications of the sensors that were installed.

Methods for collecting atmospheric stability

The atmospheric stability was calculated for each hour from July 17, 2007 through July 16, 2008 from hourly averages of measurements of wind speed and solar radiation taken at 1-minute intervals. This is consistent with paragraph 3, Section C-1 of Reg. Guide 3.63. See also TR_RAI-Table MET-2.5-2 below; a Compilation of atmospheric stability data collected July 17, 2007 through July 16, 2008 in joint relative frequency form (in percent of total data). Calm winds compose of 2.52% of the data and 0.28% of the data is reported missing due to the criteria of 15 minutes of continuous data per hour interrupted due to maintenance down time.

TR_RAI-Table MET-2.5-2: Wind Direction

	Wind Speed	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
Class A	0-3	0.026	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.026
	4-7	0	0	0	0	0	0	0	0	0	0	0	0.026	0	0	0	0	0.026
	8-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	13-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	19-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	0.026	0	0	0	0	0	0	0	0	0	0	0.026	0	0	0	0	0.052
Class B	0-3	0.393	0.236	0.131	0.105	0.079	0.183	0.157	0.341	0.734	0.734	0.786	0.498	0.865	0.839	0.917	0.708	7.706
	4-7	0.052	0	0	0.026	0	0.026	0	0.052	0.079	0.079	0.052	0.105	0.262	0.079	0.183	0.105	1.1
	8-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0.079	0	0	0.079
	13-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	19-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	0.445	0.236	0.131	0.131	0.079	0.209	0.157	0.393	0.813	0.813	0.838	0.603	1.127	0.997	1.1	0.813	8.885
Class C	0-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	4-7	0.052	0	0.026	0	0.026	0.079	0.341	0.236	0.314	0.026	0.105	0.288	0.629	1.101	0.865	0.681	4.769
	8-12	0	0	0	0	0.105	0.026	0.288	0.236	0.026	0	0.026	0.026	0.131	0.839	0.681	0.446	2.829
	13-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	19-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	0.052	0	0.026	0	0.131	0.105	0.629	0.472	0.34	0.026	0.131	0.314	0.76	1.94	1.546	1.126	7.598
Class D	0-3	1.76	0.472	0.183	0.157	0.262	0.21	0.288	0.629	0.812	0.472	0.498	0.865	0.577	0.498	0.943	1.179	9.595
	4-7	1.02	0.157	0.157	0.341	0.839	0.629	0.524	0.629	0.236	0.236	0.026	0.157	0.498	1.389	2.096	1.887	10.821
	8-12	0.314	0.105	0.105	0.603	1.074	0.524	0.55	0.183	0	0	0.131	0.079	0.472	2.463	4.193	1.468	12.264
	13-18	0.026	0	0.026	0.393	0.577	0.105	0.105	0.079	0	0	0.183	0.183	0.314	1.73	4.769	0.812	9.302
	19-24	0	0	0	0.052	0.026	0	0	0	0	0	0	0.079	0.183	0.865	2.516	0.157	3.868
	>24	0	0	0	0	0	0	0	0	0	0	0	0.026	0.026	0.052	0.97	0.026	1.1
	Total	3.12	0.734	0.471	1.546	2.778	1.468	1.467	1.52	1.048	0.708	0.838	1.179	2.07	6.787	15.487	5.529	46.75
Class E	0-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	4-7	0.812	0.079	0.131	0.183	0.21	0.157	0.262	0.288	0.026	0	0.026	0	0.052	0.288	0.603	0.865	3.982
	8-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	13-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	19-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	0.812	0.079	0.131	0.183	0.21	0.157	0.262	0.288	0.026	0	0.026	0	0.052	0.288	0.603	0.865	3.982
Class F	0-3	5.56	3.354	2.07	1.205	0.865	0.839	0.891	1.205	1.127	0.786	0.524	0.577	0.943	1.494	2.594	5.425	29.459
	4-7	0.76	0.157	0.105	0.105	0.131	0.21	0.079	0.131	0.183	0	0.052	0.026	0.105	0.183	0.288	0.76	3.275
	8-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	13-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	19-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	6.32	3.511	2.175	1.31	0.996	1.049	0.97	1.336	1.31	0.786	0.576	0.603	1.048	1.677	2.882	6.185	32.734
Total		10.775	4.56	2.934	3.17	4.194	2.988	3.485	4.009	3.537	2.333	2.409	2.725	5.057	11.689	21.618	14.518	100.001

TR RAI-2.5-3

Regulatory Guide 3.63 recommends that quarterly and annual wind direction, wind speed, and atmospheric stability data be compiled in joint frequency and joint relative frequency (i.e., decimal frequency) form for heights representative of effluent releases. In addition, stability categories should be established to conform as closely as possible with those of Pasquill. Please provide this data consistent with Regulatory Guide 3.63 or provide justification for an alternate methodology.

Response: TR RAI-2.5-3

Table 2.5-10 displays a joint relative frequency table of the atmospheric stability data collected July 17, 2007 through July 16, 2008. Quarterly joint frequency and joint relative frequency tables were not generated because this information is not used in MILDOS to estimate public dose limits which are annual limits. Quarterly data is not helpful in estimating annual public doses from operations. A joint frequency table of the atmospheric stability data collected July 17, 2007 through July 16, 2008 was not generated because the same information, albeit in a different form, is displayed in Table 2.5-10.

Table 2.5-10: Compilation of atmospheric stability data collected July 17, 2007 through July 16, 2008 in joint relative frequency form (in percent of total data). Calm winds compose of 2.52% of the data and 0.28% of the data is missing.

	Wind Speed (mph)	Wind Direction																Total
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	
Class A	0-3	0.026	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.026
	4-7	0	0	0	0	0	0	0	0	0	0	0	0.026	0	0	0	0	0.026
	8-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	13-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	19-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	0.026	0	0	0	0	0	0	0	0	0	0	0.026	0	0	0	0	0.052
Class B	0-3	2.593	0.236	0.131	0.105	0.079	0.183	0.157	0.341	0.734	0.724	0.786	0.498	0.305	0.839	0.917	0.703	7.706
	4-7	0.052	0	0	0.026	0	0.026	0	0.052	0.079	0.079	0.152	0.105	0.262	0.079	0.183	0.105	[illegible]
	8-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0.079	0	0	0.079
	13-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	19-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	2.445	0.236	0.131	0.131	0.079	0.209	0.157	0.393	0.813	0.813	0.938	0.603	1.127	0.997	1.1	0.812	8.885
Class C	0-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	4-7	1.052	0	0.125	0	0.026	0.079	0.341	0.236	0.314	0.026	1.105	0.288	0.629	1.101	0.865	0.681	4.769
	8-12	0	0	0	0	0.105	0.026	0.288	0.236	0.026	0	1.026	0.026	0.131	0.839	0.681	0.445	2.829
	13-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	19-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	2.052	0	0.025	0	0.131	0.105	0.629	0.472	0.34	0.026	2.131	0.314	0.75	1.94	1.546	1.125	7.598
Class D	0-3	1.76	0.472	0.183	0.157	0.262	0.21	0.288	0.629	0.812	0.472	2.498	0.655	0.577	0.498	0.943	1.173	9.595
	4-7	1.02	0.157	0.157	0.341	0.839	0.629	0.524	0.629	0.236	0.236	1.126	0.157	0.493	1.389	2.096	1.367	10.821
	8-12	1.314	0.175	0.105	0.603	1.074	0.524	0.55	0.183	0	0	1.131	0.079	0.472	2.403	4.193	1.465	12.264
	13-18	1.026	0	0.124	0.393	0.577	0.105	0.105	0.079	0	0	1.183	0.123	0.314	1.73	4.769	0.312	9.302
	19-24	0	0	0	0.052	0.026	0	0	0	0	0	0	0.079	0.187	0.655	2.516	0.157	3.668
	>24	0	0	0	0	0	0	0	0	0	0	0	0.026	0.123	0.052	0.97	0.123	1.1
	Total	3.12	0.734	0.471	1.546	2.778	1.463	1.467	1.52	1.048	0.708	3.938	1.179	2.07	6.787	15.467	5.525	46.75
Class E	0-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	4-7	0.812	0.079	0.131	0.183	0.21	0.157	0.262	0.288	0.026	0	0.026	0	0.052	0.288	0.603	0.865	3.982
	8-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	13-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	19-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	0.812	0.079	0.131	0.183	0.21	0.157	0.262	0.288	0.026	0	0.026	0	0.052	0.288	0.603	0.865	3.982
Class F	0-3	5.56	3.354	2.07	1.205	0.865	0.839	0.891	1.205	1.127	0.786	2.524	0.577	0.243	1.494	2.591	5.125	29.459
	4-7	0.76	0.157	0.105	0.105	0.131	0.21	0.079	0.131	0.183	0	0.052	0.026	0.105	0.183	0.288	0.73	3.275
	8-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	13-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	19-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	>24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	6.32	3.511	2.175	1.31	0.996	1.049	0.97	1.336	1.31	0.786	2.576	0.603	1.348	1.677	2.883	6.185	32.734
Total (All Classes)		12.775	4.56	2.231	3.17	4.194	2.988	3.485	4.009	3.537	2.333	2.492	2.725	5.257	11.689	21.618	11.518	100.001

TR RAI-2.5-4

Consistent with Regulatory Guide 3.63, please provide an annual wind rose summary for the 16 compass directions for the project site.

Response: TR RAI-2.5-4

The annual wind rose summary data is provided in Oswald, 2008 Appendix C "Site-Specific Wind Analysis" on page C-3 submitted in TR_RAI Response Dec 2010.

TR RAI-2.5-5

The following questions refer to Section 2.5.3.2 (Wind Patterns) regarding the applicant's discussion of wind at the project site.

TR RAI-2.5-5(a)

a. ***On page 2-83, the applicant discusses wind speed in units of miles per hour when referring to Table 2.5-7. However, the data in Table 2.5-7 (and Figures 2.5-22 and 2.5-23) are presented in units of knots. Please make units of wind speed consistent.***

Response: TR RAI-2.5-5(a)

Wind units have been converted to knots within the text of the last paragraph on page 2-83. As shown in TR Table 2.5-7, a majority of the winds (51 percent) come from the southeast and approximately 55 percent of all winds were less than 4.0 knots. December had the least amount of wind with 7.66 percent of the total winds being classified as calm and having an average wind speed of 2.43 knots. In contrast, May was the windiest month with only 0.41 percent of calm winds and an average wind speed of 6.0 knots. Southeasterly winds were prevalent in the winter months (38 percent of total shown in Figure 2.5-22) as well as the summer months (56 percent of total shown in Figure 2.5-23).

TR RAI-2.5-5(b)

The following questions refer to Section 2.5.3.2 (Wind Patterns) regarding the applicant's discussion of wind at the project site.

b. ***Also on page 2-83, the applicant discusses wind data for the months of May and December. However, this data cannot be confirmed because the data in Table 2.5-7 appears to be a yearly tabulation while the data in Figures 2.5-22 and 2.5-23 are seasonal. Please provide data to confirm the applicant's statements for wind data.***

Response: TR RAI-2.5-5(b)

All site specific data has been provided within Oswald, 2008 Appendix C "Site-Specific Wind Analysis".

See pages C-12-13 for May data and pages C-26-27 for the December data.

TR RAI-2.5-6

Figures 2.5-22 and 2.5-23 summarize seasonal wind patterns on wind roses. Please specify the location and months included in each seasonal wind rose on the legend and/or titles of the figures.

Response: TR RAI-2.5-6

See Response: TR_RAI-MET-2.5-2 for months included into each season; also, refer to Figures 4-6 and 4-7 in Oswald, 2008 page 30.

TR RAI-2.5-7

Regulatory Guide 3.63 recommends that an indication of the atmospheric stability can be obtained by a method such as isolation-cloud cover and wind speed (pasquili-Gifford and similar methods), temperature lapse rate method, wind fluctuation method, split-sigma method, or Richardson Number. Please explain the method by which the applicant obtained the atmospheric stability.

Response: TR RAI-2.5-7

The atmospheric stability was estimated with the Solar Radiation Delta-T method for estimating Pasquill-Gifford stability categories. The method uses measurements of daytime solar radiation, nighttime vertical temperature gradient, and wind speed to assign Pasquill-Gifford stability categories to time periods (EPA, 1993). TR_RAI-Table_MET-2.5-7 summarizes the method.

TR RAI-Table MET-2.5-7: Solar Radiation Delta-T method for estimating Pasquill-Gifford stability categories (EPA, 1993).

Wind Speed (m/s)	*Daytime Solar Radiation*				*Wind Speed (m/s)*	*Nighttime Temperature Gradient*	
	≥925	*675-925*	*175-675*	*<175*		*<0*	*≥0*
<2	A	A	B	D	<2	E	F
2-3	A	B	C	D	2-2.5	D	E
3-5	B	B	C	D	≥2.5	D	D
5-6	C	C	D	D			
≥6	C	D	D	D			

Measurements of nighttime temperature gradient were not made. Instead, the more conservative stability class was chosen for each nighttime hour (the stability class for the nighttime temperature gradient ≥0).

TR RAI-2.5-8

Consistent with Regulatory Guides 3.63, 3.46 and NUREG-1569, Acceptance Criterion 2.5.3(1), please provide a discussion of wind stability class and average inversion height in the description of the local meteorological conditions.

Response: TR RAI-2.5-8

Atmospheric stability was compiled from meteorological data collected July 17, 2007 through July 16, 2008. Table 1 summarizes the atmospheric stability in joint relative frequency form. The atmospheric stability was Class A ~0.1 % of the time, Class B ~8.9 % of the time, Class C ~7.8 % of the time, Class D ~46.8 % of the time, Class E ~4.0 % of the time, and Class F ~32.7 % of the time. The atmospheric stability classes are briefly described in TR RAI-Table-1_ MET-2.5-8.

TR RAI-Table-1 MET-2.5-8: Pasquill's categories of atmospheric stability (Cember, 1996).

Class	Stability
A	Extremely Unstable Conditions
B	Moderately Unstable Conditions
C	Slightly Unstable Conditions
D	Neutral Conditions
E	Slightly Stable Conditions
F	Moderately Stable Conditions

Average mixing heights were derived from the AERMOD calculations used for dispersion modeling and are based on hourly data obtained from the National Weather Service stations in Rapid City (upper air), Custer, and the local Edgemont Station. The AERMOD calculation is based on a combination of mechanically and convectively driven boundary layer processes. As a result, seasonal and monthly mixing height averages are provided in Tables TR RAI-Table-2_ MET-2.5-8 and TR RAI-Table-3_ MET-2.5-8, respectively.

TR RAI-Table-2 MET-2.5-8: Seasonal Mixing Height Averages

-	Winter	Spring	Summer	Fall
Average Mixing Height (m)	936	1285	1382	839

TR RAI-Table-3 *MET-2.5-8*: Monthly Mixing Height Averages

Month	Average Mixing Height (m)
January	835
February	963
March	1189
April	1237
May	1245
June	1217
July	1487
August	1333
September	1297
October	1146
November	550
December	815

References

EPA, 1993. *An Evaluation of a Solar Radiation/Delta-T Method for Estimating Pasquill-Gifford (P-G) Stability Categories* (EPA-454/R-93-055). Washington, DC: U.S. Government Printing Office.

Cember, 1996. *Introduction to Health Physics Third Edition*. New York: McGraw-Hill.

TR RAI-2.5-9

Consistent with Regulatory Guide 3.63, please provide threshold values for the meteorological instruments measuring wind direction and wind speed.

Response: TR RAI-2.5-9

Refer to Table 4-1 "Specifications for Weather Instruments Installed to Perform Dewey-Burdock Site-Specific Analysis" in Oswald, 2008; page 24.

TR RAI-2.5-10

Regulatory Guide 3.63 recommends that meteorological systems should be inspected at least once every 15 days and serviced at a frequency that will minimize extended periods of outage and ensure an annual data recovery of at least 90% for each individual parameter measured (at least an annual 75% joint data recovery for wind speed, wind direction, and atmospheric stability). Please demonstrate that the applicant's system maintenance and servicing schedule during the onsite data collection period is consistent with Regulatory Guide 3.63 or provide justification for an alternate methodology.

Response: TR RAI-2.5-10

This site was installed in cooperation with the South Dakota State University (SDSU) Climatology office in Brookings, South Dakota, according to the standards they use to install their Automatic Weather Data Network (AWDN) stations. The data are quality assured/quality controlled (QA/QC) through an internal querying process at SDSU to determine if sensors and the associated data logging equipment function properly. All data collected during the sampling period had over a 90 percent recovery rate. Sites were visually inspected periodically throughout the sampling period to assess any defects in sampling equipment.

TR RAI-2.5-11

Regulatory Guide 3.63 recommends that meteorological systems be calibrated at least semiannually to ensure that the system accuracies in this guide are met. Please demonstrate that the applicant's calibration program during the onsite data collection period is consistent with Regulatory Guide 3.63 or provide justification for an alternate methodology.

Response: TR RAI-2.5-11

The station was part of the SDSU AWDN, therefore the SDSU recalibration schedule was used, which is approximately once per year. The station was calibrated just prior to the sampling period and monitored by the SDSU internal querying process (as explained above), it is assumed that all the weather instruments were functioning properly and calibrated throughout the sampling period.

Geology and Seismology 2.6

TR RAI-2.6-1

Figure 2.2-3 in the TR indicates that the Newcastle Sandstone may be 0 to 150 feet thick in the Black Hills area. Sections 2.6.2.2 and 2.7.2.2.6 of the TR provide conflicting site information concerning the presence of the Newcastle Sandstone within the overlying confining unit (Graneros Group). NRC staff requests that the application clarify the presence or absence of the Newcastle Sandstone at the project site.

Response: TR RAI-2.6-1

While from a regional stratigraphic perspective the Newcastle Sandstone is part of the Graneros Group, this unit is absent across the PAA. In the review of thousands of drill holes across the PAA, it has been determined that the Newcastle Sandstone has been removed by erosion. Surface examination and drilling within the Dewey-Burdock Project has encountered no Newcastle Sandstone.

TR RAI-2.6-2

NRC staff notes that the U.S. Geological Survey's Burdock Quadrangle (Schnable, 1963) shows the presence of the Minnewaste Limestone where it outcrops east of the license area. The application indicates that the Minnewaste unit is not present at the site. Please further clarify where the Minnewaste Limestone may be present within the license area (i.e., using logs and other site data). If present, please provide a description of the unit and any anticipated affects the unit may have on the proposed operations.

Response: TR RAI-2.6-2

The type section for the Minnewaste Limestone is at the falls of the Cheyenne River, 25 miles southeast of the Dewey-Burdock project area and now under the Angostura Reservoir. In Gott's description of the Minnewaste Limestone in USGS Professional Paper 763, he describes this unit in the type locality as being a pure limestone, but grading out laterally to a sandy limestone and to a calcareous sandstone at its margins. He also states that it is discontinuous west and northwest of the type locality, toward the project area. Where it does occur in the Flint Hill, Edgemont NE and Burdock quadrangles, it generally has a thickness of less than 10 feet. The Minnewaste Limestone crops out approximately 2½ miles east of the permit boundary in the northeastern portion of the Burdock quadrangle. Here, the Minnewaste consists of a series of thin, discontinuous lenticular beds of sandy limestone. These thin, discontinuous lenticular beds do not extend unto the Dewey-Burdock project. A review of all drill hole and geologic lithology logs show the Minnewaste Limestone was not deposited within the PAA.

TR RAI-2.6-3

NRC staff notes that the description of the geochemistry of the ore zones is limited. The applicant's description did not sufficiently describe site-specific minerals in the clays, silts, and carbonaceous media that are present in the ore zones of the two sub-aquifers of the Inyan Kara. Also, the applicant did not provide a sufficient description of the geochemistry associated with site specific mineralogy, common ions present, and oxidation-reduction conditions. NRC staff requests a further description of the mineralogy and associated geochemistry of the mineralized zones consistent with NUREG 1569, which states, "A geologic and geochemical description of the mineralized zone and the geologic units immediately surrounding the mineralized zone is provided."

Response: TR RAI-2.6-3

Uranium deposits within the project are classic, sandstone, roll-front type deposits, similar to those in Wyoming and Texas. These type deposits are usually "C" shaped in cross section, with the concave side of the deposit extending up-dip, toward the outcrop. Roll-front deposits are a few tens of feet-to-100 or more-feet wide and often thousands of feet long. It is generally believed these epigenetic uranium deposits are the result of uranium minerals leached from the surface environment, transported down-gradient by oxygenated groundwater and precipitated in the subsurface upon encountering a reducing environment at depth. These roll-front deposits are centered at and follow the interface of naturally-occurring chemical boundaries between oxidized and reduced sands (See Figure 2.6-7). Within the PAA, roll front deposits occur at depths of less than 100 feet in the outcrop area of Fall River Formation and at depths of up to 800 feet in the Lakota in the northwest part of the project. The average thickness of this mineralization has been calculated to be 6 feet and the average grade is 0.21 percent U3O8.

There is a geochemical "footprint" associated with these uranium roll-front systems, resulting in 1) a reduced zone 2) an oxidized zone and 3) an ore zone. The following is a geological and geochemical description of each of these zones for uranium deposits within the Dewey-Burdock Project. Information included in this description was taken from a 1971 petrographic study of core from the Dewey Area by Homestake-Wyoming Partners, utilizing microscopic, thin section, polished section, x-ray powder diffraction and spectrographic analyses (Honea, 1971).

<u>Reduced Zone</u> – This zone represents the original character of the Inyan Kara sediments, unaffected by any mineralizing events. Today, it is the unaltered portion of the system, ahead of or down-gradient of the roll front. Reduced sandstones are grey in color, pyritic and/or carbonaceous. Organic material consists of carbonized wood fragments and interstitial humates. Pyrite is abundant within the host sandstones and present as very small cubic crystal or as very fine grained aggregates. Marcasite is also present as nodular masses in the sandstones. This disseminated pyrite, resulted from replacement of original iron (magnetite or similar minerals) and organic material. This early-stage pyrite precipitation contains trace amounts of transition metals (Cu, Ni, Zn, Mo and Se) and resulted from either biogenic (bacterial) or inorganic reduction of groundwater sulfate. Plagioclase and potassium feldspar clasts are fresh and, with the exception of localized areas of calcite cementing, calcite is sparce - averaging only

0.15%. A heavy mineral suite (ranging from trace to 3%) of tourmaline, ilmenite, apatite, zircon and garnet is typical of those found in mature, siliceous sandstones.

Oxidized Zone – This portion of the system, behind the roll front, is characterized by the presence of iron oxides - resulting in a brown, pink, orange or red staining of host sandstones. The oxidized zone maps the progression of the down-gradient movement of mineralizing solutions through the host sandstones. Within the oxidized zone, original iron has been altered and is present as hematite or goethite as grain coatings, clastic particles or as pseudomorphs after original pyrite. Goethite is considered to be metastable and is found near the oxidation/reduction boundary, while the more stable hematite is found greater distances up-gradient from the roll front. The heavy mineral leucoxene – a white titanium oxide, is also present as a pseudomorph of ilmenite. All organic material has been destroyed in the oxidized zone, quartz particles will show solution or etching effects and feldspars have been replaced with clays.

In the oxidation process of the original pyrite, it is believed the transition metals (Cu, Ni, Zn, Mo and Se) were liberated and incorporated into the mineralizing solution. This solution was considered to be slightly alkaline and initially having a positive oxidation potential. Uranium was in solution as the anionic uranyl dicarbonate complex. Other metals associated with uranium were also carried in anionic complexes. Within the PAA, the oxidized zone in Inyan Kara sands has been mapped over a lateral distance of 15 miles and found to extend up to 4-5 miles down-dip from the outcrop.

Ore Zone – This portion of the system is located at the oxidation/reduction boundary where metals were precipitated when mineralizing solutions encountered a steep Eh gradient and a strong negative oxidation potential. Sandstones in this zone are greenish-black, black, or dark grey in color. The primary uranium minerals are uraninite and coffinite, which occur interstitial to sand grains and as intergrowths with montroseite (VO(OH)) and pyrite. Other vanadium minerals (Haggite and Doloresite) are found adjacent to the uranium mineralization and extending up to 500 feet into the oxidized portion of the system. Overall, the V:U ratios can be as high as 1.5:1. The high concentrations of uranium and vanadium within the ore zone indicate the original source of these metals were external to the Inyan Kara sediments.

Transition metals were also precipitated at or adjacent to the oxidation/reduction boundary. Native arsenic and selenium are found adjacent to the uranium, in the oxidized portion of the front - filling pore spaces between quartz grains. Molybdenum is found as jordisite adjacent to the uranium on the reduced portion of the front. The relatively low concentrations of transition metals indicate their source could have been internal to the Inyan Kara sediments.

Late stage deposition of calcite and pyrite also appear to be part of the ore-forming process. Filling of pore spaces by nodular and concretionary calcite is found with the uranium mineralization and extending out into the reduced portion of the front. It is believed that uranium was transported as a uranyl dicarbonate complex and carbonate deposition took place along with the precipitation of uranium. Late stage, coarse grained, nodular or concretionary pyrite is also found associated with uranium ore and adjacent to the uranium in the reduced portion of the front.

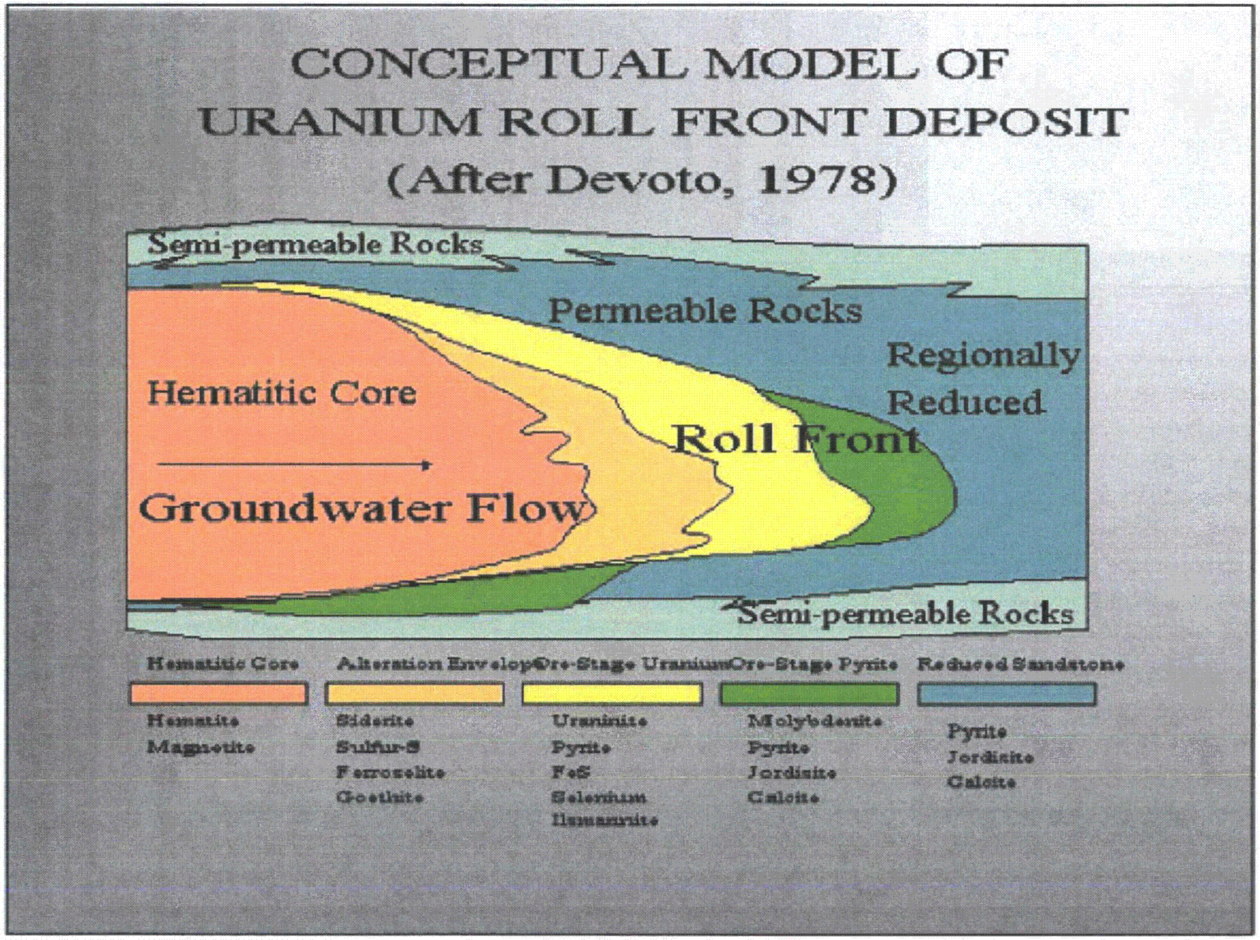


Figure 2.6-7

Roll Front Diagram

POWERTECH (USA) INC.

DRAWN RC	PROJECT Dewey-Burdock		DATE Oct. 13,2010
CHECKED Jim Bonner	COORDS		PLOT DATE 13-Oct-2010
SCALE	FILENAME p:\dewey-burdock\nrc\roll front diagram after devoto.dwg		REF

TR RAI-2.6-4

Page 2-15 of the TR states, "Twenty-six wells in the vicinity of the project site were deemed abandoned because of the condition and inactivity of the well; these wells termed abandoned are not considered properly plugged and abandoned." Figure 2 in Appendix 2.2-A indicates that abandoned wells 606, 636, 659, 690 are at or near proposed well field areas. NRC staff notes that the application does not contain well abandonment and plugging records for the above-referenced wells and other Appendix 2.2A abandoned wells within the license area. Consistent with Section 2.6.3 of NUREG 1569, please provide abandonment records for abandoned water wells within the license area. For abandoned water wells that cannot be documented with abandonment records, please clarify whether such wells that are located at or near well fields may potentially impact the containment of process fluids (i.e., improper well construction or poor well condition that may potentially lead to an excursion).

Response: TR RAI-2.6-4

Groundwater well abandonment reports are not available for wells identified as abandoned or non-verified in Figure 2 and Figure 3 of Appendix 2.2-A. However during development of a well field, and prior to its operation, aquifer pumping tests will be conducted specifically designed to detect faulty abandonment of exploration boreholes or monitoring wells if they exist. This is done by designing a detailed three-dimensional network of observation wells that are screened within the aquifer underlying the mineralized zone, screened within all aquifers that overly the mineralized zone, and screened within the mineralized zone itself. If faulty boreholes exist, their presence and location will be detected by the aquifer pumping tests. Faulty boreholes will be properly abandoned prior to mining operations.

Hydrology 2.7

TR RAI-2.7-1

NRC staff found the proposed satellite plant location in Figure 2.7-1 of the TR abuts the northern license boundary, where surface drainage appears to flow to the north directly outside of the license boundary. Staff notes that Exhibit 3.2-1 of the TR Supplement does not show the satellite plant to be near the proposed license boundary. Staff requests clarification of the proposed satellite plant location shown in Figure 2.7-1.

Response: TR RAI-2.7-1

The generalized location of the SF and CPP on TR Figure 2.7-1 should be disregarded and has been replaced with SR Exhibits 3.1-2 and 3.1-3.

TR RAI-2.7-2

Exhibit 3.2-1 of the TR Supplement indicated that the horizontal excursion monitoring well ring for Dewey Well field #1 is traversed by a set of railroad tracks. Staff was uncertain of the surface drainage in the topographic low areas on the northeast side of the tracks and whether the construction of the tracks includes any type of drainage system you might see for a double track construction (i.e., surface and/or subsurface drainage system). Staff is uncertain if standing water in poorly drained areas will hamper access to wells and potentially facilitate well leakage. Please clarify the surface drainage of this area.

Response: TR RAI-2.7-2

In Section 29, T6S, R1E, a small number of monitoring wells are proposed on the northeast side of the tracks (Exhibit 3.2-1 of the TR). The surface drainage in this area is still dominantly toward the southwest (Figure 2.7-11 below), but the raised track beds do provide some potential for standing water. The potential for collection of water is predominantly immediately adjacent to the north east side of a raised-bed for the railroad tracks. Standing water is not expected in the location of any of the monitor wells as the area is well drained in a south easterly direction along the tracks and to a culvert in the immediate vicinity.

Construction of well heads are detailed in TR Section 3.1.3 and shown in TR Figure 3.1-1 and TR Figure 3.1-2. It should also be noted that monitor wells will be constructed in the same fashion as production wells shown in TR Figure 3.1-2. All wells are constructed such that the interior of the well casing is sealed to the external environment. Additionally, cement secures the well casing from total depth to surface level preventing any erosion of the well head. Because of these design considerations, all wells are expected to be sufficient to withstand submergence without contamination to external or internal environment of the well casing.

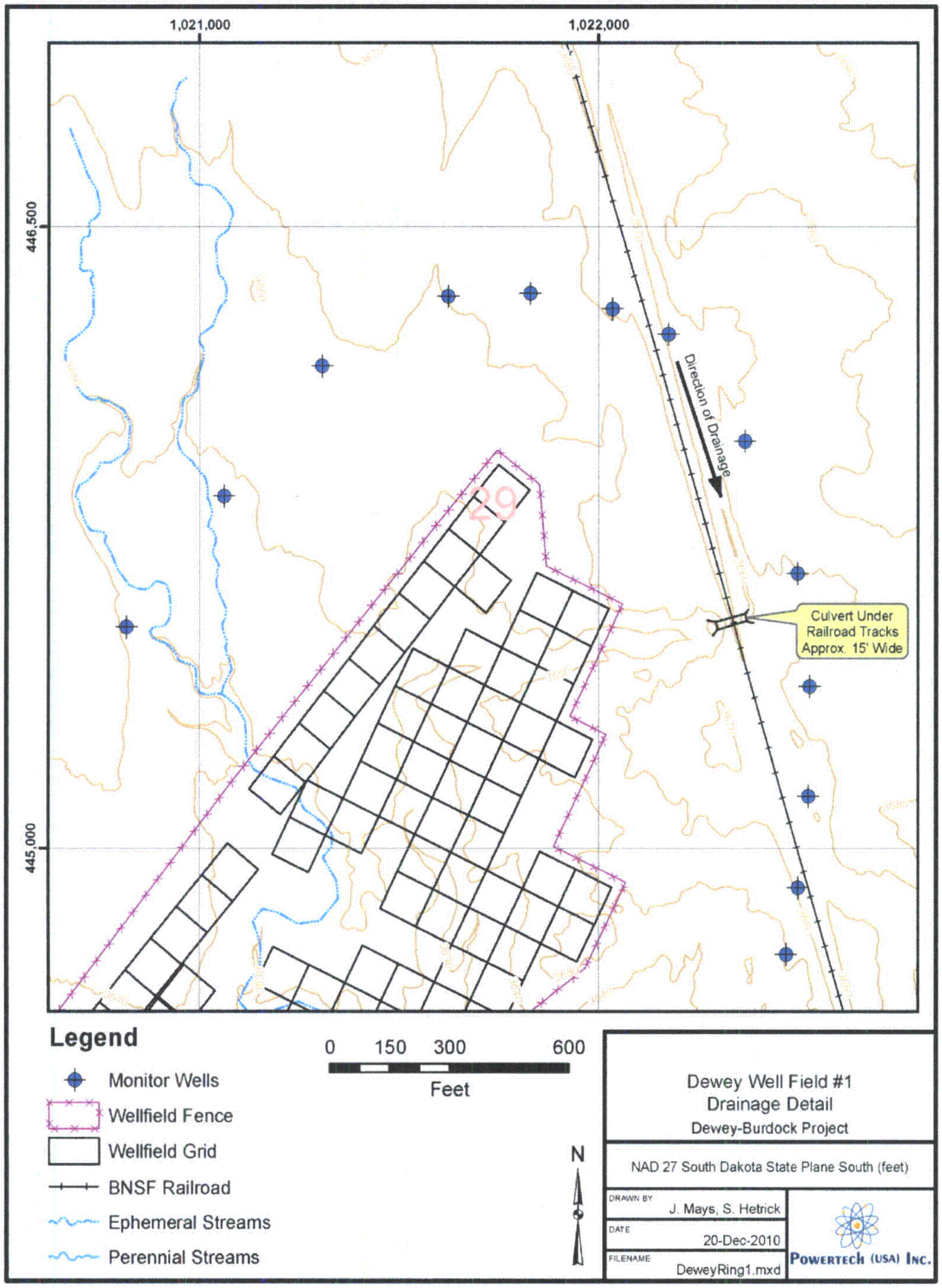


Figure 2.7-11: Dewey Well field #1 Drainage Detail

TR RAI-2.7-3

Consistent with criteria of Section 2.7.3 of NUREG-1569, please provide appropriate estimates of peak flood discharges and water levels produced by large floods on Pass Creek, Beaver Creek, and local small drainage areas. Please also provide an appropriate estimate of the aerial extent of significant peak flow during flooding of Beaver Creek and Pass Creek in the areas where Dewey Well fields I and III and Burdock Well fields III and V. Furthermore, please discuss the safety measures to be undertaken for well fields and monitoring wells located in areas that may be subject to erosion or inundation.

Response: TR RAI-2.7-3

Detailed analysis of potential flooding of Pass Creek is described in TR section 2.7.1.4.3. TR Exhibit 2.7-3 in TR RAI Response December 2010 shows the aerial extent of 100 year flooding event on Beaver Creek and Pass Creek and relative position of well fields proposed in this application. Smaller ephemeral drainages in the Pass Creek and Beaver Creek watershed were also modeled and are included in the responses to TR-RAI-MI-5. It should be noted that results of the modeling of the smaller ephemeral drainages during a 100-year peak flooding event shows a relatively small aerial extent near each channel being inundated. If necessary, other small ephemeral drainages crossing proposed well field areas may be modeled using HEC-RAS or other methods and included within the hydrogeologic data packages for each well field.

Placement of well field infrastructure, with the exception of buried pipelines and individual well heads, will be outside of drainages and low areas to avoid any possibility of flooding. Design of well heads is detailed in TR-RAI-2.7-2 such that all well heads are sufficiently sealed to accommodate brief periods of submergence. Due to the relative small size of the ephemeral channels, it is expected that well spacing will be able to accommodate most small drainages such that wells will be located near but outside the possible extent of flooding. If the well must be located within a channel or low area of a drainage, then the well location will be evaluated for the potential effects of flooding. If necessary, diversions or erosion control structures will be constructed to divert the flow and further protect the well head. All pipelines will be buried below the maximum depth of frost, estimated at a minimum of 6 feet below ground surface. Flooding events are expected to be infrequent and of a relatively short duration. Because of the design features of the well heads and pipelines, it is expected that inundation and erosion by any flooding event will not adversely affect the structural integrity or interfere with the operation of the well heads or pipelines.

The proposed plant to plant pipeline and other pipelines will often be constructed across ephemeral drainage channels including Pass Creek. All pipeline design includes burial below the maximum depth of frost, estimated at a minimum of 6 feet below ground surface, and back-filled and compacted back to grade. Flooding events do not affect the operation of the pipelines and are not likely to erode into the pipeline at its burial depth within the lifetime of the project.

It should be noted that Pass Creek is normally dry except for brief periods of runoff following major storms.

TR RAI-2.7-4

NRC staff notes that ephemeral stream tributaries flow through all the proposed well fields shown in Exhibit 3.1-4 of the TR Supplement. NRC also notes that the plant-to-plant pipeline and Burdock Well field V-to-plant pipeline crosses several ephemeral drainage channels including Pass Creek. Please provide an estimate of high water marks of significant channel flow and provide specific plans for the protection of infrastructure (e.g., well heads and header houses) within the high water marks of significant channel flow. This information is necessary to assess erosion risks to well field infrastructure and pipelines.

Response: TR RAI-2.7-4

Addressed in response to TR-RAI-2.7-3.

TR RAI-2.7-5

NRC Staff notes that the location of several of the potentiometric contour lines in Figures 2.7-14 and 2.7-15 of the TR conflicts with water level data posted at several of the well points. Please explain the cause of this error.

Response: TR RAI-2.7-5

Revised potentiometric surface maps for the Fall River and Lakota are provided in TR Figure 2.7-and TR Figure 2.7-5.2. These replace Figures 2.7-14 and Figure 2.7-15 respectively. An explanation of the measurements and why how they are used in the revisions is provided below.

Summary of Groundwater Wells USED in Contour Maps – Dewey Burdock

Fall River Formation

Hydro ID 38:

This well was originally thought to be screened within the Lakota aquifer based on its interpretation in the TVA DES as having a total depth of 550 feet. However, data from the well completion report shows this well to have an actual total depth of 494 feet. This depth is consistent with the Fall River Formation. The groundwater potentiometric surface of this well is also very consistent with that of surrounding water wells known to be completed within the Fall River.

Hydro ID 49:

The exact screened interval of this well is unknown. However its total depth of 600 feet is very consistent with nearby wells that are known to be screened within the Fall River Formation. Additionally, the potentiometric surface of the groundwater well correlates nicely with the surrounding Fall River wells.

Hydro ID 607:

This groundwater well is known to be screened within the Fall River Formation. The well is located about 3.5 miles down gradient from the nearest Fall River monitoring well within the Dewey Burdock project area, but its potentiometric surface correlates well with the Fall River groundwater gradient.

Hydro ID 610:

This groundwater well is known to be screened within the Fall River Formation as indicated in the well completion report stating that the well is screened from 630-672 feet. This is located immediately adjacent to groundwater well 609, which is completed within the Lakota Formation.

Hydro ID 622:

This groundwater well is known to be completed within the Fall River Formation. The well completion report states that the well is screened from a depth of 503-580 feet, which is consistent with the Fall River Formation at this locality. Additionally, water level measurements from this well correlate nicely with other surrounding Fall River wells. There is also a marked difference between the potentiometric surface elevation within this well and that compared to a known Lakota well located very close by.

Hydro ID 628:

This well is interpreted to be screened within the Fall River Formation. The exact completion interval of the well is unknown, but lowering a hand tag revealed that the total depth of the well is 520 feet. This is in line with the elevation of the Fall River, whereas the Lakota Formation is much deeper at this locality. The groundwater potentiometric surface of the well fits with Fall River well 610, which is located 0.5 miles directly down gradient.

Hydro ID 631:

This groundwater well is known to be screened within the Fall River Formation from 30-80 feet below the ground surface. The well is located immediately down-gradient from the Fall River outcrop recharge zone, which is why the well is relatively shallow.

Hydro ID 681:
This groundwater well is screened from 585-600 feet and is known to be completed within the Fall River Formation.
Hydro ID 683:
This groundwater well is screened from 635-650 feet and is known to be completed within the Fall River Formation.
Hydro ID 685:
This groundwater well is screened from 580-595 feet and is known to be completed within the Fall River Formation. The water level in this well is slightly (4 feet) higher than the nearby 683 Fall River well. This may be an artifact of the heterogeneous nature of the fluvial stratigraphy and sedimentology, resulting in slightly varied zone of aquifer hydraulic conductivity and transmissivity.
Hydro ID 688:
This groundwater well is screened from 245-255 feet and is known to be completed within the Fall River Formation.
Hydro ID 694:
This groundwater well is screened from 377-392 feet and is known to be completed within the Fall River Formation.
Hydro ID 695:
This groundwater well is screened from 493-508 feet and is known to be completed within the Fall River Formation.
Hydro ID 698:
This groundwater well is screened from 180-205 feet and is known to be completed within the Fall River Formation.

Lakota Formation
Hydro ID 12:
The exact screened interval for this well is unknown, and significant effort disassembling the well head would be required to log the well. The landowner would prefer that logging the well not be performed at this time. However, the total depth of the well (805 feet) and the groundwater potentiometric surface is consistent with other nearby wells known to be screened within the Lakota.
Hydro ID 608:
This groundwater well is known to be screened within the Lakota Formation. The well is located about 3.5 miles down gradient from the nearest Lakota monitoring well within the Dewey Burdock project area, but its potentiometric surface correlates well with the Lakota groundwater gradient.
Hydro ID 609:
This groundwater well is known to be screened within the Lakota Formation as indicated in the well completion report stating that the well is screened from 903-966 feet.
Hydro ID 615:
This groundwater well is known to be screened within the Lakota Formation as indicated in the well completion report stating that the well is screened from 712-800 feet. The total depth of this groundwater well was verified by field personnel using a hand tag.
Hydro ID 619:
The exact screened interval of this groundwater well is unknown and significant disassembly of the well head, which is fitted with an electrical pump-jack, would be required to log the well. The landowner would prefer this well not be logged at this point.
The groundwater well has been interpreted to be screened within the Lakota Formation based primarily on the total depth of the well which is 280 feet. The groundwater potentiometric surface of the water well correlates with that of other surrounding water wells that are known to be screened within the Lakota Formation.

Hydro ID 650:
The exact screened interval of this groundwater is unknown. Significant disassembly of the well head would be required to log the well, and the landowner would prefer this not take place at this point. However, this groundwater well is interpreted to be screened within the Lakota Formation. This interpretation is based on the fact that the water level within this well is very similar to a nearby water well (3026) known to be screened within the Lakota.
Hydro ID 680:
This groundwater well is screened from 426-436 feet and is known to be completed within the Lakota Formation.
Hydro ID 689:
This groundwater well is screened from 715-730 feet and is known to be completed within the Upper Lakota Formation. The measured groundwater potentiometric surface of this well is consistent with other nearby Lakota groundwater wells.
Hydro ID 696:
This groundwater well is screened from 572-587 feet and is known to be completed within the Lakota Formation.
Hydro ID 697:
This groundwater well is screened from 667-682 feet and is known to be completed within the Lakota Formation.
Hydro ID 3026:
This groundwater well is screened from 166-196 feet and is known to be completed within the Lakota Formation.

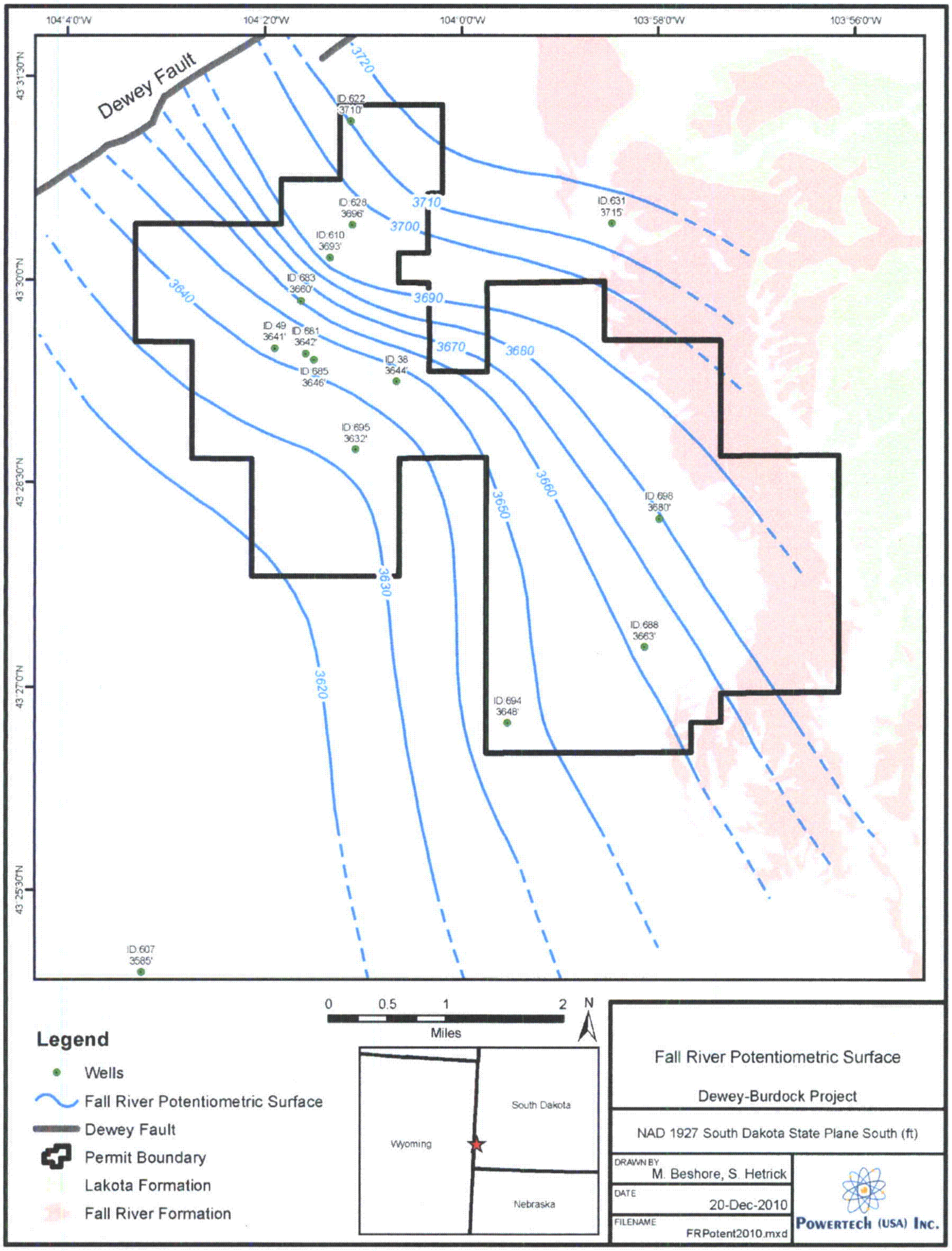
Summary of Groundwater Wells NOT USED in Contour Maps – Dewey Burdock
Fall River Formation
Hydro ID 613:
This groundwater well was originally utilized in the Fall River Potentiometric Surface map, but its water level does not correlate well with surrounding wells known to be screened within the Fall River. The well completion report states that well 613 is screened from 504-580 feet which is in line with the Fall River Formation. However, further investigations in which a hand tag was lowered into the groundwater well yielded a total well depth of 506 feet. Therefore, this well is not a reliable source of groundwater data for the Fall River Formation, and has been dropped from the potentiometric surface map.

Lakota Formation
Hydro ID 8002:
This groundwater well has a known depth of 500 feet, but the exact screened interval is unknown. Based on the well depth it is interpreted that the well is screened within the Lakota Formation:
Pipe works are installed from the groundwater well head to an outlet that supplies stock water to a tank via artesian pressure. Previously, artesian pressure measurements were used to generate a data point for original potentiometric contour maps for the Lakota Formation. However, it is not known if the pipe works can be fully shut in to generate accurate artesian pressure measurements. Therefore this groundwater well data point has not been used in the recent version of potentiometric surface maps.
Inyan Kara Group (Hydro ID):
Hydro ID 668:
The exact screened interval of this groundwater well is unknown. The groundwater well is artesian and is likely screened within the Fall River or Lakota Formation of the Inyan Kara Group. Significant disassembly of the well head would be required to log the well, and the landowner would prefer that this not take place at this point. Because the potentiometric surface measured by artesian pressure is

very similar to both that expected from the Fall River and Lakota aquifers, a definitive differentiation cannot be justified at this point. Therefore this water well has not been utilized in generating potentiometric surface maps.

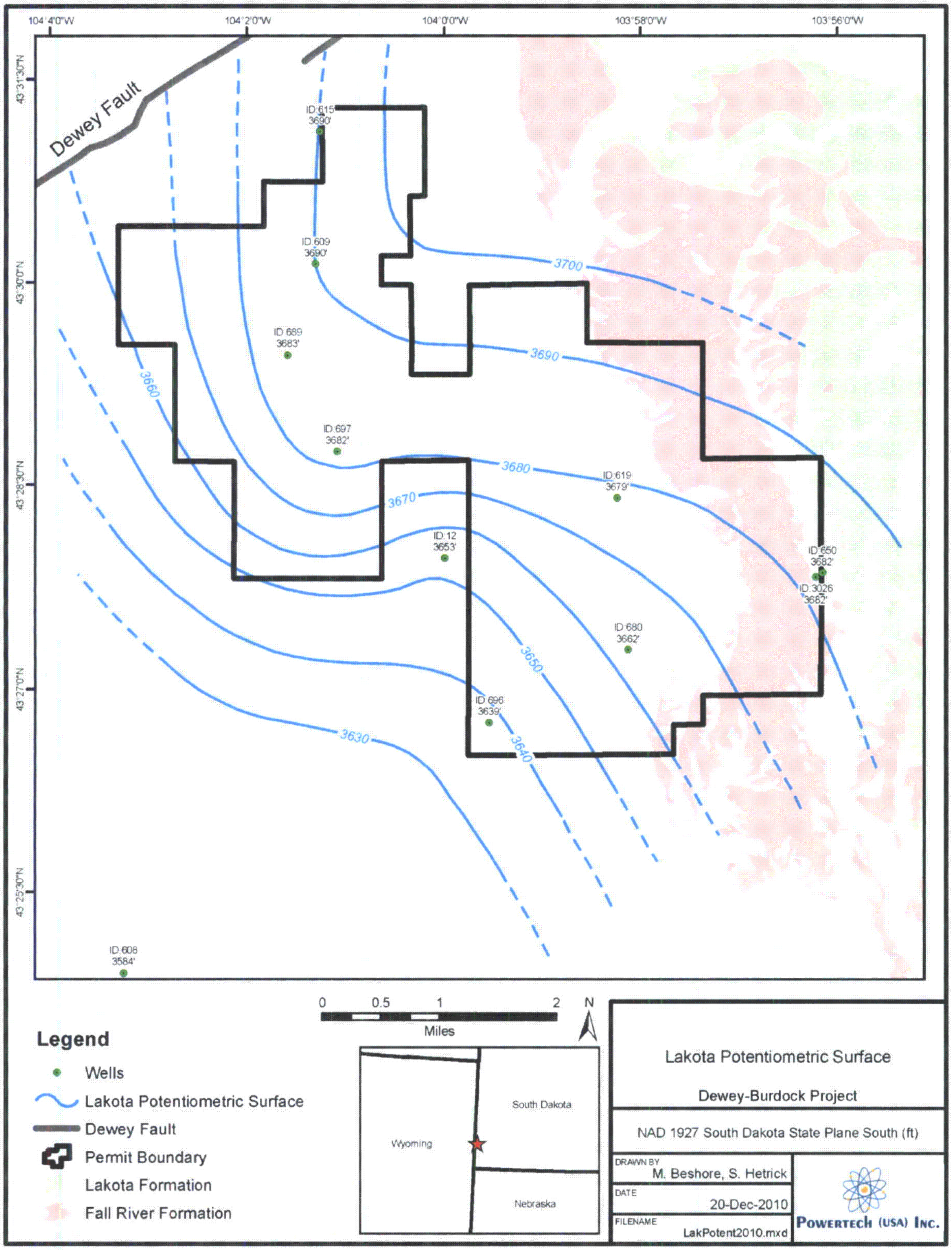
Hydro ID 8003:

This groundwater well has an unknown completion interval and depth. Therefore it is not a reliable source of data for groundwater monitoring.



Note: Potentiometric surface based on average water level values at the project site. Contours are dashed where approximate.

Figure 2.7-14 Potentiometric Surface of the Fall River Aquifer



Note: Potentiometric surface based on average water level values at the project site. Contours are dashed where approximate.

Figure2.7-15: Potentiometric Surface of the Lakota Aquifer

TR RAI-2.7-6

NRC Staff found that the description of the methods used to measure the groundwater levels or water potential measurements and the subsequent method of calculation used to establish groundwater elevations at each well in Section 2.7.2.2.8 of the TR were incomplete. Please provide a complete description of the method used to determine potentiometric head for the artesian wells.

Response: TR RAI-2.7-6

- Water levels were measured in monitoring wells as follows:
  - Static water levels were measured at most wells prior to sample collection with regard to a reference elevation, usually a mark on the well or on a permanent structure above or near to the well.
  - When possible, free-flowing wells were measured with a 15 lb/in^2 (psi) or 30 psi N.I.S.T.-certified pressure gauge.
  - The well was shut in and the pressure was allowed to stabilize before a reading was recorded.
  - Pressure values were recorded to within at least 0.1 psi and typically to within 0.01 psi.
  - Wells with subsurface water levels were measured using an electric water level tape with measurements reported to within at least one tenth of a foot and typically to within a hundredth of a foot.

TR RAI-2.7-7

The Fall River isopach map of Dewey Well field I (Supplemental Exhibit 3.2-9) and Dewey Well field I Cross Section (Supplement Exhibit 2.1-3) show ore zones proposed for uranium recovery within a plausible channel deposit. This scenario is also seen in the detailed information for Burdock Well field I (Supplemental Exhibit 3.2-12 and Supplement Exhibit 2.1-4). Staff notes that these data illustrations do not provide sufficient information concerning these plausible channel deposits. Staff requests structure maps of the base of the Chilson aquifer for Burdock Well field I and the base of the Fall River aquifer for Dewey Well field I. Also, please modify Exhibits 2.1-3 and 2.1-4 to show all interbedded sandstones and shales within the Chilson and Fall River aquifers as well as the perimeter, overlying, and underlying monitoring wells and their screened intervals. Noting that Section 3.2 of the TR Supplement states, "location of any flow problems caused by clay stringers," please further discuss the effects of channel deposits and interbedded shales on the containment of production fluids and the adequacy of groundwater monitoring layout.

Response: TR RAI-2.7-7

Uranium ore bodies developed within channel sand deposits is not unique to the Dewey-Burdock Project. For the past thirty years, ISL mining for uranium has been successfully developed within fluvial channel sands in the States of Texas, Wyoming and Nebraska. A Structure Contour Map to the top of the Morrison for Burdock Well field I was developed for the ER RAI (RAI_ER Exhibit WR-6.3). This map is the equivalent to the requested structure contour map of the base of the Chilson aquifer. It shows an indication of some east-west scouring into the Morrison within the eastern portion of the proposed well field. As shown on the cross section in TR Exhibit 2.7-1a, the thickest portion of the Lower Chilson sand channel generally coincides with this scouring. The lowermost mineralized unit (L1) is contained in this portion of the Lower Chilson.

A separate structure contour map to the top of the Fuson Member for Dewey Well field I (**TR 2.7-2**) has been developed in response to this RAI. On this Fuson structure contour map, there appears to be no indication of scouring associated with Fall River sand channels. However, the axis of this Fall River channel system is located to the east is an area of relatively sparse drilling.

Cross sections across each of the proposed well fields were prepared in response to TR RAI P&R-1. As opposed to modifying the small-scale **Supplemental Exhibits 2.1-3 and 2.1-4** to show interbedded clays, along with perimeter, overlying and underlying monitor wells on, NRC staff is referred to these larger-scale cross sections in order to see this same information.

These cross sections illustrate that interbedded clay beds isolate upper channel sand bodies from lower channel sands within the same formation. Multiple mineralized units may occur within single channel sand and all such ore bodies can be monitored by a perimeter monitoring well within that channel sand. Underlying and overlying monitor wells will be placed into underlying and overlying channel sand accumulations.

The text in Section 3.2 of the TR Supplement referred to delineation drilling being used to identify the location of any flow problems caused by clay stringers. This is a reference to potential smaller scale lenticular, interbedded clay zones within the mineralized sands. Detailed delineation drilling will be conducted to map smaller changes in the depositional environment which may have a potential to change flow on a smaller scale. Design of the pattern areas for each well field, as well as the associated monitoring system, will be done to account for any of these potential flow features to ensure such lixiviant can be contained within the production zone and adequately monitored. Well field pump tests will also be conducted in order to ensure proper communication between mining zones and perimeter monitor well rings. All of this mapping, design, and testing information will be provided for review by NRC in the well field hydrogeologic packages for each well field prior to operation.

TR RAI-2.7-8

Considering the uncertainty of the flow regime close to the Dewey Fault and the size and potential complexity of the rest of the project site, NRC staff found amount of well points used to represent the potentiometric maps of the Fall River, Lakota, and Unkpapa water bearing units to be insufficient. Staff noted an unusual potentiometric surface in the Dewey portion and was unable to determine the source of the anomally. Staff also noted that well points used in Figures 2.7-14 and 2.7-15 of the TR did not include available wells provided in Appendix 2.2-A (e.g., Fall River Wells 7, 8, 17, 18. and 20; and Lakota Wells 1, 2,13,14,16,42,51,96,115,147,510,620,696,697, and 7002). Staff notes that Section 2.7.2.2.8 of the TR indicated that some of the additional wells listed in Appendix 2.2-A are difficult to access for water level measurements. However, staff is uncertain if the wells can be reasonably accessed with additional efforts. Staff requests potentiometric maps of the Fall River, Lakota, and Unkpapa water bearing units that include all wells that are reasonably accessible for water level measurements.

Response: TR RAI-2.7-8

Table 2.7-15: Reasons no Measurements were Obtainable During Sampling Period.

Well	Reason for no measurements
1	**Could not be sealed for pressure measurement because of leaks caused by corrosion and age**
2	**Could not be sealed for pressure measurement because of leaks caused by corrosion and age**
7	**Domestic cannot measure without pulling pump**
8	**Domestic cannot measure without pulling pump and shutting in for period of time**
13	**Domestic cannot measure without pulling pump**
14	**Difficult surface access**
16	**Difficult surface access because of fittings, domestic well would have to be shut in for period**
17	**Stock well would need pump pulled and to stop being used to stabilized**
18	**Domestic cannot measure without pulling pump and shutting in for period of time**
20	**Domestic cannot measure without pulling pump and shutting in for period of time**
42	**Domestic could not measure without pulling pump. W**
51	**Surface casing in poor condition, leaking**
96	**Domestic well cannot measure without pulling pump and shutting in for period of time**
115	**Domestic well cannot measure without pulling pump and shutting in for period of time**
147	**Not measured because of location north of Dewey Fault**
510	**Difficult access, would require shutting in for a period of time**
619	**Well that contained pumps and pump tubing making it difficult to retrieve a water level tape**
620	**Stock well would need pump pulled and to stop use to be stabilized**
635	**Free-flowing well that could not be sealed due to leaks caused by corrosion and age**
696	**Free-flowing well that could not be sealed due to poor valve fittings or cracked valves**
4002	**Free-flowing wells that could not be sealed due to leaks caused by corrosion and age**
7002	**Because of the age of this well, it is believed that pressurizing may cause a line to rupture**

TR RAI-2.7-9

NRC staff notes that the potentiometric groundwater surfaces of the Fall River and the Lakota are above ground surface within the southern portion of Well field Dewey I, the western portion of Well field Dewey III, and Well field Burdock V. These areas are within alluvium along Beaver Creek and Pass Creek. NRC staff notes that unplugged exploration test holes recognized in Section 2.7.2.2.16 of the TR (Le., Section 2.7.2.2.16 of the TR states, "Locally unidentified structural features or more likely old, unplugged exploration holes enhance this interaquifer connection.") may be a pathway for production zone groundwater to be discharged via artesian flow to alluvial aquifers and plausibly be discharged from alluvial aquifers to Beaver Creek and/or Pass Creek. Please provide additional information regarding the potential for whether groundwater is discharging to alluvial aquifers as referenced above.

Response: TR RAI-2.7-9

Near the PAA, there are several possible modes of interaction between groundwater and surface water. Groundwater becomes surface water where free-flowing artesian wells discharge into surface water impoundments. There are no natural springs in the PAA. The only other major avenue for interchange is along the alluvium where Pass Creek crosses the Inyan Kara outcrop. Here, the alluvium may either gain or lose flow to the underlying aquifer. There is currently no stream loss data for Pass Creek to quantify this interaction.

There is no known evidence of any groundwater flowing upward from springs originating in the Inyan Kara to surface water features in the PAA, with the exceptions of the Triangle mine open pit and a location of surface water flow in the north half of the north east quarter of S 15, T 7 south, R 1 east in the Burdock area. Typically the presence of the Graneros shale prohibits this flow between the Inyan Kara and the surface.

Most of the surface impoundments are in the form of stock dams which collect surface runoff. Wetlands are only known to be centered on stream beds and recharged only by stream flow.

The Triangle mine, the Darrow mine, and other open pits previously used for mining are open to the Fall River Aquifer. In the case of the Triangle mine, the bottom of the open pit is below the potentiometric surface of the Fall River aquifer which has flooded the pit. The Darrow pits are believed to be above the potentiometric surface of the Fall River and Lakota aquifers. However, water level data on the outcrop region is not sufficient at this time to fully evaluate this.

The surface water feature near the Burdock area is believed to be Inyan Kara as it is artesian at this location. This area contains historic localized drilling into the Inyan Kara. The cause will be investigated and mitigated if necessary prior to development of the initial well field at Burdock. If determined to be an improperly plugged exploration hole, licensee will locate and plug.

Development of each well field will include more detailed hydrogeologic study in the form of pump testing and mapping of the potentiometric surface in greater detail to illustrate the presence of any potential connection of each well field production zone to surface water bodies and presented for review in the hydrogeologic data packages. Surface water features will be monitored during pump testing to determine any hydraulic connection with the well field production zone. Typically, a larger number of wells consisting of the perimeter monitor ring and overlying and underlying non-production zone monitor wells will be monitored for response during a pumping test or multiple tests for each well field. If surface water features are within a distance calculated to be of possible hydrogeologic connection, then these surface water features will also be monitored for response during the pump testing. If a surface water feature can otherwise be shown to be completely isolated from the production zone hydrogeologic unit then it will not be monitored during pump testing.

TR RAI-2.7-10

The application states that springs are not present within the license area. NRC staff is uncertain if the statement includes potential springs that may directly feed wetlands and/or surface impoundments in the license area. Staff is uncertain if unplugged exploratory drill holes (discussed in the above-referenced RAI 12) may have potentially created a spring(s) that feeds a wetlands and/or surface impoundment with production zone groundwater in areas of flowing artesian conditions and the unconfined Fall River aquifer. Please provide a discussion to clarify whether wetlands, surface impoundments, and open mine pits at or downgradient of all proposed production are potentially spring fed with production zone groundwater.

Response: TR RAI-2.7-10

Please refer to the response in TR-RAI-2.7-9. There are no known springs within the PAA. There is a location of surface water flow in the north half of the north east quarter of S 15, T 7 South, R 1 East that is down gradient of Burdock well field area addressed in TR-RAI-2.7-9.

TR RAI-2.7-11

The TR Supplement stated "Any such water which falls within an area to be mined by POWERTECH shall be removed." NRC staff notes that the applicant may have intended to say "water well" instead of "water." This discrepancy should be corrected or clarified. Please also identify wells to be removed.

Response: TR RAI-2.7-11 (Supplemental Report Section 5.1.1 and TR Section 6.1.8)

This language is correct based on language in lease agreements. If a landowner is utilizing ground water within a mining zone, the well will be removed from the owner's use. This response also addresses (in part) TR RAI 2.7-13 (a), (b), (c) and (d).

It is premature until well field packages are developed to specifically identify the well(s) that may need replacement or removal. This language (extracted from a lease agreement) is placed within the application to demonstrate to the NRC that Powertech (USA) has binding agreements in place with landowners to secure other water for landowners so that owner's water quality and availability is not diminished and that domestic water wells will not interfere with well field control. Before any well is replaced, Powertech (USA) will inform the well owner.

TR RAI-2.7-12

The application stated "if any water well on the Property outside of a mining area or well field is materially and substantially diminished in quantity or quality due to POWERTECH's exploration, development or mining activities, POWERTECH will provide LESSOR with such additional water well or wells as may be necessary to provide water in a quantity equal to the original well and of a quality which was suitable for all uses the diminished well served." This statement appears to imply that the applicant will wait until a water well experiences diminished water quality before acting. Please state those measures to be used to detect and inform potential human receptors of a water quality impact.

Response: TR RAI-2.7-12 (Supplement Report Section 5.1)

Location of Existing Wells

During well field design and development, all existing wells that could potentially be affected by well field operations or could potentially interfere with well field operations will be evaluated. Pumping test results, sampling program data, vertical and geographic locations will all be considered before final design of a well field package, which will be presented to the NRC for review prior to mining. If water wells are determined to exist within an ore zone or if the potential exists for operations to diminish quantity or quality of the well water in such a manner that the designated use is prohibitive, Powertech (USA) may utilize the well within the well field design and operation while restricting the owner's use and replace the existing well; well owner will be notified in writing. For additional information refer to SR Section 5.1.1 and TR Section 6.1.8.

TR RAI-2.7-13
Below are comments and associated requests for information from NRC's review of water wells located at or near the project site.

TR RAI-2.7-13(a)

a. ***Non-verified wells in Appendix 2.2-A of the TR are described as wells that were not located at the site and may or may not still exist. If any of these wells or other wells are discovered prior to the closure of the project site, please describe those procedures to be used to protect public health.***

For each of the wells above, please provide the applicant's plans for protecting public health, determining when well replacement is necessary, the means of notifying the affected parties and the NRC staff when such a replacement is necessary, and the manner in which the potential for contamination migration is precluded.

Response to: TR RAI-2.7-13(a) (TR Section 2.2.3.3 and TR Appendix 2.2-A)

TR Section 2.2.3.2.3 Study Area Groundwater Use

Non-verified wells are described in Appendix 2.2-A. The non-verified wells are wells that were not able to be located upon field investigations. Many years have passed since the plugging of the historical wells; for this reason many wells listed in the data base are no longer in existence on the property. Powertech (USA) continues building and maintaining a complete well database. In doing so, the applicant thought it important to include both historical and existing wells. If any wells are discovered within the PAA and are found to pose a threat to human health or the environment prior to site closure, Powertech (USA) will plug and abandon the wells based on procedures described in TR Section 6.1.8.

Although much of the information in Section 6.1.8 is descriptive of wells owned and operated by Powertech (USA), plugging and abandonment procedures are applicable to any well determined to need replacement. Well replacement determination is based upon whether or not the well:

i) poses a risk for aquifer contamination (determined via water quality analysis results and well field delineation pump test(s))
ii) poses a safety risk for humans and/or animals (determined by physical condition)
iii) potentially could interfere with control of a well field (determined via well field delineation pump test(s))
iv) and if the integrity of the well is compromised and will not pass testing requirements (determined by MIT).

If wells are located that require plugging and abandonment the steps described in Section 6.1.8 will be utilized to protect public health and the environment.

Each domestic well will be evaluated in detail for its potential effect on well field operations and the possibility for migration of lixiviant during normal and unusual well field operating conditions. Should the well be determined to be affected or present a risk of possible lixiviant migration outside of the well field, then the well will be plugged and abandoned and a new replacement well will be provided to the owner in an aquifer below the Inyan Kara. If the well is within ¼ mile of the planned well field monitor ring, it will be plugged and abandoned and replaced as described. All pertinent data evaluating the estimated effects, risks, and plan of action for each local domestic well will be presented in the well field hydrogeologic package for each well field.

In every monitor well ring, water levels will be monitored and compared to initial baseline levels. Any changes in these levels will indicate changes within the well field cone of depression but will also indicate gradient changes exterior to the well field which may flow away from the well field. The possibility of migration of lixiviant to any domestic source outside of the monitor well ring will be avoided by the fact that the gradient will be directed interior to the well field pattern areas at all times. Lixiviant migration outside of the monitor ring will be controlled and monitored by the routine sampling of monitor wells for excursion indicators, water level monitoring, and routine pattern balancing of well field injection and production flow rates.

TR RAI-2.7-13(b)

Below are comments and associated requests for information from NRC's review of water wells located at or near the project site.

b. ***Appendix 2.2-A of the TR indicates that stock wells 618 and 628 tap an unknown water-bearing zone and the Inyan Kara water-bearing zone, b.respectively. According to Figure 11 in Appendix A, these stock wells appear to be located within a proposed wellfield area. NRC staff notes that the construction and condition of these wells are unknown. Appendix 2.2-A of the Technical Report indicates that stock wells 618 and 628 tap an unknown water-bearing zone and the Inyan Kara water-bearing zone, respectively. According to Figure 11 in Appendix A, these stock wells appear to be located within a proposed wellfield area. NRC staff notes that the construction and condition of these wells are unknown. Please describe the applicant's plans to address these wells if they are located in a well field, completed in the ore zone, and to protect public health.***

For each of the wells above, please provide the applicant's plans for protecting public health, determining when well replacement is necessary, the means of notifying the affected parties and the NRC staff when such a replacement is necessary, and the manner in which the potential for contamination migration is precluded.

Response: TR RAI-2.7-13(b) (TR Section 6.1.8 and TR Appendix 2.2-A)

See TR_RAI-Response 2.7-12 and 13(a) above.

TR RAI 2.7-13(c)

Below are comments and associated requests for information from NRC's review of water wells located at or near the project site.

c. ***Appendix 2.2- A of the TR indicates that TVA wells 605, 609, 637, and 668 appear to be*** **within proposed wellfield areas.** ***NRC staff notes that the condition of these monitoring wells is unknown.***

For each of the wells above, please provide the applicant's plans for protecting public health, determining when well replacement is necessary, the means of notifying the affected parties and the NRC staff when such a replacement is necessary, and the manner in which the potential for contamination migration is precluded.

Response: TR RAI-2.7-13(c) (TR Appendix 2.2-A)

See TR_RAI-Response-2.7-13(a) above. Supplemental Section 5.1 concerning Powertech (USA)'s rights by landowner agreement to replace wells. Information known about the condition of these wells obtained post submittal is listed below. If P&A historical records are located, the records will be submitted to the NRC.

605:

- Has not been located at present. This well is PZ-3 from the Burdock TVA pump test and is likely screened throughout the Inyan Kara. Field investigation reports no indication of well presence.

609:

- This well is currently monitored and is screened from 903-966 feet.
- Screened within the Lakota. Water levels are consistent with other Lakota wells in the area.

637:

- Has not been located at present. This well is BPZ-5 from the Burdock TVA pump test. Field investigation reports no indication of well presence.

668:

- This is the Burdock TVA test well. It is screened from 280-555 feet, and is screened throughout the entire Inyan Kara.
- This well will have to be plugged prior to additional pump testing and after direct verification of the precise screened interval.

All of these wells will be additionally investigated to locate and identify their current connection to any aquifer. With the determination of potential interference to any well field operations, these wells will be plugged prior to well field operation.

TR RAI-2.7-13 (d)

Below are comments and associated requests for information from NRC's review of water wells located at or near the project site.

d. Figure 8 in Appendix 2.2-A of the TR appears to show that domestic well 16 is within or immediately adjacent to a proposed well field area. Staff is uncertain if production at this well field is proposed in the Lakota water bearing zone that the domestic well taps.

Response: TR RAI-2.7-13 (d) (TR Appendix 2.2-A)

Powertech (USA) has drilled a replacement well and will take Well 16 prior to well field operations. See Section TR RAI 2.7-12 and 13(a) above.

TR RAI-2.7-13 (e)

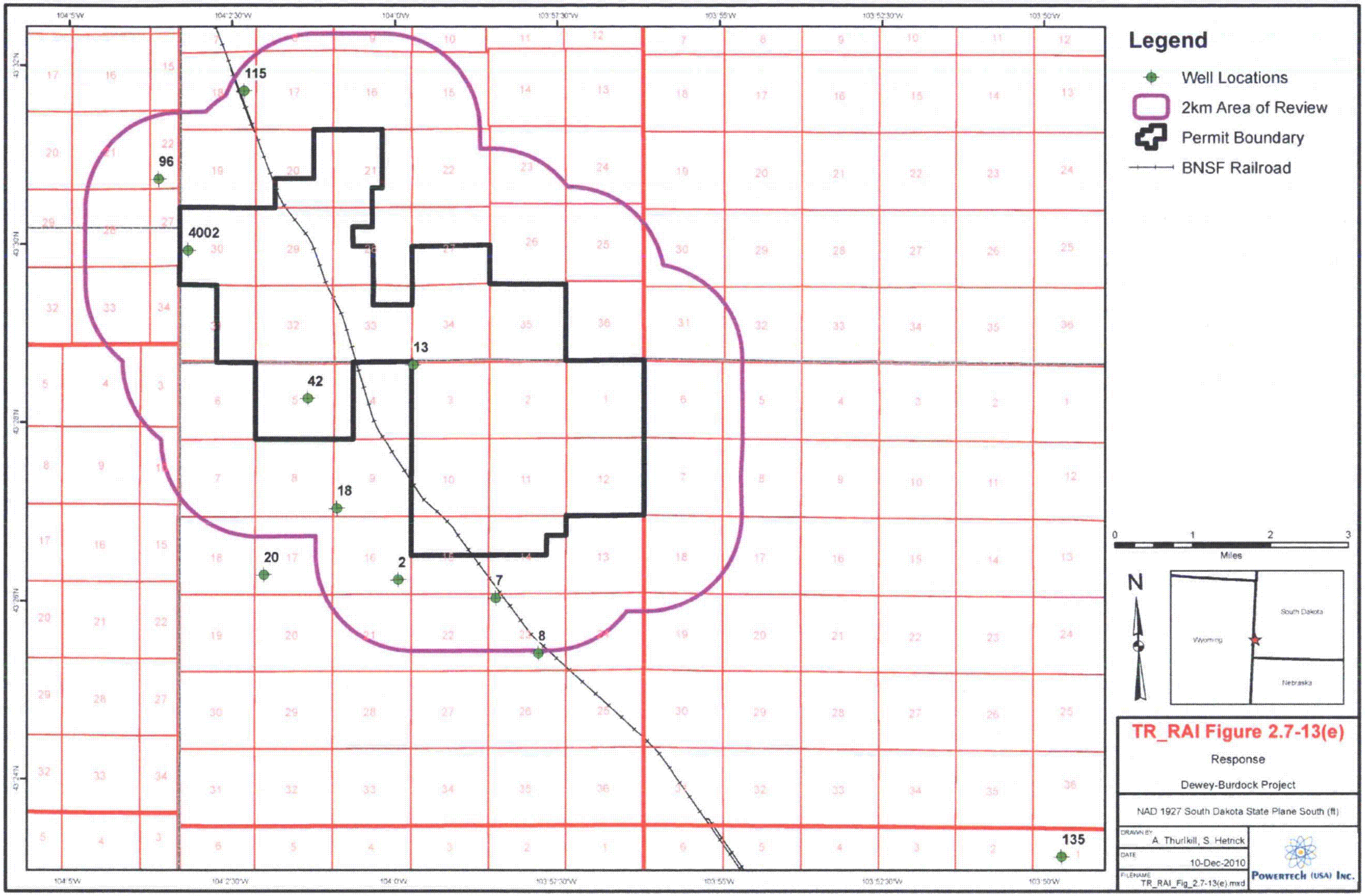
Below are comments and associated requests for information from NRC's review of water wells located at or near the project site.

e. ***Appendix 2.2- A of the TR indicated that Lakota domestic wells 13 and 42 are within the license boundary and Inyan Kara domestic wells 2,7,8,18,20,96, 115, and 135, 4002 are outside of the license boundary in the vicinity of the site.***

For each of the wells above, please provide the applicant's plans for protecting public health, determining when well replacement is necessary, the means of notifying the affected parties and the NRC staff when such a replacement is necessary, and the manner in which the potential for contamination migration is precluded.

Response: TR RAI-2.7-13(e) (TR Appendix 2.2-A)

Well 13 (section 1) and 42 (section 5) are within the PAA; well 2 is located southwest of the PAA boundary and just south of the SD School property in section 16; well 7 (section 23) located south of the PAA boundary; well 8 (Section 23) is approximately 1300 ft. outside the AOR; well 18 (section 9) located west of the proposed PAA boundary just north of the SD School property. Well 20 (section 17) is outside the AOR for the PAA; well 96 is not located within the AOR for the proposed affected area (SWSW section 22). Well 115 (section 18) within the AOR and outside the PAA. Well 135 (section 1) within township 8; this location is approximately 8 miles southwest of the PAA boundary. Well 4002 (section 30) located within the PAA. See TR_RAI – Figure 2.7-13(e). See Section TR RAI 2.7-12 and 13(a) above.


Legend
Well Locations
2km Area of Review
Permit Boundary
BNSF Railroad
115
96
4002
13
42
18
20
2
7
8
135
Miles
N
South Dakota
Wyoming
Nebraska
TR_RAI Figure 2.7-13(e)
Response
Dewey-Burdock Project
NAD 1927 South Dakota State Plane South (ft)
A. Thurlkill, S. Hetnck
10-Dec-2010
TR_RAI_Fig_2.7-13(e).mxd
POWERTECH (USA) INC.

TR RAI-2.7-13 (f)
Below are comments and associated requests for information from NRC's review of water wells located at or near the project site.

f. ***Appendix 2.2- A of the TR indicated that stock wells 17,49,38, and 61 tap either the Fall River or Lakota water-bearing zones. These stock wells appear to be located at, or immediately adjacent to, possible production zones.***

For each of the wells above, please provide the applicant's plans for protecting public health, determining when well replacement is necessary, the means of notifying the affected parties and the NRC staff when such a replacement is necessary, and the manner in which the potential for contamination migration is precluded.

Response: TR RAI-2.7-13 (f) (TR Appendix 2.2-A)
See Section TR_RAI 2.7-12 and 13(a) above.

TR RAI-2.7-13 (g)

Below are comments and associated requests for information from NRC's review of water wells located at or near the project site.

*g. **Appendix 2.2- A of the TR indicated that Lakota stock wells 12, 51, 510, 619, 620, and 650 are located within the license boundary.***

For each of the wells above, please provide the applicant's plans for protecting public health, determining when well replacement is necessary, the means of notifying the affected parties and the NRC staff when such a replacement is necessary, and the manner in which the potential for contamination migration is precluded.

Response: TR RAI-2.7-13 (g) (TR Appendix 2.2-A)

See TR_RAI-Response; Section TR_RAI-2.7-12 and 13(a) above.

TR RAI-2.7-14

Referring to Appendix 2.2- A of the TR, please determine and provide the "Type Use" of Lakota wells 51 and 14, which are located within the license boundary. Once their use is determined, provide additional discussion, as needed, of the water quality risk to the well(s) from the project and any measures that will assure environmental and humans receptors of water from a well are not subjected to any potential diminished water quality from project operations.

Response: TR RAI-2.7-14 (TR Appendix 2.2-A)

Type Use for Lakota well 14 is unused stock; water quality risks will be assessed further via performing pump test for Burdock Well Field I, however, the designated use is stock and is unused, therefore there is no anticipated risk to humans or the environment from the water quality. If a potential environmental risk or an interference with well field operation is determined via the pump test the well would require plugging and abandonment. This well is located approximately ¾ of a mile NW of the proposed Burdock Well Field I, beyond the location of the monitoring well ring, therefore no environmental or human risks are anticipated from mining operations.

Type Use for Lakota well 51 is designated as a stock well currently in use. This well is located outside the PAA in section 9 and is approximately 1 mile east from the proposed Burdock Well Field I. Unless testing indicates a potential for environmental risk or an interference with well field operations, no measures will be taken to plug the well. If a potential for an environmental or human risk is indicated during testing the measures discussed in Response to: TR_RAI-2.7-13(a) for plugging and abandonment would apply as also discussed above.

TR RAI-2.7-15

Consistent with Section 2.7.4 of NUREG-1569, please provide a table listing the data on a parameter-by-parameter, well-by-well or surface-water location by surface-water-location basis using appropriate statistical methods. Include results of all field-measured parameters including elevations and/or depth to water. For sampling locations that were dry or ice, please note that information in the appropriate column rather than omitting the data altogether from the table. For concentrations below the minimum detection level, please report the data as "less than" and the PQl. Based on the data presented in the application, the staff cannot reconstruct this information with any degree of certainty to perform an independent, statistically valid basis. Furthermore, duplicate samples should be used only for QA/QC evaluations and should not be used for statistically evaluations.

Response: TR-RAI-2.7-15 (TR Appendix 2.2-A)

See TR_RAI Response; Section RI-5 for TR_RAI Attachment RI-5 a Letter received from Energy Laboratory on 22 October 2010 concerning Powertech (USA)'s data consistency inquiry and Appendix 2.7-G Attachment A (Submitted December 2010) for Parameter by Parameter for Well data and surface water data.

TR-RAI-2.7-16

Please provide the rationale or justification for only one location to establish the pre-operational groundwater quality of the Sundance/Unkpapa waterbearing zone. The staff notes that several wells are completed in the Sundance/Unkpapa aquifer; however, no samples were collected by the applicant. Spatial variations in water quality should be determined to establish a conceptual model for the aquifer. This information is especially important if the applicant proposes not to monitor the Sundance/Unkpapa aquifer as the lower aquifer. Is the Sundance/Unkpapa the underlying aquifer?

Response: TR-RAI-2.7-16 (TR Section 2.6.2 and 2.7.2)

The Morrison formation overlays the minor Sundance aquifer and is designated as the lower confining unit for the project (TR_Section 2.6.2.2). The Morrison has an average thickness of 100' below the project area and permeabilities range from 3.9×10^{-9} cm/sec to 4.2×10^{-8} cm/sec. Furthermore it is uncommon for the Sundance to serve as a water source in this area due to the depth and low flows encountered (See TR_Section 2.7.2.1.6).

During the development and into the 2007-2008 baseline sampling program there was only one Sundance well (#635) within the AOR. Well into the baseline sampling effort other Sundance wells were drilled by Powertech (USA) for pump test purposes; these additional Sundance wells were completed just 1-3 months prior to the end of baseline sampling.

The Sundance/Unkpapa is considered a minor underlying aquifer. For more information regarding the testing efforts (past, present, and future) for this aquifer refer to TR Section 2.7.2.2.8. Powertech (USA) is cautious when determining quantity and location of holes that penetrate the proposed project's lower confining unit. Fewer intrusions through the underlying Morrison unit prove to be more protective to the minor aquifers below during mining activities.

TR-RAI-2.7-17

The heading in Table 2.7-3 implies that a parameter concentration exceeds a Maximum Contaminant level even for those parameters that do not have an MCL. Please explain whether or not the applicant was referring to standards other than MCLs.

Response: TR-RAI-2.7-17

The heading for Table 2.7-3: PKFQWin Flood Estimate Results for Beaver Creek and is located in TR Section 2.7.1.4.2. Powertech (USA) believes that Table 2.7-35 is the actual table in question.

For this table, the column title "EPA Maximum Contaminant Level (MCL)" refers to various limits as listed below in the footnotes. These include EPA maximum contaminant level for primary drinking water standards, secondary drinking water standards, health advisory limits, EPA Region 8 permit limits, treatment action limits, and proposed MCLs.

TR RAI-2.7-18

The applicant identified 48 sub impoundments in the application. The applicant did not provide summary data on the eight sub impoundments (Sub12 through Sub19). The staff cannot determine whether or not the subset of impoundments is representative of the 48 impoundments without that information. Please address this comment.

Response: to TR RAI-2.7-18 (TR Section 2.7.3.1)

The apparent data gap (Sub 12 – Sub 19), in Table 2.7-24 initially included the eight (8) stream surface water sampling sites within Pass Creek, Beaver Creek and the Cheyenne River basins. However, these sites were removed from the sequential numbering of the sub impoundments, because they are of a stream sample type. The eight stream sampling locations not included in Table 2.7-21 are designated as BVC01, BVC04, CHR01, CHR05, PSC01, PSC02, BEN01, and UNT01.

TR RAI-2.7-19

The analytical data includes results for the dissolved, suspended and total analyzed fractions of a constituent at one or more sampling events at a single location. The applicant did not discuss differences/relationships between the various fractions and at times appears to include more than one fraction in a statistical analysis. Please clarify the analytical results as discussed above.

Response: to TR RAI-2.7-19 (TR Section 2.7.3.1)

Based on guidance contained in RG 4.14 (p.4.14-3), both groundwater and surface water samples are to be analyzed for dissolved and suspended radionuclide fractions. Also see "Table 1 Preoperational Radiological Monitoring Program for Uranium Mills" (p.4.14-8) for this same guidance. RG 4.14 states "Groundwater samples from sources that could be used as drinking water for humans or livestock or crop irrigation should also be analyzed for suspended natural uranium, thorium-230, radium-226, polonium-210, and lead-210." Therefore, the applicant will determine the concentrations of both dissolved and suspended radionuclide fractions in the groundwater and surface water radionuclide samples to be collected and analyzed on a quarterly basis. The dissolved fraction will be compared against the baseline dissolved fraction. In the case of drinking water or stock water wells, the suspended fraction will also be compared against the baseline suspended fraction. The comparison of total concentrations in the application was simply for added information and was not intended to be an indication that total concentrations will be used to compare operational data to baseline data.

It is important to clarify that while the thorium-232 analytical results appear to be positive, they are all essentially non-detect (ND), or less than the PQL. The data tables generally show a value of 0.0025 mg/l, which is one-half the value of the PQL, 0.005 mg/l, which is typical protocol when calculating statistics. Consequently, with no or negligible concentrations of thorium-232, very few analyses of radium-228 were performed.

After re-examining the groundwater radionuclide data, it became apparent that there could be some confusion regarding the recordation of suspended, dissolved and total concentrations. To clarify, the results recorded for "total" are only those analyses for total concentration, and not the sum of the suspended and dissolved fractions.

TR RAI-2.7-20

The applicant includes surface impoundment Sub05 in the surface water monitoring program. However, sampling results for surface impoundment Sub05 are not presented in the application nor is the lack of results discussed. Please explain this lack of data.

Response: to TR RAI-2.7-20 (TR Section 2.7.3.1)

Surface impoundment Sub05 was dry at the time of sampling.

TR RAI-2.7-21

On Page 2-195, the applicant indicates that water quality data were collected during the 2008 pumping test at additional wells listed in a table entitled "Additional Well Data"; however, the data are not presented in the application in either Appendix 2.7-G (Groundwater Quality Data), a table entitled "Additional Water Quality Data and Statistics by Well" in Appendix 2.7-1, or Appendix 2.7-B 2008 (Pumping Tests: Results and Analyses). Please address this discrepancy.

Response: to TR RAI-2.7-21 (TR Appendix 2.7-G)

The table on page 7 of Appendix 2.7-I includes statistics for groundwater constituents at or above PQL for 14 wells, including the nine wells that were sampled once during the 2008 pumping test. Attachment A to Appendix 2.7-G for the new table prepared which includes the water quality results for each parameter and date of event for samples obtained from these nine wells during the 2008 pumping test.

TR RAI-2.7-22

Please address discrepancies in the following data.

- ***Data for Well 2 in Appendix 2.7-G differ from the data for Well 2 in Appendix 2.7-1.***
- ***Data for Well 7 in Appendix 2.7-1 list an additional sampling event from the data for Well 7 in Appendix 2.7-G.***

Response: TR RAI-2.7-22 (TR Appendix 2.7-G)

See attached revised tables for Appendix 2.7-G below

Revised Table for Appendix 2.7-G inserted for water quality data for well #2 and well #7.

- Data submitted in Appendix 2.7-G for sampling event 2/12/2008 regarding well # 2 is well data specific to sampling event 2/12/2008 for well #4. Data submitted in Appendix 2.7-I is the correct data for all sampling events regarding the specified well #2.
- Five sampling events occurred during 2007-2008 for well #7, therefore Appendix 2.7-I represents the correct number and data for each sampling event that occurred for this well during baseline characterization.

Revised Table for Appendix 2.7-G: Water Quality Data for Well #7

Well #7					
Analyte	10/3/2006 11:12	9/28/2007 17:28	11/12/2007 8:20	2/20/2008 8:45	5/29/2008 11:10
A/C Balance (± 5) (%)		-3.73	1.13	-2.5	8.11
Actinium 228-Dissolved	<20				
Alkalinity-Total as CaCO3	170	176	170	170	170
Aluminum-Dissolved (mg/L)	<0.1	<0.1	<0.1	<0.1	<0.1
Americium 241-Dissolved	<20				
Ammonia (mg/L)	0.4	0.3	0.4	0.3	0.3
Anions (meq/L)		14.1	15.6	15.9	14.4
Antimony-Total (mg/L)				<0.003	<0.003
Arsenic-Dissolved (mg/L)	<0.01	<0.001	<0.001	<0.001	<0.001
Arsenic-Total (mg/L)				<0.001	0.003
Barium 133-Dissolved (pCi/L)	<20				
Barium-Dissolved (mg/L)	<0.1	<0.1	<0.1	<0.1	<0.1
Barium-Total (mg/L)				<0.1	<0.1
Beryllium-Total (mg/L)				<0.001	<0.001
Bicarbonate as HCO3 (mg/L)	210	215	207	207	207
Bismuth 212-Dissolved (pCi/L)	<20				
Bismuth 214-Dissolved (pCi/L)	300				
Bismuth precision (±) (pCi/L)	18				
Boron-Dissolved (mg/L)	<0.1	<0.1	<0.1	<0.1	<0.1
Boron-Total (mg/L)				<0.1	<0.1
Cadmium-Dissolved (mg/L)	<0.001	<0.005	<0.005	<0.005	<0.005
Cadmium-Total (mg/L)				<0.005	<0.005
Calcium-Dissolved (mg/L)	37	30	36	32.9	42.1
Carbonate as CO3 (mg/L)	<5	<5	<5	<5	<5
Cations (meq/L)		13	15.9	15.1	17
Cesium 134-Dissolved (pCi/L)	<20				
Cesium 137-Dissolved (pCi/L)	<20				
Chloride (mg/L)	13	12	12	11	11
Chromium-Dissolved (mg/L)	<0.01	<0.05	<0.05	<0.05	<0.05
Chromium-Total (mg/L)				<0.05	<0.05
Cobalt 60-Dissolved (pCi/L)	<20				
Conductivity @ 25 C	1530	1490	1440	1600	1650
Copper-Dissolved (mg/L)	<0.01	<0.01	<0.01	<0.01	<0.01
Copper-Total (mg/L)				<0.01	<0.01
Fluoride (mg/L)	0.37	0.3	0.4	0.3	0.4
Gross Alpha precision (±)	0.8				
Gross Alpha-Dissolved (pCi/L)	17	4.4	7.2	15.5	3.3
Gross Beta precision (±)	1.6				
Gross Beta-Dissolved (pCi/L)	16	5	14.9	10.1	9.6
Gross Gamma-Dissolved	<20	1200	130	77	
Iodine 125-Dissolved (pCi/L)	<20				
Iron-Dissolved (mg/L)	<0.03	<0.03	<0.03	<0.03	<0.03
Iron-Total (mg/L)				0.41	0.41
Lead 210-Dissolved (pCi/L)		<1	<1	24	0.5
Lead 210-Suspended (pCi/L)		<1	<1	<1	-7.4

Well #7					
Analyte	10/3/2006 11:12	9/28/2007 17:28	11/12/2007 8:20	2/20/2008 8:45	5/29/2008 11:10
Lead 210-Total (pCi/L)		<1			
Lead 212-Dissolved (pCi/L)	<20				
Lead 214 precision (±) (pCi/L)	30				
Lead 214-Dissolved (pCi/L)	350				
Lead-Dissolved (mg/L)	<0.01	<0.001	<0.001	<0.001	<0.001
Lead-Total (mg/L)				<0.001	<0.001
Magnesium-Dissolved (mg/L)	16	11.5	15.3	14	18.2
Manganese 54-Dissolved	<20				
Manganese-Dissolved (mg/L)	0.03	0.03	0.03	0.03	0.03
Manganese-Total (mg/L)				0.03	0.03
Mercury-Dissolved (mg/L)		<0.001	<0.001	<0.001	<0.001
Mercury-Total (mg/L)	<0.001	<0.0002	<0.001	<0.001	<0.0001
Molybdenum-Dissolved (mg/L)	<0.005	<0.1	<0.1	<0.1	<0.1
Molybdenum-Total (mg/L)				<0.01	<0.1
Nickel-Dissolved (mg/L)	<0.01	<0.05	<0.05	<0.05	<0.05
Nickel-Total (mg/L)				<0.05	<0.05
Nitrogen, Nitrate as N (mg/L)		<0.1	0.1	<0.1	<0.1
Nitrogen, Nitrite as N (mg/L)	<0.1	<0.1	<0.1	<0.1	<0.1
Non-polar organic materials	<5				
Oxidation-Reduction Potential			210	180	210
pH	8.08	8.13	8.05	8.14	8.17
Polonium 210-Dissolved		<1	2.1	<1	
Polonium 210-Suspended		<1	<1	<1	-0.1
Polonium 210-Total (pCi/L)		<1			
Potassium 40-Dissolved (pCi/L)	<20				
Potassium-Dissolved (mg/L)	10	11	11.1	10.8	11
Radium 223-Dissolved (pCi/L)	<20				
Radium 224-Dissolved (pCi/L)	<20				
Radium 226 precision (±)	0.6				
Radium 226-Dissolved (pCi/L)	2.6	0.6	1.1	0.7	0.9
Radium 226-Suspended (pCi/L)		<0.2	<0.2	<0.9	-0.3
Radium 226-Total (pCi/L)		<0.2			
Radium 228-Dissolved (pCi/L)	<1				
Radon 222-Total (pCi/L)			206	242	451
Selenium-Dissolved (mg/L)	<0.005	<0.001	<0.001	<0.001	<0.001
Selenium-IV-Dissolved (mg/L)			<0.001	<0.001	<0.001
Selenium-Total (mg/L)				<0.001	<0.001
Selenium-VI-Dissolved (mg/L)			<0.001	<0.001	<0.001
Silica-Dissolved (mg/L)	7	7.5	7.8	7.5	4.1
Silver-Dissolved (mg/L)	<0.005	<0.005	<0.005	<0.005	<0.005
Silver-Total (mg/L) Sodium				<0.005	<0.005

Well #7					
Analyte	10/3/2006 11:12	9/28/2007 17:28	11/12/2007 8:20	2/20/2008 8:45	5/29/2008 11:10
Sodium Adsorption Ratio (SAR)(meq/L)			10	10	9.7
Sodium-Dissolved (mg/L)	270	237	289	276	300
Solids-Total Dissolved		896	1040	1050	1010
Solids-Total Dissolved TDS @ 180 C	1000	1000	1000	990	960
Strontium-Total (mg.L)				1	1.1
Sulfate (mg/L)	546	586	567	583	514
TDS Balance (0.80 - 1.20)		1.16	0.98	0.94	0.95
Thallium 208-Dissolved (pCi/L)	<20				
Thallium-Total (mg/L)				<0.001	<0.001
Thorium 228-Dissolved (pCi/L)	<20				
Thorium 230-Dissolved (pCi/L)		<0.2	<0.2	<0.2	
Thorium 230-Suspended		<0.2	<0.2	0.2	0.2
Thorium 230-Total (pCi/L)		<0.2			
Thorium 232-Dissolved (pCi/L)		<0.005	<0.005	<0.005	<0.005
Thorium 234-Dissolved (pCi/L)	<20				
Uranium 238-Dissolved (pCi/L)	<20				
Uranium-Dissolved (mg/L)	<0.001	<0.0003	<0.0003	<0.0003	<0.0003
Uranium-Suspended (mg/L)		<0.0003	<0.0003	<0.0003	<0.0003
Uranium-Total (mg/L)				<0.0003	<0.0003
Vanadium-Dissolved (mg/L)	<0.1	<0.1	<0.1	<0.1	<0.1
Water Temperature (lab, deg F)	48				
Zinc 65-Dissolved (pCi/L)	<20				
Zinc-Dissolved (mg/L)	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc-Total (mg/L)				<0.01	<0.01

POWERTECH (USA) INC.

Revised Table for Appendix 2.7-G: Water Quality Data for Well #2

Well #2				
Analyte	9/26/2007 12:46	11/12/2007 9:25	2/12/2008 10:21	5/30/2008 15:21
A/C Balance (± 5) (%)	-2.46	0.663	-2.6	3.25
Alkalinity-Total as CaCO3 (mg/L)	214	208	88	212
Aluminum-Dissolved (mg/L)	<0.1	<0.1	<0.1	<0.1
Ammonia (mg/L)	<0.1	0.4	0.8	0.3
Anions (meq/L)	16.7	16.5	53.3	16.6
Antimony-Total (mg/L)			<0.003	<0.003
Arsenic-Dissolved (mg/L)	<0.001	<0.001	<0.001	<0.001
Arsenic-Total (mg/L)			<0.001	0.004
Barium-Dissolved (mg/L)	<0.1	<0.1	<0.1	<0.1
Barium-Total (mg/L)			<0.1	<0.1
Beryllium-Total (mg/L)			<0.001	<0.001
Bicarbonate as HCO3 (mg/L)	261	254	107	258
Boron-Dissolved (mg/L)	<0.1	<0.1	0.7	0.1
Boron-Total (mg/L)			0.6	<0.1
Cadmium-Dissolved (mg/L)	<0.01	<0.005	<0.005	<0.005
Cadmium-Total (mg/L)			<0.005	<0.005
Calcium-Dissolved (mg/L)	48.5	51.7	241	57.8
Carbonate as CO3 (mg/L)	<5	<5	<5	<5
Cations (meq/L)	15.9	16.7	50.6	17.7
Chloride (mg/L)	10	11	26	9
Chromium-Dissolved (mg/L)	<0.05	<0.05	<0.05	<0.05
Chromium-Total (mg/L)			<0.05	<0.05
Conductivity @ 25 C (umhos/cm)	1570	1500	4400	1670
Copper-Dissolved (mg/L)	<0.01	<0.01	<0.01	<0.01
Copper-Total (mg/L)			<0.01	<0.01
Fluoride (mg/L)	0.2	0.2	0.4	0.3
Gross Alpha-Dissolved (pCi/L)	1.4	8.7	3.5	8.2
Gross Beta-Dissolved (pCi/L)	9.3	12.4	14.4	10.3
Gross Gamma-Dissolved (pCi/L)	<20	260	<20	
Iron-Dissolved (mg/L)	<0.03	<0.03	<0.03	<0.03
Iron-Total (mg/L)			1.32	1.54
Lead 210-Dissolved (pCi/L)	<1	<1	<1	3.1
Lead 210-Suspended (pCi/L)	<1	<1	<1	1.4
Lead 210-Total (pCi/L)	<1			
Lead-Dissolved (mg/L)	<0.05	<0.001	<0.001	<0.001
Lead-Total (mg/L)			<0.001	<0.001
Magnesium-Dissolved (mg/L)	15.8	16.6	87	19
Manganese-Dissolved (mg/L)	0.08	0.08	0.07	0.08
Manganese-Total (mg/L)			0.06	0.09
Mercury-Dissolved (mg/L)	<0.0002	<0.001	<0.001	<0.001
Mercury-Total (mg/L)	<0.001	<0.001	<0.001	<0.0001
Molybdenum-Dissolved (mg/L)	<0.1	<0.1	<0.1	<0.1
Molybdenum-Total (mg/L)			0.02	<0.1
Nickel-Dissolved (mg/L)	<0.05	<0.05	<0.05	<0.05
Nickel-Total (mg/L)			<0.05	<0.05
Nitrogen, Nitrate as N (mg/L)	<0.1	<0.1	<0.1	<0.1
Nitrogen, Nitrite as N (mg/L)	<0.1	<0.1	<0.1	<0.1
Oxidation-Reduction Potential (mV)		140	120	190
pH	7.91	7.85	7.94	7.92
Polonium 210-Dissolved (pCi/L)	<1	2	2.7	0.1
Polonium 210-Suspended (pCi/L)	<1	<1	<1	
Polonium 210-Total (pCi/L)	<1			
Potassium-Dissolved (mg/L)	11.5	11.4	7.8	11

Well #2				
Analyte	9/26/2007 12:46	11/12/2007 9:25	2/12/2008 10:21	5/30/2008 15:21
Radium 226-Dissolved (pCi/L)	<0.2	1.3	1.1	2.1
Radium 226-Suspended (pCi/L)	2.2	<0.2	0.7	0.2
Radium 226-Total (pCi/L)	2.2			
Radon 222-Total (pCi/L)		674	908	727
Selenium-Dissolved (mg/L)	<0.001	<0.001	<0.001	<0.001
Selenium-IV-Dissolved (mg/L)		<0.001	0.001	<0.001
Selenium-Total (mg/L)			0.002	<0.001
Selenium-VI-Dissolved (mg/L)		<0.001	0.001	<0.001
Silica-Dissolved (mg/L)	8	8.1	10.2	4.3
Silver-Dissolved (mg/L)	<0.01	<0.005	<0.005	<0.005
Silver-Total (mg/L)			<0.005	<0.005
Sodium Adsorption Ratio (SAR) (meq/L)		8.8	10	8.7
Sodium-Dissolved (mg/L)	273	286	716	297
Solids-Total Dissolved Calculated (mg/L)	1070	1090	3600	1110
Solids-Total Dissolved TDS @ 180 C(mg/L)	1100	1100	3700	1100
Strontium-Total (mg.L)			5.7	1.8
Sulfate (mg/L)	583	577	2440	579
TDS Balance (0.80 - 1.20) (dec.%)	1	0.97	1.02	0.96
Thallium-Total (mg/L)			<0.001	<0.001
Thorium 230-Dissolved (pCi/L)	<0.2	<0.2	<0.2	
Thorium 230-Suspended (pCi/L)	<0.2	<0.2	<0.2	0.1
Thorium 230-Total (pCi/L)	<0.2			
Thorium 232-Dissolved (pCi/L)	<0.001	<0.005	<0.005	<0.005
Uranium-Dissolved (mg/L)	<0.0003	<0.0003	0.0004	<0.0003
Uranium-Suspended (mg/L)	0.0003	<0.0003	<0.0003	<0.0003
Uranium-Total (mg/L)	0.0004		<0.0005	<0.0003
Vanadium-Dissolved (mg/L)	<0.1	<0.1	<0.1	<0.1
Zinc-Dissolved (mg/L) Zinc-Total (mg/L)	<0.01	<0.01	<0.01	<0.01

TR RAI-2.7-23

The mean value for radon for well #18 is 5 pCi/L in Appendix 2.7-1; however, this mean is not consistent with the listed range in data values (762-1210 pCi/L). Please explain this apparent discrepancy.

Response: TR RAI-2.7-23

Appendix 2.7-I is in error, therefore, what seems to be 5pCi/L is actually the 5 from the number 1079.7**5**. The columns should read 1079.75 pCi/L and the range of data vary from 762 pCi/L to 1220 pCi/L.

Background Radiological Characteristics 2.9

The applicant has not provided sufficient information regarding background radiological characteristics. Background radiological characterization is necessary to determine whether the applicant's future operations will affect human health and the environment. Specifically, the staff is requesting the following information.

TR RAI-2.9-1

Regulatory Guide 4.14 provides criteria for determining air particulate sampling locations. NRC staff cannot locate the applicant's criteria for determining air particulate sampling locations in section 2.9 of the TR. Consistent with Regulatory Guide 4.14 and NUREG-1569, Acceptance Criterion 2.9.3(1), provide the criteria used to establish air particulate sampling locations or indicate where this information can be found in the TR.

Response: TR RAI-2.9-1 (TR Section 2.9.6.1 Methods)

Methods

NUREG 1569 (NRC, 2003), Section 2.9.3 states that the characterization of the site background radiological characteristics is acceptable if the monitoring programs, including sampling frequency, methods, locations and density are established in accordance with pre-operational monitoring guidance provided in Regulatory Guide (RG) 4.14, Revision 1, Section 1.1 (NRC, 1980). In addition, air monitoring stations are to be located in a manner consistent with the principal wind directions as discussed in Section 2.5 of NUREG 1569. The predominant wind directions at the site, as shown in the annual wind rose in Appendix 2.5-C of the Technical Report (TR), are from the northwest and the southeast. Demonstration of how the pre-operational air particulate monitoring locations meet or exceed the recommendations in RG 4.14 is shown below.

Table 2.9-11 compares the air monitoring station locations suggested by RG 4.14 to those established for the site. The locations of the air monitoring stations are shown on Figure 2.9-8 (p. 2-325) of the TR.

The air monitoring locations suggested by RG 4.14 were developed for a conventional uranium mill. The "site boundary" for a conventional uranium mill is typically the restricted area and members of the public are precluded from entering the restricted area. Uranium in-situ recovery operations typically have a restricted area around the central processing plant much like a conventional mill, but the site boundary includes the well fields and represents a much larger area. In addition, it is not uncommon for residences to be located within the "site boundary" at a uranium in-situ recovery facility. This scenario changes the monitoring focus from the site boundary in the case of conventional mills, to actual receptors in the case of in-situ recovery operations.

The number of air monitoring locations at the site is consistent with the guidance in RG 4.14 and exceeds the minimal recommendation of four locations. The number and locations reflect the change of emphasis from permit boundary to receptor monitoring as discussed in Table 2.9-11.

Table 2.9-11: Regulatory Guide 4.14 recommended versus actual air monitoring locations.

Regulatory Guide 4.14 Suggested Location	***Actual Dewey Burdock Pre-Operational Monitoring Locations***
Three locations at or near the site boundary	AMS-01 is near the eastern permit boundary of the southern portion of the site; approximately 2 kilometers (km) east of the proposed central processing plant (CPP). AMS-01 was positioned here to evaluate particulate emissions potentially resulting from disturbed areas associated with existing open pit uranium mines to the west and northwest of this location. AMS-02 is near the site boundary in the center of the site. It is approximately 3.5 km east southeast of the proposed satellite facility in the northern portion of the site and 2.5 km northwest of the proposed CPP in the southern portion of the site. This location includes a residence. AMS-02 was positioned here to evaluate particulate emissions potentially resulting from both the proposed satellite facility and the CPP at a residence and permit boundary receptor in predominant wind directions from both proposed facilities. AMS-03 is near the northwest site boundary of the northern portion of the site. It is approximately 2 km northwest of the proposed satellite facility. This location includes a residence. AMS-03 was positioned here to evaluate particulate emissions potentially resulting from the proposed satellite facility at a residence and permit boundary receptor in a predominant wind direction. AMS-06 is near the southwest permit boundary of the southern portion of the site. It is approximately 3 km southwest of the proposed CCP. Currently no residents are at this location. AMS-06 was positioned here to evaluate potential particulate emissions from the proposed CCP at a boundary receptor southwest of the CCP.
Regulatory Guide 4.14 Suggested Location	Actual Dewey Burdock Pre-Operational Monitoring Locations
If within 10 kilometer of the site, an air sampler should be at or near the structure with the highest predicted airborne radionuclide concentration due to milling operations and at or near at least one structure in any area where predicted doses exceed five percent of the standards in 40 CFR Part 190.	AMS-04 is approximately 4 km north of the proposed satellite facility in the northern portion of the site. This location includes a residence within the town of Dewey. AMS-04 was positioned here to evaluate potential emissions from the proposed satellite facility in the town of Dewey. AMS-05 is approximately 5 km south of the proposed CPP in the southern portion of the site. This location includes a residence and is near Dewey Road and the Burlington Northern Railroad. AMS-05 was positioned here to evaluate potential emissions from the proposed CPP as well as from trains hauling coal from the Powder River Basin of Wyoming. AMS-07 is approximately 7 km south of the proposed CPP in the southern portion of the site. This location includes a residence and is near Dewey Road and the Burlington Northern Railroad. It was positioned here to evaluate potential emissions from trains hauling coal from the Powder River Basin of Wyoming.

A remote location that represents background conditions at the mill site.	AMS-BKG is approximately 7 km south of the proposed satellite processing plant and 6 km east southeast of the proposed CPP. AMS-BKG is in one of the least prevalent wind directions from both the proposed satellite plant and the CPP. It is also located away from the Burlington Northern Railroad. It is expected that this location would be unaffected by mining or other related uranium recovery operations.

TR RAI-2.9-2

Regulatory Guide 4.14 recommends that filters for continuous air samples be changed weekly or more often as required by dust loading. In Section 2.9.6.1 of the TR, the applicant stated that filters were collected approximately bi-weekly, prior to saturation. Please provide information (e.g., operating procedures, test results, etc.) on how the applicant determined filter saturation.

Response TR RAI-2.9-2(TR Section 2.9.6.1)

Methods

No attempt was made to determine the level of filter saturation or dust loading. An approximately bi-weekly filter collection was chosen for the following reasons:

1. The high volume air sampler model number was an HVP-4200AFC manufactured by Hi-Q Environmental Products Company, San Diego, CA. This air sampler contains a three stage centrifugal blower powered by a brushless, variable speed motor. The motor speed is controlled by a programmable logic controller that accepts input from a mass air flow sensor placed in the air flow path downstream of the filter paper. Any changes in the pre-set flow rate due to changes in dust loading, barometric pressure and temperature are detected by the air flow sensor. The programmable logic controller compensates for these changes by adjusting the motor speed to maintain the pre-set flow rate.

2. If dust loading is large enough that the motor cannot adjust air flow to compensate, the air flow rate will decrease. The HVP-4200AFC contains an air flow totalizer which can be reset at the time of the filter change out. If an unforeseen dust loading event occurs that overcomes the motor's ability to compensate and the air flow is reduced, the total volume of air sampled is still known.

3. The Dewey Burdock area is in rural South Dakota. Given the site location, coupled with the features of the sampling unit described above, it was not expected that total suspended particulate concentrations in air would interfere with air flow rates over a two week period.

4. Filters were composited quarterly and sent to the laboratory. At the laboratory, all the filters within the composite were digested together, using acid. The digestate was then analyzed for the appropriate radionuclides. The glass fiber filters contain materials which can interfere with radiochemical procedures at the vendor laboratory. Limiting the number of filters by collecting quarterly composites reduced the potential of sample matrix interference.

TR RAI-2.9-3

Regulatory Guide 4.14 recommends that individual procedures should be prepared and used for specific methods of calibrating all sampling and measuring equipment to ensure that the equipment will operate with adequate accuracy and stability over the range of intended use. For all air sampling equipment, please describe the procedures used by the applicant for the calibration of air sampling and measuring equipment consistent with Regulatory Guide 4.14 or indicate where this information can be found in the TR.

Response TR RAI-2.9-3 (TR Section 2.9.6.1)

Methods

The model number of the high volume air sampler used at the Dewey-Burdock site was an HVP-4200AFC. The unit is manufactured by Hi-Q Environmental Products Company, San Diego, CA. The procedure to operate and maintain this equipment is described in the manufacturer's operations and maintenance manual (Hi-Q, 2006). The samplers were purchased new from the manufacturer and deployed on or near August 13, 2007. The operations and maintenance manual states that the unit is calibrated before leaving the factory and there is no need to calibrate it upon use.

The operations and maintenance manual also states that all air flow devices should be recalibrated at least once a year against a traceable standard. Air monitoring was discontinued on August 13, 2008, one year after installation.

TR RAI-2.9-4

10 CFR 40, Appendix A, Criterion 7, requires that a preoperational monitoring program be conducted at least one full year prior to any major site construction. The applicant stated in Appendix 2.9-A of the TR that air particulate sampling was performed for 351 days. Consistent with 10 CFR 40, Appendix A, Criterion 7, and Regulatory Guide 4.14 provide justification for not sampling air particulates for one full year.

Response TR RAI-2.9-4 (TR Section 2.9.6.1)

Methods

Appendix 2.9-A of the TR describes the monitoring period for particulate sampling as the beginning of Period 1 which is August 13, 2007 to the end of Period 5 which is August 13, 2008. The statement in Appendix 2.9-A that the air particulate sampling was performed for 351 days is an error. Air particulate sampling was conducted for 366 days (February 2008 contained 29 days), consistent with the recommendations of RG 4.14.

TR RAI-2.9-5

Table 2.9-12 (Radionuclide Concentrations in Air) of the TR presents lower limit of detection LLD values for U-nat that are higher than what is recommended by Regulatory Guide 4.14. For those U-nat LLD values that are higher than the Regulatory Guide 4.14, value, please provide an analysis that the reported values are consistent with Regulatory Guide 4.14 or justification for providing alternate values.

Response TR RAI-2.9-5 (TR Section 2.9.6.2)

After review of Table 2.9-12 of the TR, it was identified that Periods 1 through 5 in the table do not correspond to Periods 1 through 5 described in the text. The information in Tables 2.9-12 and 2.9-13 has been revised to reflect the appropriate monitoring periods. Relevant text within Section 2.9.6.2 of the TR has also been revised as provided in the response to RAI TR-2.9-7.

It was identified in the first two laboratory reports (Periods 1 and 2) that the detection limit for natural uranium would not meet the U-nat LLD recommendations contained in RG 4.14. The laboratory was contacted to determine whether the samples could be re-analyzed with more sensitivity and instruct the laboratory that future samples would have to meet the more restrictive sensitivity requirements. The laboratory indicated that all the sample solution (i.e., air filter digestate) had been used in the analysis and the samples could not be re-run. The laboratory did commit to meeting the more restrictive sensitivity requirements for future samples.

The U-nat results for sampling Periods 1 and 2 range from 1.4 E-16 to 7.1E-15 µCi/ml with an average of 2.9E-15 µCi/ml. The maximum value (7.1E-15 µCi/ml) is 7.9 percent of the most restrictive effluent concentration for natural uranium (Class Y) listed in Appendix B, Table 2 of 10 CFR 20. It is clear that the maximum LLD for natural uranium is still sufficiently sensitive to demonstrate compliance with the requirement of 10 CFR §20.1302.

Table 2.9-12: Radionuclide Concentrations in Air

Location	Period	Concentration (μCi/ml)							% of Effluent Concentration				Lower Limit of Detection (μCi/ml)			
		U-nat	Th-230	Th-230 2σ Error	Ra-226	Ra-226 2σ Error	Pb-210	Pb-210 2σ Error	U-nat	Th-230	Ra-226	Pb-210	U-nat	Th-230	Ra-226	Pb-210
AMS-01	1	7.1E-15	1.7E-17	2.8E-17	5.3E-17	4.3E-17	2.4E-14	6.2E-16	0.24%	0.00%	0.01%	4.00%	7.1E-15	4.2E-18	4.8E-17	2.1E-17
	2	0.0E+00	1.6E-18	1.1E-17	7.2E-18	9.1E-18	4.1E-14	6.9E-16	0.00%	0.00%	0.00%	6.78%	1.6E-16	1.6E-18	1.6E-18	7.9E-18
	3	-1.3E-17	3.4E-18	1.0E-17	1.8E-17	1.7E-17	2.1E-14	3.5E-16	0.00%	0.00%	0.00%	3.54%	1.7E-18	1.7E-18	1.2E-17	2.1E-16
	4	2.4E-17	1.3E-17	9.8E-18	1.4E-17	9.7E-18	2.1E-14	4.9E-16	0.00%	0.00%	0.00%	3.51%	1.5E-18	1.5E-18	8.3E-18	4.2E-16
	5	-1.7E-17	6.5E-18	2.5E-17	-3.1E-17	2.7E-17	1.0E-14	6.5E-16	0.00%	0.00%	0.00%	1.74%	4.3E-18	4.3E-18	5.6E-17	6.7E-16
AMS-02	1	7.0E-15	4.1E-18	2.8E-17	-8.3E-18	2.9E-17	1.1E-14	4.5E-16	0.23%	0.00%	0.00%	1.85%	7.0E-15	4.1E-18	3.7E-17	2.1E-17
	2	0.0E+00	1.6E-17	1.1E-17	-2.3E-18	7.0E-18	2.0E-14	4.7E-16	0.00%	0.00%	0.00%	3.26%	1.5E-16	1.5E-18	1.5E-18	7.6E-18
	3	-2.0E-17	4.7E-18	1.1E-17	-8.6E-18	1.3E-17	8.9E-15	2.5E-16	0.00%	0.00%	0.00%	1.49%	1.6E-18	1.6E-18	1.1E-17	1.9E-16
	4	4.2E-18	0.0E+00	7.4E-18	-4.2E-18	7.4E-18	8.2E-15	4.2E-16	0.00%	0.00%	0.00%	1.37%	1.4E-18	1.4E-18	7.6E-18	3.9E-16
	5	-1.3E-17	0.0E+00	8.0E-18	-4.9E-17	2.3E-17	1.5E-14	6.5E-16	0.00%	0.00%	0.00%	2.44%	4.0E-18	4.0E-18	5.3E-17	6.2E-16
AMS-03	1	5.0E-15	-1.5E-18	2.0E-17	-5.9E-18	2.1E-17	1.2E-14	3.7E-16	0.17%	0.00%	0.00%	1.97%	5.0E-15	3.0E-18	2.7E-17	1.5E-17
	2	0.0E+00	9.3E-18	1.0E-17	5.4E-18	8.9E-18	1.3E-14	3.9E-16	0.00%	0.00%	0.00%	2.16%	1.6E-16	1.6E-18	1.6E-18	7.8E-18
	3	-3.0E-17	9.3E-18	1.2E-17	-1.4E-17	1.3E-17	9.2E-15	2.5E-16	0.00%	0.00%	0.00%	1.53%	1.5E-18	1.5E-18	1.2E-17	1.9E-16
	4	1.8E-17	8.9E-18	9.0E-18	9.6E-18	9.5E-18	8.0E-15	4.4E-16	0.00%	0.00%	0.00%	1.34%	1.5E-18	1.5E-18	8.9E-18	4.1E-16
	5	-1.6E-17	1.9E-17	9.7E-18	-3.2E-18	3.1E-17	1.2E-14	6.5E-16	0.00%	0.00%	0.00%	1.99%	4.2E-18	4.2E-18	5.0E-17	6.6E-16
AMS-04	1	5.0E-15	5.9E-18	2.5E-17	4.6E-17	2.9E-17	1.1E-14	3.7E-16	0.17%	0.00%	0.01%	1.89%	5.0E-15	3.0E-18	3.0E-17	1.5E-17
	2	0.0E+00	9.4E-18	1.1E-17	2.3E-18	8.3E-18	2.2E-14	5.1E-16	0.00%	0.00%	0.00%	3.66%	1.6E-16	1.6E-18	1.6E-18	7.8E-18
	3	-2.6E-17	2.5E-18	1.1E-17	-2.8E-17	1.2E-17	8.5E-15	2.6E-16	0.00%	0.00%	0.00%	1.42%	1.7E-18	1.7E-18	9.9E-18	2.0E-16
	4	1.9E-17	6.6E-18	9.0E-18	1.2E-17	9.5E-18	1.0E-14	4.6E-16	0.00%	0.00%	0.00%	1.74%	1.5E-18	1.5E-18	8.1E-18	4.1E-16
	5	-1.0E-18	2.7E-17	9.7E-18	-5.2E-18	3.3E-17	1.3E-14	6.7E-16	0.00%	0.00%	0.00%	2.23%	4.2E-18	4.2E-18	5.5E-17	6.6E-16
AMS-05	1	5.9E-15	2.6E-17	2.5E-17	-4.5E-17	2.4E-17	1.1E-14	5.3E-16	0.20%	0.00%	0.00%	1.82%	5.9E-15	3.5E-18	4.5E-17	1.7E-17
	2	0.0E+00	2.0E-17	1.4E-17	4.7E-17	1.3E-17	2.5E-14	2.6E-16	0.00%	0.00%	0.01%	4.09%	1.6E-16	1.5E-18	1.5E-18	7.7E-18
	3	1.0E-18	4.7E-18	1.1E-17	1.1E-17	1.5E-17	1.0E-14	4.4E-16	0.00%	0.00%	0.00%	1.66%	1.6E-18	1.6E-18	1.1E-17	1.9E-16
	4	2.5E-17	1.3E-17	9.2E-18	1.3E-17	9.0E-18	1.0E-14	6.3E-16	0.00%	0.00%	0.00%	1.74%	1.4E-18	1.4E-18	7.7E-18	3.9E-16
	5	2.4E-17	5.6E-17	9.5E-18	2.2E-17	3.4E-17	1.1E-14	0.0E+00	0.00%	0.00%	0.00%	1.85%	4.1E-18	4.1E-18	4.9E-17	6.4E-16

Table 2.9-12: Radionuclide Concentrations in Air (concl.)

Location	Period	Concentration (μCi/ml)							% of Effluent Concentration				Lower Limit of Detection (μCi/ml)			
		U-nat	Th-230	Th-230 2σ Error	Ra-226	Ra-226 2σ Error	Pb-210	Pb-210 2σ Error	U-nat	Th-230	Ra-226	Pb-210	U-nat	Th-230	Ra-226	Pb-210
AMS-06	1	5.0E-15	1.5E-18	2.0E-17	-3.9E-17	1.8E-17	1.4E-14	4.0E-16	0.17%	0.00%	0.00%	2.28%	5.0E-15	3.0E-18	3.1E-17	1.5E-17
	2	0.0E+00	1.4E-17	1.2E-17	2.3E-17	1.0E-17	2.1E-14	4.8E-16	0.00%	0.00%	0.00%	3.56%	1.5E-16	3.0E-18	1.5E-18	7.3E-18
	3	-1.4E-17	9.4E-18	1.2E-17	0.0E+00	1.4E-17	6.0E-15	2.2E-16	0.00%	0.00%	0.00%	0.99%	1.6E-18	3.0E-18	1.1E-17	1.9E-16
	4	1.5E-17	4.9E-18	9.1E-18	-4.9E-18	7.4E-18	9.5E-15	4.3E-16	0.00%	0.00%	0.00%	1.58%	1.4E-18	3.0E-18	8.3E-18	3.9E-16
	5	-2.6E-18	2.0E-17	9.1E-18	6.9E-18	3.3E-17	1.9E-14	6.9E-16	0.00%	0.00%	0.00%	3.25%	4.0E-18	3.0E-18	4.9E-17	6.2E-16
AMS-07	1	1.5E-14	2.0E-17	2.1E-17	-4.3E-18	2.5E-17	1.8E-14	4.4E-16	0.51%	0.00%	0.00%	3.03%	4.8E-15	2.8E-18	3.4E-17	1.4E-17
	2	0.0E+00	1.3E-17	1.2E-17	2.9E-17	1.0E-17	2.8E-14	5.3E-16	0.00%	0.00%	0.00%	4.62%	1.4E-16	1.4E-18	1.4E-18	6.9E-18
	3	-1.1E-17	6.3E-18	9.0E-18	-1.3E-17	1.1E-17	7.2E-15	2.2E-16	0.00%	0.00%	0.00%	1.19%	1.4E-18	1.4E-18	9.1E-18	1.7E-16
	4	2.0E-17	7.9E-18	8.1E-18	-6.6E-19	7.5E-18	1.3E-14	4.4E-16	0.00%	0.00%	0.00%	2.13%	1.3E-18	1.3E-18	7.3E-18	3.7E-16
	5	-9.2E-19	1.7E-17	8.5E-18	1.4E-17	3.0E-17	1.3E-14	5.9E-16	0.00%	0.00%	0.00%	2.10%	3.7E-18	3.7E-18	4.6E-17	5.8E-16
AMS-BKG	1	5.7E-15	3.0E-17	2.6E-17	5.0E-18	3.1E-17	1.4E-14	4.2E-16	0.19%	0.00%	0.00%	2.26%	5.7E-15	3.3E-18	4.0E-17	1.7E-17
	2	0.0E+00	-7.8E-19	9.4E-18	1.2E-17	9.5E-18	2.0E-14	4.8E-16	0.00%	0.00%	0.00%	3.29%	1.6E-16	1.6E-18	1.6E-18	7.8E-18
	3	1.6E-18	2.0E-17	1.3E-17	-5.6E-18	1.4E-17	8.3E-15	2.5E-16	0.00%	0.00%	0.00%	1.38%	1.6E-18	1.6E-18	1.2E-17	2.0E-16
	4	1.5E-17	1.4E-18	8.6E-18	2.1E-18	8.0E-18	1.3E-14	4.6E-16	0.00%	0.00%	0.00%	2.13%	1.4E-18	1.4E-18	8.5E-18	4.0E-16
	5	-8.1E-18	2.4E-17	9.3E-18	-1.7E-17	2.4E-17	1.2E-14	6.3E-16	0.00%	0.00%	0.00%	2.00%	4.0E-18	4.0E-18	4.0E-17	6.3E-16

Notes:

a. *The laboratory reported no blank assay data for Period 5. Blank assays in the sample concentration calculation were assumed to be 50 percent of the values for blanks reported for the previous period. The assumption is based on the relative, approximate run-time of the air samplers in both periods. No blank corrections were performed on uranium results for the first monitoring period since sample results were reported as non-detects.*

Table 2.9-13: Summary of Radionuclide Concentrations in Air

Location	U-nat Concentration (μCi/ml)				Th-230 Concentration (μCi/ml)				Ra-226 Concentration (μCi/ml)				Pb-210 Concentration (μCi/ml)			
	Average	σ	Min	Max	Average	σ	Min	Max	Average	σ	Min	Max	Average	σ	Min	Max
AMS-01	1.4E-15	3.2E-15	-1.7E-17	7.1E-15	8.2E-18	6.4E-18	1.6E-18	1.7E-17	1.2E-17	3.0E-17	-3.1E-17	5.3E-17	2.3E-14	1.4E-17	9.1E-18	4.3E-17
AMS-02	1.4E-15	3.1E-15	-2.0E-17	7.0E-15	4.9E-18	6.5E-18	0.0E+00	1.6E-17	-1.4E-17	1.9E-17	-4.9E-17	-2.3E-18	1.3E-14	9.7E-18	7.0E-18	2.9E-17
AMS-03	1.0E-15	2.2E-15	-3.0E-17	5.0E-15	9.0E-18	7.2E-18	-1.5E-18	1.9E-17	-1.6E-18	9.3E-18	-1.4E-17	9.6E-18	1.1E-14	9.2E-18	8.9E-18	3.1E-17
AMS-04	1.0E-15	2.2E-15	-2.6E-17	5.0E-15	1.0E-17	9.8E-18	2.5E-18	2.7E-17	5.3E-18	2.7E-17	-2.8E-17	4.6E-17	1.3E-14	1.1E-17	8.3E-18	3.3E-17
AMS-05	1.2E-15	2.6E-15	0.0E+00	5.9E-15	2.4E-17	1.9E-17	4.7E-18	5.6E-17	9.6E-18	3.4E-17	-4.5E-17	4.7E-17	1.3E-14	1.0E-17	9.0E-18	3.4E-17
AMS-06	1.0E-15	2.3E-15	-1.4E-17	5.0E-15	9.9E-18	7.2E-18	1.5E-18	2.0E-17	-2.6E-18	2.3E-17	-3.9E-17	2.3E-17	1.4E-14	9.9E-18	7.4E-18	3.3E-17
AMS-07	3.1E-15	6.9E-15	-1.1E-17	1.5E-14	1.3E-17	5.7E-18	6.3E-18	2.0E-17	4.9E-18	1.7E-17	-1.3E-17	2.9E-17	1.6E-14	1.0E-17	7.5E-18	3.0E-17
AMS-BKG	1.1E-15	2.5E-15	-8.1E-18	5.7E-15	1.5E-17	1.4E-17	-7.8E-19	3.0E-17	-6.3E-19	1.1E-17	-1.7E-17	1.2E-17	1.3E-14	9.8E-18	8.0E-18	3.1E-17

TR RAI-2.9-6

In Section 2.9.6.1 of the TR, the applicant describes how laboratory data for air particulate monitoring results were converted from picocuries per filter composite to units of microcuries per milliliter. However, natural uranium (U-nat) results are reported as milligram per filter composite. Please demonstrate how the U-nat concentration in microcuries per milliliter was derived from the value in milligram per filter composite.

Response TR RAI-2.9-6 (TR 2.9.6.1)

The specific activity for natural uranium contained in Footnote 3 to 10 CFR Part 20 Appendix B was used to convert from mass to activity units. Footnote 3 states that the specific activity of natural uranium is 6.77E-7 curies per gram uranium. By unit conversion this is equivalent to 677 picocuries per milligram of uranium. Once the results of uranium per filter composite in milligrams were converted to picocuries per filter composite, the equation in Section 2.9.6.1 of the TR was used to convert the result to an air concentration in units of microcuries per milliliter.

TR RAI-2.9-7

NRC staff notes that the air particulate monitoring collection time periods are not consistent in the main body of the TR (p. 2-358) and Appendix 2.9-A (Page 16) of the same report. Specifically, the beginning dates for period 1 and ending dates for period 2 are not the same. Please address this discrepancy in the collection dates.

Response TR RAI-2.9-7 (TR Section 2.9.6.1, 2.9.6.2 and TR Section 2.9.6.3)

The air particulate monitoring collection time periods described in Appendix 2.9-A (p.16) are correct. The collection time periods and associated calculations in the TR should be revised as provided in replacement pages for section 2.9.6.1, 2.9.6.2, 2.9.6.3 to reflect the correct monitoring periods. The associated calculations in Appendix 2.9-A are not reported correctly and have also been revised as provided in replacement pages for Section 8.1.1 and 8.2.1, to reflect the correct monitoring periods.

TR Section 2.9.6.1 High Volume Air Sampling

Eight Hi-Q Model HVP-4200AFC high volume air samplers were established within and surrounding the proposed permit area. The samplers operated nearly continuously from August 2007 to August 2008. The locations of the air samplers are shown on Figures 2.9-8 and 2.9-13. Each high volume air sampler was equipped with an 8-in. by 10-in. 0.8 micron glass fiber filter paper. The air filters were collected approximately bi-weekly, prior to saturation, from each of the eight air samplers. Flow rate and total flow data were recorded at the same time. Over the course of 366 days, the filters were collected as follows:

- Period 1: August 13 to October 2, 2007
- Period 2: October 2, 2007 to January 4, 2008
- Period 3: January 4 to April 1, 2008.
- Period 4: April 1 to July 9, 2008
- Period 5: July 9 to August 13, 2008

The filters were composited and digested by the external analytical laboratory. The samples were analyzed for radium-226, thorium-230, natural uranium, and lead-210, using the same methods as listed for the soil samples.

A blank set of filter composites was also submitted to the laboratory for analysis with the composite samples to evaluate the radionuclide content of the filter material.

The laboratory data were reported in units of picocuries per filter composite (pCi/f). The data were converted to units of microcuries per milliliter (μCi/ml), as follows:

$$Concentration, \mu Ci/ml = \frac{Filter\ Concentration - Blank}{TotalFlow}\left(1 * 10^{-12}\right)$$

The units of total flow and filter concentration in the equation are cubic meters and pCi/f, respectively. The resulting concentrations for each radionuclide and high volume sampler were compared to effluent concentration limits listed in Table 2 of 10 CFR 20 Appendix B and reported in Table 2.9-12 as percentages of the respective effluent limits. The most conservative effluent limits were applied to thorium-230 ($2*10^{-14}$ µCi/ml) and lead-210 ($6*10^{-13}$ µCi/ml). The Class D and W limits were applied to natural uranium ($3*10^{-12}$ µCi/ml) and radium-226 ($9*10^{-13}$ µCi/ml), respectively.

TR Section 2.9.6.2 Air Particulate Sampling Results

In general and relative to one another (e.g., natural uranium to radium-226), the average concentrations of radionuclides were consistent at each location from period to period. The radionuclide with the lowest average concentration was radium-226, followed by thorium-230, natural uranium, and lead-210. Average radium-226 concentrations were several orders of magnitude lower than lead-210 concentrations. The data are listed in Table 2.9-12 and summarized as averages and ranges in Table 2.9-13.

Site-wide, the data can be summarized as follows:

- Natural uranium concentrations ranged from $-3.0*10^{-17}$ to $1.5*10^{-14}$ µCi/ml and averaged $1.4*10^{-15}$ µCi/ml.
- Thorium-230 concentrations ranged from $-1.5*10^{-18}$ to $5.6*10^{-17}$ µCi/ml and averaged $1.2*10^{-17}$ µCi/ml.
- Radium-226 concentrations ranged from $-4.9*10^{-17}$ to $5.3*10^{-17}$ µCi/ml and averaged $1.6*10^{-18}$ µCi/ml.
- Lead-210 concentrations ranged from $6.0*10^{-15}$ to $4.1*10^{-14}$ µCi/ml and averaged $1.5*10^{-14}$ µCi/ml.

There are no clear patterns in the radionuclide concentrations, when evaluating them spatially or temporally. Natural uranium concentrations at each location fluctuated between the orders of 10^{-17} and 10^{-14} µCi/ml over the course of monitoring. The high end of this range occurred in the first monitoring period and is likely due to the low sensitivity of the uranium analytical results and not actual uranium concentrations in air. The uranium concentrations in air for the first monitoring period were reported at their detection limits. Thorium-230 concentrations fluctuated between the orders of 10^{-17} and 10^{-18} µCi/ml. Radium-226 concentrations fluctuated between the orders of 10^{-17} and 10^{-18} µCi/ml. Finally, lead-210 concentrations at each location were all on the order of 10^{-14} µCi/ml over the course of monitoring.

In terms of comparison to 10 CFR 20 Appendix B effluent concentrations, the data can be summarized as follows:

- Natural uranium concentrations were 0.0 to 0.5 percent of its effluent concentration.
- Thorium-230 concentrations were 0.0 percent of its effluent concentration.
- Radium-226 concentrations were 0.0 percent of its effluent concentration.
- Lead-210 concentrations were 1.0 to 6.78 percent of its effluent concentration.

The LLDs, in pCi/f, reported by the laboratory for each radionuclide were converted to µCi/ml by dividing pCi/f by the total flow in cubic meters and multiplying by $1*10^{-12}$ to reflect appropriate units. In no cases were the LLDs higher that their respective 10 CFR 20 effluent concentration limits. The LLDs reported in Periods 1 and 2 by the laboratory for uranium exceeded the recommendation in NRC Regulatory Guide 4.14.
The LLDs for each of the radionuclides are listed in Table 2.9-12 (Inserted into Response TR_RAI-2.9-5).

TR Section 2.9.6.3 Conclusions

With the exception of natural uranium, the values determined above are similar to U.S. background concentrations reported in the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) Report to the General Assembly, Sources and Effects of Ionizing Radiation, Annex B. The regional concentrations reported in this reference document are: uranium-238 ($2.4*10^{-17}$ to $1.4*10^{-16}$ µCi/ml), thorium-230 ($1.6*10^{-17}$ µCi/ml), radium-226 ($1.6*10^{-17}$ µCi/ml), and lead-210 ($2.7*10^{-15}$ to $2.7*10^{-14}$ µCi/ml).

8.1.1 High Volume Air Sampling

Airborne particulates were collected using the Hi-Q high volume air samplers. The samplers operated continuously from August 2007 to August 2008. The locations of the air samplers are shown on Figure 4-1.

Each high volume air sampler was equipped with an 8-in. by 10-in. 0.8 micron glass fiber filter paper. The air filters were collected approximately bi-weekly, prior to saturation, from each of the eight air samplers. Flow rate and total flow data were recorded at the same time. Over the course of 366 days, the filters were collected as follows:

- Period 1: August 13 to October 2, 2007
- Period 2: October 2, 2007 to January 4, 2008
- Period 3: January 4 to April 1, 2008.
- Period 4: April 1 to July 9, 2008
- Period 5: July 9 to August 13, 2008

The filters were composited and digested by the external analytical laboratory. The samples were analyzed for radium-226, thorium-230, natural uranium, and lead-210, using the same methods as listed for the soil samples. A blank set of filter composites was also submitted to the laboratory for analysis with the composite samples to evaluate the radionuclide content of the filter material.

The laboratory data were reported in units of picocuries per filter composite (pCi/f). The data were converted to units of micocuries per milliliter (µCi/ml), as follows:

$$Concentration, \mu Ci / ml = \frac{Filter\ Concentration - Blank}{TotalFlow}\left(1 * 10^{-12}\right)$$

The units of total flow and filter concentration in the equation are cubic meters and pCi/f, respectively. The resulting concentrations for each radionuclide and high volume sampler were compared to effluent concentration limits listed in Table 2 of 10 CFR 20 Appendix B and reported in Table 8-1 as percentages of the respective effluent limits. The most conservative effluent limits were applied to thorium-230 ($2*10^{-14}$ µCi/ml) and lead-210 ($6*10^{-13}$ µCi/ml). The Class D and W limits were applied to natural uranium ($3*10^{-12}$ µCi/ml) and radium-226 ($9*10^{-13}$ µCi/ml), respectively.

8.2.1 High Volume Air Sampling

In general and relative to one another (e.g., natural uranium to radium-226), the average concentrations of radionuclides were consistent at each location from period to period. The radionuclide with the lowest average concentration was radium-226, followed by thorium-230, natural uranium, and lead-210. Average radium-226 concentrations were five orders of magnitude lower than lead-210 concentrations. The data are listed in Table 8-1.

Site-wide, the data can be summarized as follows:

- Natural uranium concentrations ranged from $-3.0*10^{-17}$ to $1.5*10^{-14}$ µCi/ml and averaged $1.4*10^{-15}$ µCi/ml.
- Thorium-230 concentrations ranged from $-1.5*10^{-18}$ to $5.6*10^{-17}$ µCi/ml and averaged $1.2*10^{-17}$ µCi/ml.
- Radium-226 concentrations ranged from $-4.9*10^{-17}$ to $5.3*10^{-17}$ µCi/ml and averaged $1.6*10^{-18}$ µCi/ml.
- Lead-210 concentrations ranged from $6.0*10^{-15}$ to $4.1*10^{-14}$ µCi/ml and averaged $1.5*10^{-14}$ µCi/ml.

There are no clear patterns in the radionuclide concentrations, when evaluating them spatially or temporally. Natural uranium concentrations at each location fluctuated between the orders of 10^{-17} and 10^{-14} µCi/ml over the course of monitoring. The high end of this range occurred in the first monitoring period and is likely due to the low sensitivity of the uranium analytical results and not actual uranium concentrations in air. The uranium concentrations in air for the first monitoring period were reported at their detection limits. Thorium-230 concentrations fluctuated between the orders of 10^{-17} and 10^{-18} µCi/ml. Radium-226 concentrations fluctuated between the orders of 10^{-17} and 10^{-18} µCi/ml. Finally, lead-210 concentrations at each location were all on the order of 10^{-14} µCi/ml over the course of monitoring.

With the exception of natural uranium, the values determined above are similar to U.S. background concentrations reported in the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) Report to the General Assembly, Sources and Effects of Ionizing Radiation, Annex B. The regional concentrations reported in this reference document are: uranium-238 ($2.4*10^{-17}$ to $1.4*10^{-16}$ µCi/ml), thorium-230 ($1.6*10^{-17}$ µCi/ml), radium-226 ($1.6*10^{-17}$ µCi/ml), and lead-210 ($2.7*10^{-15}$ to $2.7*10^{-14}$ µCi/ml).

In terms of comparison to 10 CFR 20 Appendix B effluent concentrations, the data can be summarized as follows:

- Natural uranium concentrations were 0.0 to 0.5 percent of its effluent concentration.
- Thorium-230 concentrations were 0.0 percent of its effluent concentration.
- Radium-226 concentrations were 0.0 percent of its effluent concentration.
- Lead-210 concentrations were 1.0 to 6.78 percent of its effluent concentration.

The LLDs, in pCi/f, reported by the laboratory for each radionuclide were converted to µCi/ml by dividing pCi/f by the total flow in cubic meters and multiplying by $1*10^{-12}$ to reflect appropriate units. In no cases were the LLDs higher that their respective 10 CFR 20 effluent concentration limits. The LLDs reported in Periods 1 and 2 by the laboratory for uranium exceeded the recommendation in NRC Regulatory Guide 4.14.

The LLDs for each of the radionuclides are listed in Table 8-1.

Note: To facilitate review, revised Table 8-1 is not provided in this submittal. It is the same as revised Table 2.9-13, provided above.

TR RAI-2.9-8

NRC staff notes inconsistent language regarding the description of the monitoring duration. In the main body of the TR (p. 2-358) the applicant indicates "nearly continuously" while Appendix 2.9-A (p. 16) of the same report indicates "continuously" and "nearly continuously." Please address these inconsistencies in the description of the monitoring duration.

Response TR RAI-2.9-8 (TR Section 2.9 and Appendix 2.9-A)

The air monitoring stations were operated continuously with minimal down time due to filter changes, power outages, or other unforeseen disruptions in the power supply. This short period of down time is why the term "nearly continuously" was used. In the context of the TR and Appendix 2.9-A, "continuously" and "nearly continuously" are synonymous.

TR RAI-2.9-9

On page 2-359 of the TR, the value listed for Th-230 is that of the derived airborne concentration from 10 CFR 20 Appendix B, Table 1, not the effluent concentration value as indicated. Please address this discrepancy.

Response TR RAI-2.9-9 (TR Section 2.9.6.1)

The value listed for thorium-230 section 2.9.6.1 of the TR and Page 17 of Appendix 2.9A was inadvertently taken from 10 CFR 20 Appendix B Table 1 rather than 10 CFR 20 Appendix B, Table 2. The values for lead-210, natural uranium and radium-226 are correct. The sentence in question from these pages should be as follows:

The most conservative effluent limits were applied to thorium-230 ($2*10^{-14}$ μCi/ml) and lead-210 ($6*10^{-13}$ μCi/ml). The Class D and W limits were applied to natural uranium ($3*10^{-12}$ μCi/ml) and radium-226 ($9*10^{-13}$ μCi/ml), respectively.

TR RAI-2.9-10

Please clarify whether the "HV" designator in lab reports in Appendix 2.9-A of the TR (and Plate 2.5-1) are the same as "AMS" designators in Table 2.9-11 of the TR.

Response TR RAI-2.9-10 (TR Appendix 2.9-A)

Yes, the "HV" designator in the lab reports in Appendix 2.9-A of the TR and Plate 2.5-1 are the same as the "AMS" (Air Monitoring Station) designators in Table 2.9-11 of the TR.

TR RAI-2.9-11

Please provide an assessment of land use for food sampling.

Response TR RAI-2.9-11 (TR Section 2.9.10)

Food Sampling

To determine baseline radionuclide concentrations in local food, Powertech (USA) collected three tissue samples, one liver (DBAT 03) and two meat samples (DBAT 01 DBAT 02), from a locally grazing cow on June 25, 2008. The results are listed in Table 2.9-19. Errors are reported as ±2σ.

Powertech (USA)'s assessment of land use regarding food sampling (crop production) at the 3 km limit from the mill site and 3.3 km from the site boundary was limited to the sampling of cattle, since no crops are grown and available for sample analysis within these distances from the site. This assessment was confirmed through on-site surveys and direct communication with landowners and ranchers. The closest land with crop related land uses is located in eastern Fall River County, approximately 48 km (30 miles) east of the site boundary.

Powertech (USA) obtained general land use information for Fall River and Custer Counties from the United States Department of Agriculture 2002 census as referenced in Section 2.2.2 of the TR. However, site specific data provided by county governments regarding crop production are not available since land use plans are not required. Powertech (USA) has verified that there is no crop production within 3 km of the mill site and 3.3 km of the site boundary through on-site surveys and direct communication with the local landowners and ranchers. Since no crops are grown in the area, crop samples were not collected and analyzed.

Regulatory Guide 4.14 does not specifically require the collection and analysis of garden vegetables, although none were available for baseline sampling. It is important to note that the MILDOS Model results provided in Section 7.3 of the TR and Appendix 7.3-A show that the food ingestion pathway (food consumed from crops grown within the area) is an insignificant source of exposure to human receptors.

There are several cases where reported concentrations are at or below LLDs that, in turn, exceed the LLDs recommended in RG 4.14. This is evident for all reported concentrations of natural uranium, radium-226 and polonium-210 in Sample DBAT-01, and lead-210 in all three samples.

Table 2.9-19: Baseline Radionuclide Concentrations in Local Food

Sample ID	Radionuclide	Parameter	Result
DBAT-01	U-nat (µCi/kg)	Concentration	ND
		Error ± 2σ	-
		LLD	7.0E-06
	Ra-226 (µCi/kg)	Concentration	3.0E-06
		Error ± 2σ	2.0E-06
		LLD	3.0E-06
	Th-230 (µCi/kg)	Concentration	0.0
		Error ± 2σ	2.0E-05
		LLD	8.0E-06
	Pb-210 (µCi/kg)	Concentration	-7.0E-06
		Error ± 2σ	4.0E-05
		LLD	7.0E-06
	Po-210 (µCi/kg)	Concentration	8.0E-06
		Error ± 2σ	1.0E-04
		LLD	8.0E-06
DBAT-02	U-nat (µCi/kg)	Concentration	ND
		Error ± 2σ	-
		LLD	7.0E-06
	Ra-226 (µCi/kg)	Concentration	6.0E-05
		Error ± 2σ	3.0E-05
		LLD	4.0E-05
	Th-230 (µCi/kg)	Concentration	0.0
		Error ± 2σ	1.4E-03
		LLD	1.0E-04
	Pb-210 (µCi/kg)	Concentration	2.0E-04
		Error ± 2σ	7.0E-04
		LLD	1.2E-03
	Po-210 (µCi/kg)	Concentration	0.0
		Error ± 2σ	1.2E-03
		LLD	1.0E-04
DBAT-03	U-nat (µCi/kg)	Concentration	ND
		Error ± 2σ	-
		LLD	7.0E-06
	Ra-226 (µCi/kg)	Concentration	3.0E-06
		Error ± 2σ	1.0E-06
		LLD	2.0E-06
	Th-230 (µCi/kg)	Concentration	0.0
		Error ± 2σ	1.0E-04
		LLD	6.0E-06
	Pb-210 (µCi/kg)	Concentration	-7.0E-06
		Error ± 2σ	4.0E-05
		LLD	6.0E-05
	Po-210 (µCi/kg)	Concentration	2.0E-05
		Error ± 2σ	2.0E-04
		LLD	6.0E-06

TR RAI-2.9-12

Regulatory Guide 4.14 provides recommendations for the collection and analysis of crop samples raised within 3 km of the mill site. In Section 2.2.2 of the TR, the applicant only addressed crop production within the Permit Area. Consistent with Regulatory Guides 4.14 and 3.46, please provide the results of crop sample analyses or a justification for not collecting crop samples. In this response, please describe actions taken by the applicant to determine the agricultural use of adjacent lands, including vegetable gardens.

Response TR RAI-2.9-12 (TR Section 2.9.10)

See TR_RAI Response 2.9-11

TR RAI-2.9-13

In Section 2.2.2 of the TR, the applicant has identified livestock, poultry, and their products but did not analyze and sample them as recommended in Regulatory Guide 4.14 Section 1.1.3, "Vegetation, Food and Fish Samples." Consistent with Regulatory Guides 4.14 and 3.46, please analyze and provide results for appropriate food samples. In this response, please describe actions taken by the applicant to determine the agricultural use of adjacent lands.

Response TR RAI-2.9-13 (TR Section 2.9.2.2.2)

The intent of Section 1.1.3 of RG 4.1.4 is on the forage vegetation in the permit area and the livestock that feed upon it.

RG 3.46 focuses on data that could assess the environmental impact of the proposed action. The guide states "For commercial-scale operations and for research and development operations involving drying of yellowcake, the applicant should provide data on the count and distribution of important domestic fauna, in particular, cattle, sheep, and other meat animals that may be involved in the exposure of man to radionuclides."

The guide also states "Report site-specific radiological data, including both natural background radiation levels and results of measurements of concentrations of radioactive materials occurring in [*important*] biota..."

The TR clearly shows the predominance in numbers of beef and other cattle, relative to other livestock, in the vicinity of the proposed facility. The TR states on Page 2-3 that "no data were available for poultry, pig, or sheep inventories." This might have been better phrased as "no data regarding the numbers of poultry, pigs, or sheep exist in the immediate area."

The applicant has demonstrated compliance with the intents of both guidance documents. The applicant has sampled the important livestock which forages on vegetation in the permit area.

With the absence of significant numbers of other livestock, the primary focus of the food sampling was livestock. Three samples of livestock were collected and analyzed, in accordance with RG 4.14.

TR RAI-2.9-14

In Section 2.2.2 and 2.8.5.4.2 (pages 2-267) of the TR, the applicant identified game animals (pronghorn, wild turkey, etc) but these were not analyzed as recommended in Regulatory Guide 4.14. Consistent with Regulatory Guide 4.14, please provide results of game animal sample analyses or a justification for not collecting them.

Response TR RAI-2.9-14 (TR Section 2.9.10)

The reviewer is correct to state that game animals occur throughout the permit area. The most prevalent big game animals on the site are pronghorn antelope and mule deer.

The big game animals were not sampled because 1) game sampling is not prescribed in RG 4.14, if livestock are sampled 2) their ranges, which can be large due to migrations, were expected to be much larger than the size of the permit area and 3) one cannot be certain that any individual big game animal spends its entire life on the permit area. As such, sampling would not necessarily represent a diet that is exclusive to the permit area and sampling local beef is more representative.

Section 1.1.3 of RG 4.14 states "samples should be collected...of animals grazing...*or* livestock raised within three kilometers of the mill site.

Home range sizes for pronghorns are strongly affected by local conditions and climate, which varies yearly. Daily ranges in Wyoming have been reported at 0.2 to 0.4 square kilometers. Winter ranges are larger, at 6.5 to 22.5 square kilometers. Territories are widely spaced and do not overlap (Krejci et al, 2009).

It would not be possible to know the location and diet history of any specific individual pronghorn or mule deer taken, so one would never know how to compare or interpret the findings of such measurements.

In our opinion, sampling big and small game is an impractical, unwarranted endeavor, considering that the data would yield no significant value regarding potential site impacts, the game must be killed to obtain a sample, and ready availability of beef with known and localized feeding habits.

TR RAI-2.9-15

In Section 2.2.2 of the TR, the applicant stated that hunting is currently open to the public on 5,689 acres within the Permit Area. The applicant also stated that prior to commencement of operations all hunting will be prohibited within the Permit Boundary. However, the applicant has not addressed how the applicant will prohibit hunting on public lands. Please provide this information.

Response TR RAI-2.9-15 (TR Section 7.1.2)

Recreational use within the project boundary is limited primarily to large game hunting. Within the PAA, hunting is currently open to the public on approximately 5,689 acres. Approximately 240 acres are owned by the Bureau of Land Management (BLM); the South Dakota Game Fish and Parks (SDGF&P) lease around 3,069 acres annually of privately owned land and currently designate this acreage as walk-in hunting areas. Prior to commencement of operations, all hunting will be prohibited within the Permit Boundary.

Mineral development may occur along with other resource uses. Exploration and development would continue to be managed in accordance with existing surface and mineral management regulations; for example (43 CFR 3809 and 43 CFR Subtitle B). Temporary fencing, berms and other means of restricting public access, such as signage and gates would be installed in areas of active production and mining areas such as well fields, processing plant(s) and land application areas in order to protect the public, protect workers, prevent damage to facilities, and provide security.

According to the Bureau of Land Management (BLM), the owner of the mining claim may:
Restrict public recreational use of/or public access across claims or portions of claims that are actively used for prospecting, mining, or processing operations in the following situations:

1.) Where public recreational use of a claim would endanger or materially interfere with legitimate mining pursuits or;
2.) In cases where the mining operation is hazardous and could lead to personal injury. The claimant may protect his mining equipment and operations area with appropriate signs or other lawful means.

Powertech (USA) will utilize means to restrict hunting activities to the fullest extent permissible by the BLM, Department of the Interior regulations.

TR RAI-2.9-16

The applicant collected three tissue samples, one liver and two meat samples, from one cow instead of one sample each from three different cows as recommended in Regulatory Guide 4.14. The applicant should provide the sample results of cows consistent with Regulatory Guide 4.14 or justification for not providing them.

Response TR RAI-2.9-16 (TR Section 2.9)

In lieu of slaughtering three animals for the sake of collecting one sample from each, we chose to sample three types of tissue from one beef cattle.

Importantly, RG 4.14 states "At least three samples should be collected at time of harvest or slaughter or removal of animals from grazing for each type of crop (including vegetable gardens) or livestock raised within three kilometers of the mill site."

RG 4.14 does not specifically say three individual animals. We believe we met the intent of RG 4.14.

TR RAI-2.9-17

Please address the following issues regarding Table 2.9-19 (page 2-378) of the TR and Table 10-1 in Appendix 2.9-A of the TR:

TR RAI-2.9-17(a)

a. Reporting format is not consistent with Regulatory Guide 4.14, Section 7.5.

Response TR RAI-2.9-17(a) (TR Table 2.9-19 and Appendix 2.9-A)

Tables 2.9-19 and 10-1 transpose the format of RG 4.14, Section 7.5 to facilitate viewing and printing. The same information recommended by RG 4.14 is provided.

TR RAI-2.9-17(b)

Please address the following issues regarding Table 2.9-19 (page 2-378) of the TR and Table 10-1 in Appendix 2.9-A of the TR:

b. Lower Levels of Detection (LLD) are significantly higher than Regulatory Guide 4.14, Section 5, Recommendations.

Response TR RAI-2.9-17(b) (TR Section 2.9)

We assume by Lower Levels of Detection the NRC means Lower Limits of Detection (LLDs). We agree with the reviewer and the TR states "There are several cases where reported concentrations are at or below LLDs that, in turn, exceed the LLDs recommended in RG 4.14. This is evident for all reported concentrations of natural uranium, radium-226 and polonium-210 in Sample DBAT-01, and lead-210 in all three samples."

The LLDs for food recommended in RG 4.14 are extremely low. In the context of units of picocuries per gram (pCi/g), the LLDs for U-nat and Th-230 are $2*10^{-4}$ pCi/g, Ra-226 is $5*10^{-5}$ pCi/g; and Po-210 and Pb-210 are $1*10^{-3}$ pCi/g. It would be extremely difficult for a laboratory to meet these LLDs for samples, even without matrix interferences and large requisite sample sizes.

In addition, there are no regulatory limits for food items for the purpose of comparison, to evaluate appropriate analytical sensitivities.

TR RAI-2.9-17(c)

Please address the following issues regarding Table 2.9-19 (page 2-378) of the TR and Table 10-1 in Appendix 2.9-A of the TR:

c. ***The LLDs for meat are substantially different from each other***

Response TR RAI-2.9-17(c) (TR Section 2.9)

We agree with the reviewer. At such low LLDs, analytical errors, low concentrations, differences in sample size, and matrix interferences are more likely to influence the LLD than at relatively higher values.

TR RAI-2.9-18

Please clarify what types of vegetation were included in the vegetation sampling and state whether this includes forage samples.

Response TR RAI-2.9-18 (TR Section 2.9)

Consistent with RG 4.14, forage vegetation; i.e., grasses, were the only types of vegetation sampled during the pre-operational phase. The samples were collected in the vicinity of each of the air monitoring stations, which are in sectors of the highest predicted airborne concentrations due to facility operations.

TR RAI-2.9-19

In section 2.8.5.6.1.2.1 of the TR, the applicant has identified grazing areas within the Permit Area, but it is not clear that they were analyzed as recommended by Regulatory Guide 4.14. Please clarify if identified grazing areas were analyzed as recommended by Regulatory Guide 4.14.

Response TR RAI-2.9-19 (TR Section 2.8.5.6.1.2.1)

RG 4.14 suggests sampling grazing areas located in three different sectors having the highest predicted airborne radionuclide concentrations. Air monitoring stations were placed in sectors predicted to have the highest airborne concentrations. Forage samples were collected at all air monitoring stations. Please refer to the selection of air monitoring stations in our response to RAI 2.9-1.

Section 2.8.5.6.1.2.1 only identifies and describes generic habitats observed in the permit area.

Each of the vegetation sample locations is sited elsewhere, in areas grazed by cattle and/or horses. It is our opinion that the vegetation was sampled in accordance with the intent of RG 4.14. Forage vegetation was sampled in grazing areas in three different sectors having the highest predicted airborne radionuclide concentrations due to planned milling operations.

TR RAI-2.9-20

On page 2-280 of the TR, the applicant states that fish sampling sites BVC04 and CHR05 can be identified on Plate 2.5-1. NRC staff could not locate these sites on Plate 2.5-1. However, these sites can be found on Figure 2.9-11 of the TR. Please correct this discrepancy in the TR.

Response TR RAI-2.9-20 (TR Section 2.8.5.6.1.1)

Sampling locations BVC04 and CHR05 are not within the scale of Plate 2.5-1; Please refer to Figure 2.9-11 for the location of the sites in question. All other sampling locations are within the scale of Plate 2.5-1.

TR RAI-2.9-21

Section 1.1.3 of Regulatory Guide 4.14 recommends that fish (if any) samples should be collected semiannually from any bodies of water that may be subject to seepage or surface drainage from potentially contaminated areas. Please confirm whether the applicant ruled out the presence of fish in all impoundments, and, if not, please provide the results of fish samples from those impoundments

Response TR RAI-2.9-21 (TR Section 2.8.5.6.1.1)

Upon review of the sampling plan with the South Dakota Game Fish and Parks agency, the agency's representatives expressed a greater interest in the potential effects of the project on the flowing water (i.e., Beaver Creek and the Cheyenne River) where abundance and diversity are much greater compared to the mine pit waters, therefore sampling was focused in those areas where the potential for effect from mining operations may be more likely to occur. Therefore, the old mine pits were not the focus of concern for this particular site as part of the baseline studies for fish.

All impoundments and drainages within the PAA are ephemeral with the exception of Beaver Creek.

TR RAI-2.9-22

In Section 2.9.2.1.1 GPS based gamma survey transects were spaced at approximately 500 m intervals in the main project area and 100 m in the surface mine area (Page 2-308). The 500 m spacing does not appear to comport with RG 4.14 or with recently published data by Whicker, et. al (2008). According to this study, 100 m spacing represents approximately 14% ground coverage. It is also recommended that areas of interest receive 25%-100% ground coverage. The typical vehicle spacing for this is reported as 20-30 m (35%-45% coverage). Please provide technical justification for the 500 m spacing used by the applicant.

Response TR RAI-2.9-22 (TR Section 2.9.2.1.1)

The RG 4.14 guidance was intended for use in assessing the performance of effluent controls and releases from operating uranium mills as well as establishing baseline data for evaluating decommissioning operations. It has been well-established that airborne effluent releases, other than radon, are minimal at ISR facilities but baseline data, including gamma exposure rates, are needed to assess gamma exposure impacts proximal to processing facilities and from accidental liquid releases from well fields and processing plants. RG 4.14 recommends making direct gamma measurements at 150-meter intervals, extending from the center of the processing plant outward in the eight compass directions to 1500 meters as well as at each of the air monitoring stations. In this case, that would require only 90 measurements and cover less than 50 percent of the project site. Importantly, the number of direct gamma measurements collected by Powertech (USA) exceeds the guidance in RG 4.14.

The transect spacing in the work plan was intended to be small compared to the anticipated characteristic size of anomalous areas. Wide spacing was used for areas thought to be non-impacted; more narrow spacing was used for known or potentially impacted areas. While this work was done prior to the cited publication, we believe that the methods are similar and consistent with that publication. The authors did not recommend transect spacing. They reported typical transect spacing that they used for certain situations (including surveys for cleanup). We do not agree that the authors intended to establish a standard method. The measure of success is determined by asking the question: did the survey adequately determine the mean and variance of the exposure rates for areas within the site, and did it identify areas with highly varying exposure rates commonly referred to as anomalous areas?

Our technical justification for the 500-meter transect spacing is based on the assumption that we did not expect mineralized ore outcrops. Therefore, non-impacted areas were expected to be made up of large areas of different soil types or large fields having a unique history of fertilizer applications, if any. The characteristic sizes of these areas were expected to be large compared to 500 meters. It was also evident that the historical surface mine area was impacted. The goal of surveying this area was to determine the boundary of the impacted area and the range of exposure rates. It was not the goal to provide adequate data for developing reclamation plans.

Data from the surveys were processed and evaluated at the end of each day to determine whether the gamma count rates were consistent with the assumptions. Data anomalies were investigated and, where appropriate, the transect spacing and areal extent of the survey were changed to bound the anomaly. These daily evaluations of the data and changes to the survey density were made to correct for small departures from the conditions that were assumed when developing the plans.

Gamma surveys at closer spacing will be performed for the purpose reclamation planning and implementation a minimum of 1 year before planned reclamation.

TR RAI-2.9-23

Consistent with Regulatory Guide 4.14, please describe the criteria, and basis for the criteria, used to determine the acceptability of the daily function tests performed on the sodium iodide detectors provided in Appendix 2.9-A of the TR. Using these criteria, please comment on the following specific examples and provide missing data where necessary.

Date	4410 Serial #	Efficiencies
9/14/07	PR118372	0.5% (6:50 am) 0.3% (8:20 pm different configuration)
9/14/07	PR198936	0.64% (6:50 am reported as 0.7%) 0.57% (8:30 pm)
7/18/08	PR198936	2nd daily function check not recorded

Response TR RAI-2.9-23 (TR Appendix 2.9-A)

The comments regarding function checks during September 2007 rightfully question whether the detector systems performed in a consistent manner over the 11-day survey period. The following information and analysis was done in response to those comments.

RG 4.14 allows direct measurements to be made with "properly calibrated portable survey units". While RG 4.14 doesn't provide acceptance criteria for function checks, other guidance accepts consensus standards such as ANSI N323A-1997,
Radiation Protection Instrumentation Test and Calibration, Portable Survey Instruments (ANSI, 1997). Section 4.8 of the standard states *"to ensure proper operation of the instrument between calibrations, each instrument (with the exception of neutron instruments and high-dose equivalent rate photon instruments) shall be checked with a source during operation at least daily or prior to each intermittent use, whichever is less frequent. If at any time the instrument response to the source differs from the reference reading by more than ±20% (for any photon instrument the reading should be at least ten times background), the instrument shall be returned to the calibration facility for calibration or for maintenance, repair, and recalibration, as required. Reference readings shall be obtained for each instrument when exposed to a source in a constant and reproducible manner, either at the time that the instrument is received in the field or before its first use."* For the discussion that follows, we can assume that ±20 percent is equivalent to a coefficient of variation (CV=standard deviation/mean value) of 0.20/3 Standard Deviations=0.067.

Acceptance ranges other than deviations of 20 percent from the mean are often specified as a function of the mean ± a multiple of the standard deviation, recognizing that there will be failures. To reduce the probably of failing an instrument due to a statistical fluctuation, the function check is repeated and accepted if it then passes.

The response changes for a normally functioning instrument used in the gamma survey occur primarily as a result of small changes in the high voltage of the digital ratemeter. These changes may be induced by large changes in the temperature but are normally smaller than the allowable 20 percent change mentioned above. These changes are not source or count-rate dependent and thus they affect the background count rates as well as the count rate from a source. It unfortunately took four days before problems with the function check method were identified and rectified (September 13-17, 2007). The detectors were function-checked while mounted on the ATVs with the source placed on the ground. Larger deviations than normal resulted in the net count rates primarily due to changes in the detector height from tire pressure changes and possibly due to the suspension systems of the ATVs. The procedure was changed on September 18, 2007 by removing the detectors and placing them at a fixed distance from the source, resulting in a CV=0.02 for the 14 measurements taken during the last 7 days for both detector systems. No measurements were outside of the ±20 percent limit (i.e., 0.067).

During the initial four-day period when the various procedures were applied in conducting the function checks, the data support that the morning checks differed by less than 20 percent from the checks made at the end of the day. Unfortunately, the function check for System A on September 14, 2007 at the end of the day did not have the same geometry as that at the beginning of the day, thus making a comparison impossible.

As stated above, performance changes in the detector systems will be reflected in changes in the background readings. In addition, the background count rates are less dependent on detector placement and therefore, in this case, may be used to evaluate whether the detectors were functioning properly each day. An analysis of the background count rate data taken the first four days of the survey shows that the detector systems have similar means with CVs of 0.05 and 0.04. Background data for the last seven days of the survey were almost identical with the means differing by less than 3 percent from those during the first four days, with CVs of 0.04 for each detector system. All data were within ±20 percent of the mean. Therefore, one can conclude that the responses of the detector systems during September 2007 were performing in a consistent manner each day throughout the survey period with CVs much less than allowed under ANSI N323A-1997.

To address the question regarding the missing function check data for July 18, 2008, a review of the field log books shows that the survey instruments were function-checked in the morning but not used on that day.

TR RAI-2.9-24

Regulatory Guide 4.14 recommends that direct radiation measurements be made at sites chosen for air particulate samples. As discussed in RAI # 1 in this section, the applicant has not provided sufficient information to demonstrate that the placement of the air monitoring stations is consistent with RG 4.14. Therefore, there is not sufficient information to determine if the placement of TLDs at air monitoring stations is consistent with RG 4.14. Consistent with Regulatory Guide 4.14 and NUREG-1569, Acceptance Criterion 2.9.3(1) provides the criteria used to establish TLD monitoring locations or indicate where this information can be found in the TR.

Response TR_RAI-2.9-24 (TR Section 2.9.6.1 Methods)

Please see response TR_RAI-RC-2.9-1

TR RAI-2.9-25

NRC staff could not locate the laboratory reports for TLD results in the TR. Please provide this information or indicate where these can be found in the application.

Response TR RAI-2.9-25 (TR Section 2.9.5.1.1)

The laboratory reports for the TLDs have been provided below and lists the Landauer Location ID Numbers shown on the reports against the sample location at which it was deployed. The table lists only those Landauer Location ID Numbers and locations for which results are available.

Table 2.9-5.1.1: List of Landauer Location ID Numbers and Sample Locations

Period	Date Deployed	Date Collected	Landauer Location ID Number	Sample Location
1	08/15/2007	02/04/2008	00001	AMS-06
	08/15/2007	02/04/2008	00002	AMS-02
	08/15/2007	02/04/2008	00003	AMS-07
	08/15/2007	02/04/2008	00004	AMS-03
	08/16/2007	02/04/2008	00005	AMS-BKG
	08/15/2007	02/04/2008	00006	AMS-05
	08/15/2007	02/04/2008	00007	AMS-BKG
	08/15/2007	02/04/2008	00008	AMS-01
	08/15/2007	02/04/2008	00009	AMS-04
2	02/04/2008	05/17/2008	00010	AMS-01
	02/04/2008	05/17/2008	00011	AMS-01
	02/04/2008	05/17/2008	00012	AMS-02
	02/04/2008	05/17/2008	00013	AMS-05
	02/04/2008	05/17/2008	00014	AMS-03
	02/04/2008	05/17/2008	00015	AMS-06
	02/04/2008	05/17/2008	00016	AMS-07
	02/04/2008	05/17/2008	00017	AMS-04
	02/04/2008	05/17/2008	00018	AMS-BKG
	02/04/2008	05/17/2008	00019	AMS-BKG

Table 2.9-5.1.1: List of Landauer Location ID Numbers and Sample Locations (concluded)

Period	Date Deployed	Date Collected	Landauer Location ID Number	Sample Location
3	05/17/2008	07/17/2008	00001	AMS-04
	05/17/2008	07/17/2008	00002	AMS-02
	05/17/2008	07/17/2008	00003	AMS-BKG
	05/17/2008	07/17/2008	00005	AMS-BKG
	05/17/2008	07/17/2008	00006	AMS-06
	05/17/2008	07/17/2008	00007	AMS-01
	05/17/2008	07/17/2008	00008	AMS-01
	05/17/2008	07/17/2008	00009	AMS-03
	05/17/2008	07/17/2008	00026	AMS-05
	05/17/2008	07/17/2008	00027	AMS-07

TR RAI-2.9-26

Section 2.9.5.2.1 of the TR states that AMS-01 was monitored for 303 days. However, Table 2.9-10 in the TR and Table 9-1 in Appendix 2.9-A of the TR indicate that this station was monitored for only approximately 164 days. Please clarify and provide documentation for the monitoring period for AMS-01.

Response TR RAI-2.9-26 (TR Section 2.9.5.2.1 and Appendix 2.9-A)

The reviewer is correct in that the time represented by the recovered TLDs was 164 days. This change has been incorporated in the revision to Section 2.9.5.2.1 that is addressed in the response to TR_RAI-2.9-27(a-c) as well as Section 9 of Appendix 2.9-A.

TR RAI-2.9-27

As the examples in the table below demonstrate, the ambient gamma dose rates provided in Table 2.9-10 in the TR indicate a significantly higher dose rate during the third time period (5/17/08 – 7/17/08) compared to the other measuring periods.

Station Dose Rates (mrem/day)	*2nd Measurement Period*	*3rd Measurement Period*
AMS-01	*0.36*	*0.96*
AMS-06	*0.35*	*0.85*
AMS-BKG	*0.39*	*0.975*

TR RAI-2.9-27(a)

a. ***Please provide justification that a TLD monitoring period for less than one full year is consistent with 10 CFR 40, Appendix A, Criterion 7. Specifically, please demonstrate that complete baseline data, including expected variations in gamma dose rates, has been provided in accordance with 10 CFR 40, Appendix A, Criterion 7, and as recommended by Regulatory Guide 4.14.***

Response TR RAI-2.9-27a (TR Section 2.9.5.2.1)

We agree with the observation that the average background dose equivalent rate is different for the three monitoring periods. We have re-evaluated the data and corrected some entry errors. We discovered that the dose equivalent rates had not considered the exposures that occurred during transit and while waiting to be deployed or processed. We adjusted the dose equivalent rates downward, by assuming that the dose rate for a TLD when not deployed was equal to the dose rate during deployment. This assumption is believed to be acceptable since all TLDs were deployed at locations believed to be background for the site. Since the third monitoring period was the shortest, this adjustment significantly reduced the previously reported dose equivalent rates for this period compared to the other periods.

The adjusted Table 2.9-10 in TR Section 2.9.5.2.1 presents the individual exposure rates for periods for which data are available. The missing data occurred because the TLDs were not retrievable due to possible theft or, more probable, cattle either eating the dosimeters or dragging them away from the stations. Where data are available, there is good agreement between the relative dose equivalent rates per period for all stations. Our calculations show that the average rates are 0.30, 0.26, and 0.36 mrem/day for the first, second, and third measurement periods. While variations with time in cosmic radiation occur in an unpredictable manner, variations in the terrestrial component are known to occur and depend primarily on the amount of soil moisture, vegetation cover, and snow cover. All attenuate gamma-ray emissions and thus reduces the dose equivalent rate. The first two monitoring periods cover fall, winter and spring while the third period covers the early portion of summer. It is reasonable to assume that the higher average dose equivalent rates for summer are a result of lower average soil moisture and no snow cover. While late summer, the 29-day period for which monitoring was not done, can produce relatively high rainfall events, it is difficult to predict from one year to the next. It seems reasonable that the average daily dose rate for this unmonitored period could best be approximated by that of the third monitoring period. We have therefore calculated the projected annual dose equivalent at each monitoring station where the data are complete by assuming that the 29-day period had the same average dose equivalent rate as that of the respective third monitoring period.

Criterion 7 of 10 CFR 40 Appendix A requires that a monitoring program be established one full year prior to major site construction. Reg. Guide 4.14 is consistent with that requirement but allows periodic measurements and specifies that measurements should not be made when the soil is abnormally wet. We believe that the 11-month monitoring period provides a good measure of the expected annual dose equivalent rates. While these data are useful, they will not be used for compliance during operations since any impacts from operations will be determined by comparing the values at the monitoring locations to those obtained at the background station for each monitoring interval. The baseline direct gamma-ray survey data are considered the most useful baseline data since the gamma emission rates are mapped for the entire site.

The TLD results compare favorably with the baseline direct gamma-ray survey data for the site when expressed in exposure rate units, micoRoentgen per hour (μR/h), where the average exposure rate was reported in the TR as 10.9 μR/h. Since one Roentgen is approximately equal to one rem, 10.9 μR/h can be expressed as approximately 95.5 mrem/year. This is very close to the 109 mrem/year average for the four monitoring locations reported in the table above.

During construction and operations, Powertech (USA) will establish permanent monitoring stations that are designed to limit easy access by animals and people. The impact at the locations from direct radiation will be determined by comparing the measured values to the value at the background location.

TR RAI-2.9-27(b)

As the examples in the table below demonstrate, the ambient gamma dose rates provided in Table 2.9-10 in the TR indicate a significantly higher dose rate during the third time period (5/17/08 – 7/17/08) compared to the other measuring periods.

Station Dose Rates (mrem/day)	*2nd Measurement Period*	*3rd Measurement Period*
AMS-01	*0.36*	*0.96*
AMS-06	*0.35*	*0.85*
AMS-BKG	*0.39*	*0.975*

b. ***Referring to the above table, please update the discussion on ambient gamma dose rate monitoring, taking into account the variability of the data and the lack of data collected over an entire year.***

Response TR RAI-2.9-27(b) (TR Section 2.9.5.2.1)

This response has been incorporated into TR Section 2.9.5.2.1; and Sections 9.2 and 11.0 of Appendix 2.9-A . See replacement sections below.

Revisions to Section 2.9.5.2.1 of the Technical Report

2.9.5.2 Ambient Gamma Dose Rate Monitoring

Ambient exposure rates were determined for three periods, using TLDs supplied and analyzed by Landauer, Inc. The monitoring periods were: August 18, 2007 to February 4, 2008, February 4 to May 17, 2008, and May 17 to July 17, 2008. The 29-day period between July 17 and August 15 that would make up the year was not monitored.

The TLDs were deployed at each of the eight AMS locations. Duplicates were deployed at AMS-01 and the background location (AMS-BKG). Five of the nine TLDs deployed in the August 2007 to February 2008 period were lost, presumably by way of cattle consumption and/or disturbance. Two additional TLDs were lost from subsequent deployments, presumably as a result of cattle in the area.

The ambient gamma dose rate monitoring results are listed in Table 2.9-10. All reported dose equivalents were converted to an adjusted dose rate by dividing by the time between the shipment of the dosimeters to the site to the time that the dosimeters were processed by the vendor. In order to obtain an estimate of the annual dose equivalent rate, the average daily dose rate for the 29-day period (July 17, 2008-August 15, 2008) which was not monitored was assumed equal to the May 17, 2008 too July 17, 2008 period. This is reasonable since terrestrial dose rates for a location primarily depend on soil moisture and snow and vegetation cover. For locations where TLDs were missing, no attempt was made to obtain an annual projected dose equivalent. The results for the TLDs reported in millirem per year (mrem/yr) ambient dose equivalents are as follows:

- AMS-04: 112 mrem/yr
- AMS-05: 91 mrem/yr
- AMS-07: 109 mrem/yr
- AMS-BKG: 123 mrem/yr

The range of exposure rates (91 to 123 mrem/yr) and average (109 mrem/yr) is similar to average worldwide exposures to natural radiation sources comprised of comic radiation, cosmogenic radionuclides, and external terrestrial radiation reported in the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) Report to the General Assembly, Sources and Effects of Ionizing Radiation, Annex. The typical ranges of average worldwide exposures reported in this reference document are from 60 to160 mrem/yr.

The TLD results compare favorably with the baseline direct gamma-ray survey data for the site reported in Section 2.9.2.1.1 when expressed in exposure rate units (μR/h) as reported in Section 2.9.2.2.2, where the average exposure rate was reported as 10.9 microRoentgen/h (μR/h). Since a Roentgen is approximately equal to a rem, 10.9 μR/h can be expressed as 96 mrem/yr. This is very close to the 109 mrem/y average for the four monitoring locations.

Table 2.9-10: Ambient Gamma Dose Rates

Location	Starting Date	End Date	Dose (mrem)	Adjusted Dose Rate (mrem/day)[b]	Projected Annual Dose (mrem)
AMS-01	8/15/07	2/4/08	-		
	2/4/08	5/17/08	37.2[a]	0.260	
	5/17/08	7/17/08	57.7[a]	0.412	
AMS-02	9/18/07	2/4/08	-		
	2/4/08	5/17/08	-		
	5/17/08	7/17/08	54.0	0.386	
AMS-03	8/15/07	2/4/08	-		
	2/4/08	5/17/08	38.6	0.270	
	5/17/08	7/17/08	-		
AMS-04	8/15/07	2/4/08	62.4	0.297	112
	2/4/08	5/17/08	36.1	0.252	
	5/17/08	7/17/08	54.3	0.388	
AMS-05	8/15/07	2/4/08	50.6	0.241	91
	2/4/08	5/17/08	36.7	0.257	
	5/17/08	7/17/08	36.4	0.260	
AMS-06	8/15/07	2/4/08	-		
	2/4/08	5/17/08	36.9	0.258	
	5/17/08	7/17/08	51.1	0.365	
AMS-07	8/15/07	2/4/08	73.7	0.351	109
	2/4/08	5/17/08	35.5	0.248	
	5/17/08	7/17/08	36.1	0.258	
AMS-BKG	8/15/07	2/4/08	68.8[a]	0.328	123
	2/4/08	5/17/08	40.5[a]	0.283	
	5/17/08	7/17/08	58.5[a]	0.418	

Notes:

a. Result is average of measurement plus duplicate.

b. Dose rate adjusted by dividing by the reported dose by the time from vendor shipment of dosimeters to site and the time dosimeters were processed.

Revisions to Section 9 of Appendix 2.9-A

9.2 Ambient Exposure Rates Determined using Thermoluminescent Detectors

Ambient exposure rates were determined for three periods, using TLDs supplied and analyzed by Landauer, Inc. The monitoring periods were: August 18, 2007 to February 4, 2008, February 4 to May 17, 2008, and May 17 to July 17, 2008. The 29-day period between July 17 and August 15 that would make up the year was not monitored.

The TLDs were deployed at each of the eight AMS locations. Duplicates were deployed at AMS-01 and the background location (AMS-BKG). Five of the nine TLDs deployed in the August 2007 to February 2008 period were lost, presumably by way of cattle consumption and/or disturbance. Two additional TLDs were lost from subsequent deployments, presumably as a result of cattle in the area.

The ambient gamma dose rate monitoring results are listed in Table 9-1. All reported dose equivalents were converted to an adjusted dose rate by dividing by the time between the shipment of the dosimeters to the site to the time that the dosimeters were processed by the vendor. In order to obtain an estimate of the annual dose equivalent rate, the average daily dose rate for the 29-day period (July 17, 2008-August 15, 2008) which was not monitored was assumed equal to the May 17, 2008 too July 17, 2008 period. This is reasonable since terrestrial dose rates for a location primarily depend on soil moisture and snow and vegetation cover. For locations where TLDs were missing, no attempt was made to obtain an annual projected dose equivalent. The results for the TLDs reported in millirem per year (mrem/yr) ambient dose equivalents are as follows:

- AMS-04: 112 mrem/yr
- AMS-05: 91 mrem/yr
- AMS-07: 109 mrem/yr
- AMS-BKG: 123 mrem/yr

The range of exposure rates (91 to 123 mrem/yr) and average (109 mrem/yr) is similar to average worldwide exposures to natural radiation sources comprised of comic radiation, cosmogenic radionuclides, and external terrestrial radiation reported in the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) Report to the General Assembly, Sources and Effects of Ionizing Radiation, Annex. The typical ranges of average worldwide exposures reported in this reference document are to 60 to160 mrem/yr.

The TLD results compare favorably with the baseline direct gamma-ray survey data reported in Section 3 when expressed in exposure rate units (μR/h) as reported in Section 9.1, where the average exposure rate was reported as 10.9 microRoentgen/h (μR/h). Since a Roentgen is approximately equal to a rem, 10.9 μR/h can be expressed as 95.5 mrem/year. This is very close to the 109 mrem/yr average for the four monitoring locations reported above.

Table 9-1. Ambient Gamma Dose Rates using TLDs

Location	Starting Date	End Date	Dose (mrem)	Adjusted Dose Rate (mrem/day)[b]	Projected Annual Dose (mrem)
AMS-01	8/15/07	2/4/08	-		
	2/4/08	5/17/08	37.2[a]	0.260	
	5/17/08	7/17/08	57.7[a]	0.412	
AMS-02	9/18/07	2/4/08	-		
	2/4/08	5/17/08	-		
	5/17/08	7/17/08	54.0	0.386	
AMS-03	8/15/07	2/4/08	-		
	2/4/08	5/17/08	38.6	0.270	
	5/17/08	7/17/08	-		
AMS-04	8/15/07	2/4/08	62.4	0.297	112
	2/4/08	5/17/08	36.1	0.252	
	5/17/08	7/17/08	54.3	0.388	
AMS-05	8/15/07	2/4/08	50.6	0.241	91
	2/4/08	5/17/08	36.7	0.257	
	5/17/08	7/17/08	36.4	0.260	
AMS-06	8/15/07	2/4/08	-		
	2/4/08	5/17/08	36.9	0.258	
	5/17/08	7/17/08	51.1	0.365	
AMS-07	8/15/07	2/4/08	73.7	0.351	109
	2/4/08	5/17/08	35.5	0.248	
	5/17/08	7/17/08	36.1	0.258	
AMS-BKG	8/15/07	2/4/08	68.8[a]	0.328	123
	2/4/08	5/17/08	40.5[a]	0.283	
	5/17/08	7/17/08	58.5[a]	0.418	

Notes:

a. Result is average of measurement plus duplicate.

b. Dose rate adjusted by dividing by the reported dose by the time from vendor shipment of dosimeters to site and the time dosimeters were processed.

Revisions to Section 11.0 of Appendix 2.9-A

The last bullet in Section 11.0 of Appendix 2.9-A should be revised as follows:

- Baseline ambient exposure rates, as determined using TLDs, range from 91 to 123 mrem/yr.

TR RAI-2.9-27(c)

As the examples in the table below demonstrate, the ambient gamma dose rates provided in Table 2.9-10 in the TR indicate a significantly higher dose rate during the third time period (5/17/08 – 7/17/08) compared to the other measuring periods.

Station Dose Rates (mrem/day)	*2nd Measurement Period*	*3rd Measurement Period*
AMS-01	*0.36*	*0.96*
AMS-06	*0.35*	*0.85*
AMS-BKG	*0.39*	*0.975*

c. In Section 2.9.2.1.1 of the TR, it is stated that the applicant collected GPS-based gamma dose rate data during two different time periods: September 2007 and July 2008. Additional data was collected for the land application area from July 17-19, 2008. These time periods appear to have potentially significantly different background gamma dose rate attributes. It appears that the applicant combined the data from these different time periods without accounting for the variations in background. Please address the following:

i) It is not clear which areas were surveyed during the July 14-16, 2008 timeframe. Please provide information on precisely which locations were surveyed and the corresponding dates.
ii) Considering the variations in expected gamma dose rates during different times of the year, please explain how the statistics for the GPS-based gamma ray surveys are affected by combining these different time periods. In your response, address the test for normality (and other types of distributions) of the data, transformations of the data, the identification of outliers, and the test for variance of the Main Permit Area, the anomalous north area and the Surface Mine Area.
iii) Considering the variations in expected gamma dose rates during the year, please explain how these variations will be taken into account when performing post reclamation and decommissioning radiological surveys to ensure appropriate action levels are established (e.g., that contamination above regulatory limits is detected).

Response TR RAI-2.9-27(c) (TR Section 2.9.2.1.1)

i: The initial GPS-based gamma survey was done in the Main Permit and Surface Mine Areas using 500 meter and 100 meter transect spacings, respectively, from September 13-27, 2007. The boundary of the Main Permit Area was later extended to the southwest. The 500-meter survey lines were extended south to this new boundary by mobilizing to the site and conducting the survey on July 14, 2008. Work continued from July 17-19, 2008 where additional data within the land application areas were obtained to comply with the desire to have data on 100-meter transect spacings therein. Transect spacings of 100 meters were added within the previously determined 500-meter transects within the Land Application Areas only. The figure 3.1 in Appendix 2.9-A shows the survey data with 2007 and 2008 data points in different colors.

ii: The first issue to address is whether the data from 2007 and 2008 may be combined because of possible different background count rates. To provide maximum sensitivity, a search for overlapping areas was done where the overlap was in areas considered free of anomalies. Ten areas where there was overlap of the data (within 3 feet) from the two surveys were identified and corresponding count rates were recorded as shown in **TR_RAI-Table 2.9-26(2)**. The results confirm that the survey instruments produced count rates that were nearly identical, with a mean ratio of the two count rates of 1.01 with maximum difference of any two data points of 15 percent. An Anderson-Darling Test was done to see if the differences of the paired data were of a normal distribution. The results of the Anderson-Darling Test for normality yielded a p-value of 0.093 (cannot reject normal distribution hypothesis). Then a test was done to determine whether the differences were significantly different from 0. The results of the paired t-test were a p-value of 0.787 (cannot reject zero-difference hypothesis), an average difference of 84 cpm, and a 95% confidence interval on the average difference of (-603 cpm, 772 cpm). In summary, the two data sets are not statistically different from one another.

A significant effort was made to match the instrument responses to background radiation and radiation sources prior to deployment for the 2007 survey. In preparing for the 2008 survey, again the instrument performances were matched to one another and to the performances of the instruments used in 2007. Since the instrument responses in background areas were the same for the 2007 and 2008 surveys, we therefore conclude that the background radiation was very similar for the two surveys and that merging the data was appropriate.

TR_RAI-Table 2.9-26(2): Data pairs from 2007 and 2008 surveys.

Location	2007 Count Rate (cpm)	2008 Count Rate (cpm)	Ratio 2007:2008
1	12721	14985	0.85
2	12060	11309	1.07
3	12186	11299	1.08
4	11958	11562	1.03
5	15016	15074	1.00
6	13358	13752	0.97
7	13829	13970	0.99
8	12685	12207	1.04
9	15788	14633	1.08
10	12979	12945	1.00
		Mean	**1.01**

A statistical evaluation of the total data set and sets of data corresponding to defined areas was presented in the TR_Appendix 2.9-A (Radiological Baseline Report), including tests for normality and log transforms. All frequency distributions were found to be nonparametric and conventional approaches were used to describe these distributions. We do not believe that a test of variance of the three defined areas would add anything meaningful to the discussion since the two areas were evident as different from the remainder of the permit area based on historical use and geological features.

iii: It should be noted that 10 CFR 40 Appendix A decommissioning regulations limit the radionuclide concentrations in soil. Compliance with the cleanup criteria is based on laboratory analysis of soil samples. While it is true that gamma-ray action levels are used to identify anomalies, the accuracy of the action levels is known to be limited, due to changes in background count rates, vertical distribution and aerial extent of radionuclides, soil moisture, and other factors. Experience has shown that results of gamma surveys cannot be reliably interpreted if done when there is excessive soil moisture. This limitation in itself reduces the variation in background count rates during cleanup operations. Action levels are conservatively set and periodically revaluated during cleanup, especially when known changes may influence gamma-ray emissions. The confidence lines of correlations such as is those shown in Figures 5-1 and 5-2 of the Radiological Baseline Report are useful in establishing conservative gamma-ray actions levels. Normally the application of these conservatively chosen action levels results in cleanup to near background levels, in accordance with NRC's ALARA policy.

TR RAI-2.9-28

In Section 2.9.5.2.1 of the TR, the applicant excludes AMS-02 when discussing exposure rates. Please provide justification for excluding this data point.

TR RAI-2.9-29

Provide technical justification that the projected dose for AMS-03 is a valid estimate of the actual dose at this monitoring station.

Response TR RAI-2.9-28 and 29 (TR Section 2.9.5.2.1)

External dose equivalent rate data from TLDs at Monitoring Stations AMS-04, AMS-05, AMS-07, and AMS-BKG are considered complete with the annual average dose equivalent rates for the four stations reported in the rewritten Section 2.9.5.2.1 of the TR as ranging from 91 to 123 mrem. These stations are located to the north, southwest, and south of the permit area, not near the formerly mined area or other known elevated exposure rate anomalies.

TLDs at the stations located within the permit area (AMS-01, AMS-02, AMS-03, and AMS-06) were eaten or otherwise removed by cattle for one or more of the monitoring periods. In re-evaluating the data, it was decided to not attempt to compute an annual average dose equivalent rate for these stations. To show compatibility with NRC guidance, we have relied on the extensive set of exposure rate data predicted from the GPS-based gamma surveys. The gamma-ray count rates were converted to exposure rates by developing a correlation with a pressurize ionization chamber (PIC). Using the permit area-wide (excluding the Surface Mine Area) average predicted exposure rate (10.9 μR/hr) from the correlation, an annual dose equivalent rate was calculated for the permit area (10.9*8760 hrs/yr/1000= 96 mrem). As indicated in the rewrite of Section 2.9.5.2.1 of the TR, the annual gamma dose rate for the permit area (96 mrem) agrees well with the 109 mrem annual measured dose equivalent rate from the TLD data at the four monitoring stations where the data sets are complete.

TR RAI-2.9-30

In Section 2.9.2.2.1 of the TR and Section 3.2 of Appendix 2.9-A of the TR, the applicant discusses outliers in the gamma-ray count rate data. Regarding the identification of outliers, NRC staff has consulted the statistical reference cited by the applicant (Ott and Longnecker 2001) and has not found justification for using the interquartile range (IQR) method as a sole means of proving outliers. According to Ott and Longnecker (2001, p. 86), "...the IQR does not provide sufficient useful information about a single set of measurements, but can be quite useful when comparing the variabilities of two or more data sets." This approach is consistent with other statistical sources (e.g., NIST 2006). Further, in their discussion of boxplots, Ott and Longnecker (2001, p. 100) recommend carefully examining and checking the extreme values of the measurement. Lastly, NIST (2006) discusses nonnormal distributions that may be expected to have extreme values at larger rates than for a normal distribution. One example is the Cauchy distribution. Please provide the following:

TR RAI-2.9-30(a)

a. Documentation for all statistical analyses (histograms, data transformations, etc.) performed on the GPS-based gamma surveys, including outputs from statistical software packages, or indicate where these can be found in the application.

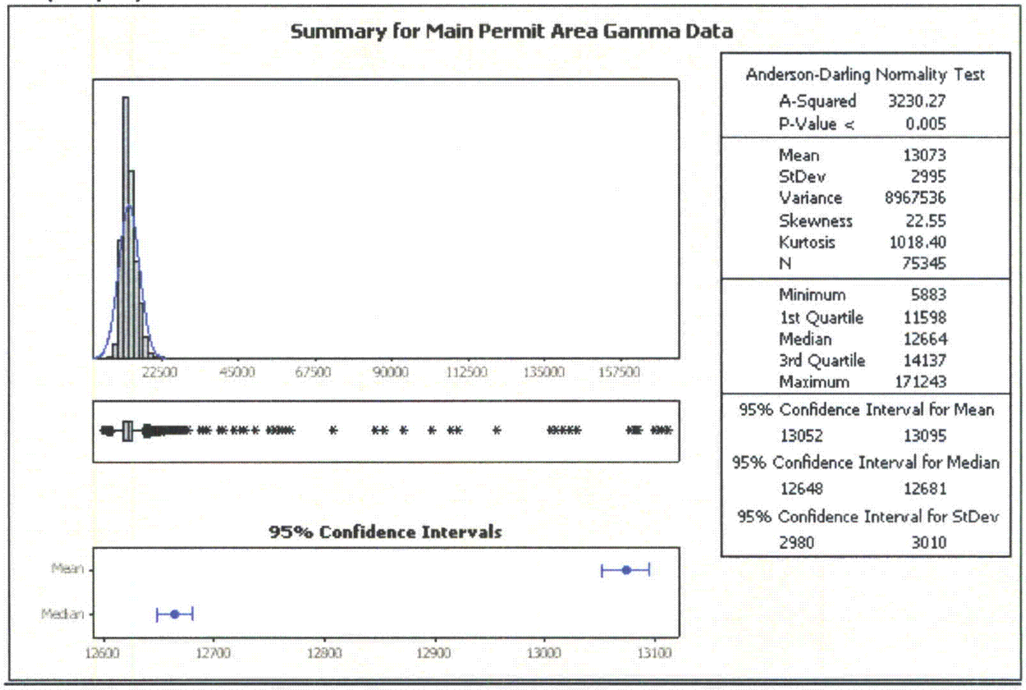
Response TR RAI-2.9-30(a) (TR Section 2.9.2.2.1 and Appendix 2.9-A)

The gamma data from the Main Permit Area, Surface Mine Area, and both land application areas (Dewey and Burdock) were analyzed separately with the statistical software package Minitab, version 15.1.1.0.

Main Permit Area

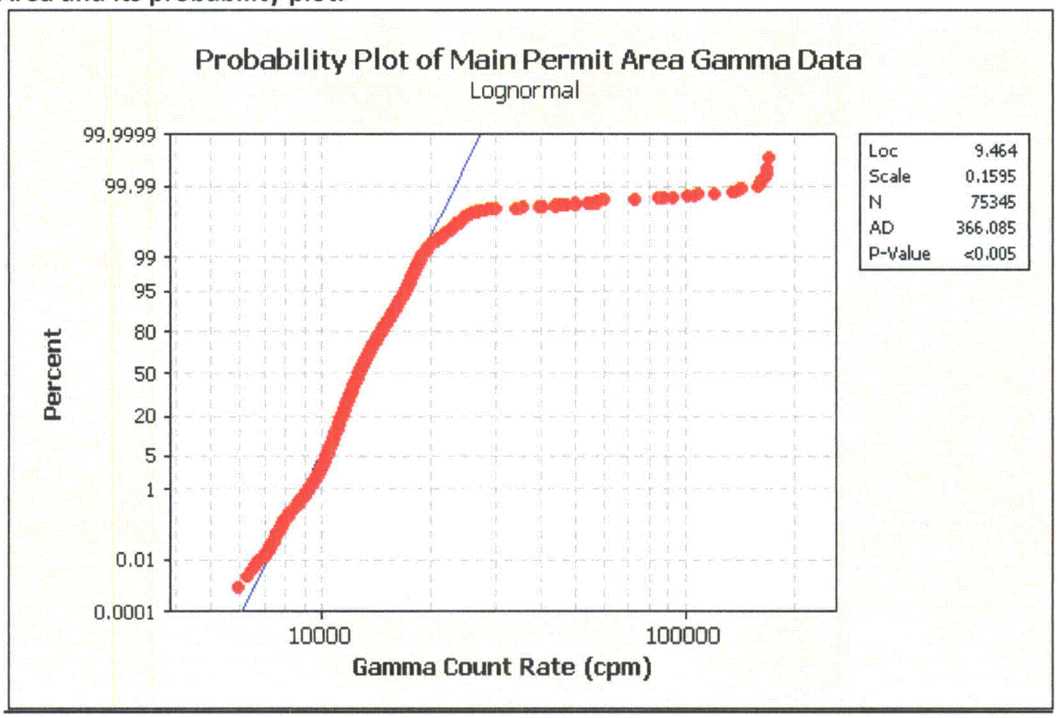
The gamma data from the Main Permit Area was tested for a normal distribution. Figure TR_RAI-RC 2.9-30(1) displays the results of the test as well as a histogram of the data and its statistical summary.

TR_RAI-Figure 2.9-30(1): Summary of statistics and normality test of gamma data from the Main Permit Area (in cpm).

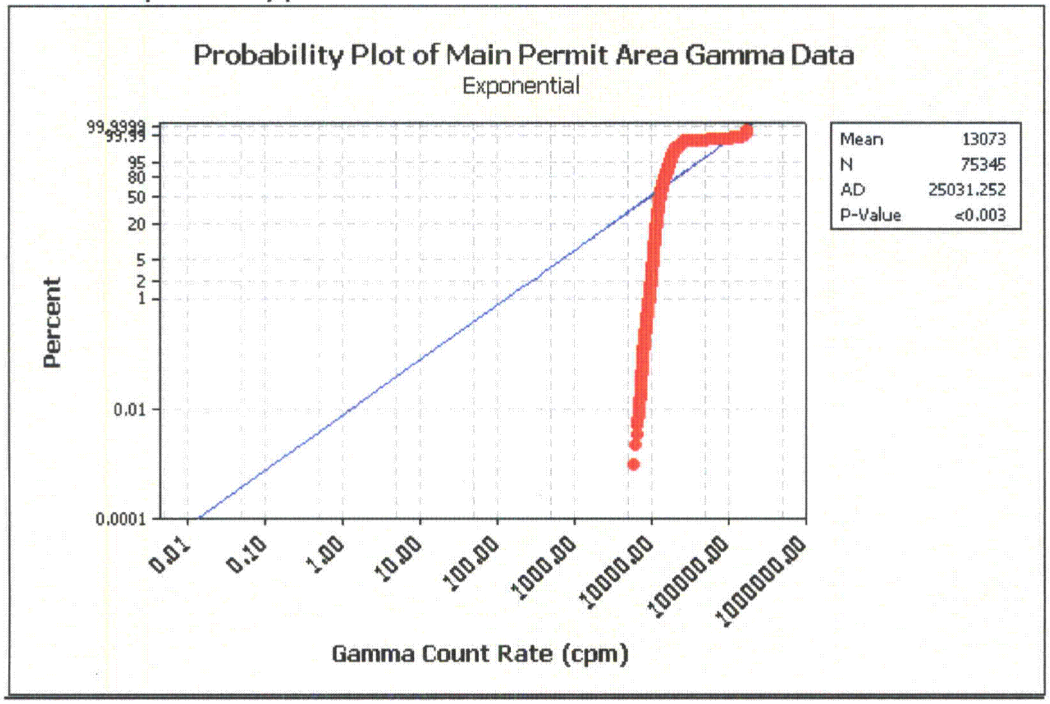


The normality test rejected the null hypothesis of a normal distribution. The data was then tested for lognormal and exponential distributions. **Figures *TR_RAI-2.9-30(2)*** and ***TR_RAI-2.9-30(3)*** show the results of the tests for lognormal and exponential distributions, along with their respective probability plots.

TR_RAI- Figure 2.9-30(2): Results of the test for lognormal distribution on the data from the Main Permit Area and its probability plot.

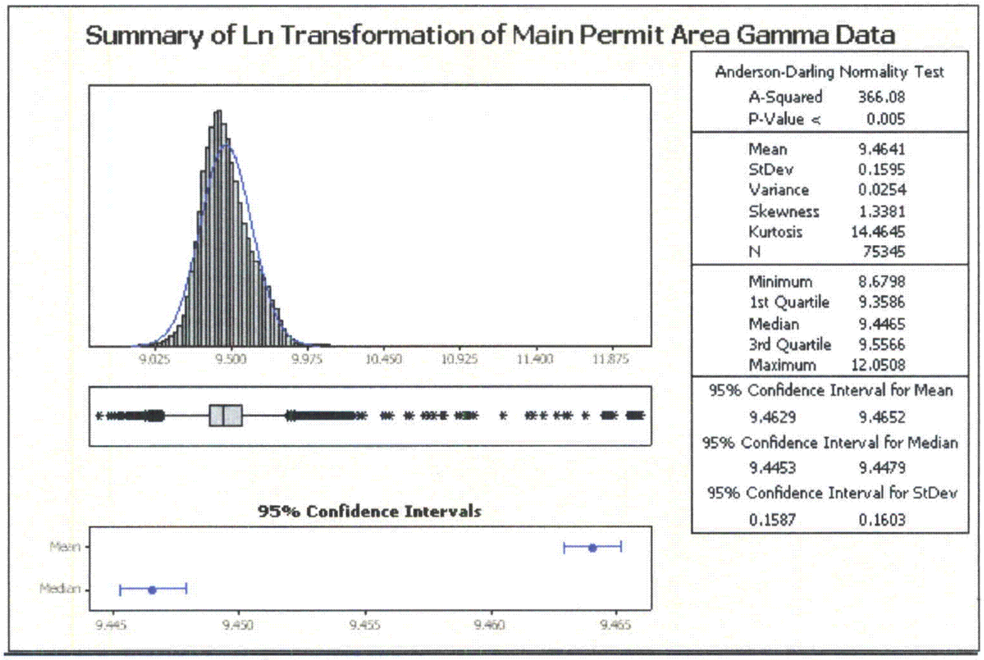


TR_RAI- Figure 2.9-30(3): Results of the test for exponential distribution on the data from the Main Permit Area and its probability plot.



The tests rejected the null hypotheses of lognormal or exponential distributions. Each value in the set of data was transformed by taking its natural logarithm and the transformed data set was tested for a normal distribution. **TR_RAI- Figure 2.9-30(4)** displays the results of the test as well as a histogram of the transformed data and its statistical summary.

TR_RAI- Figure 2.9-30(4): Summary of statistics and normality test of transformed gamma data from the Main Permit Area.

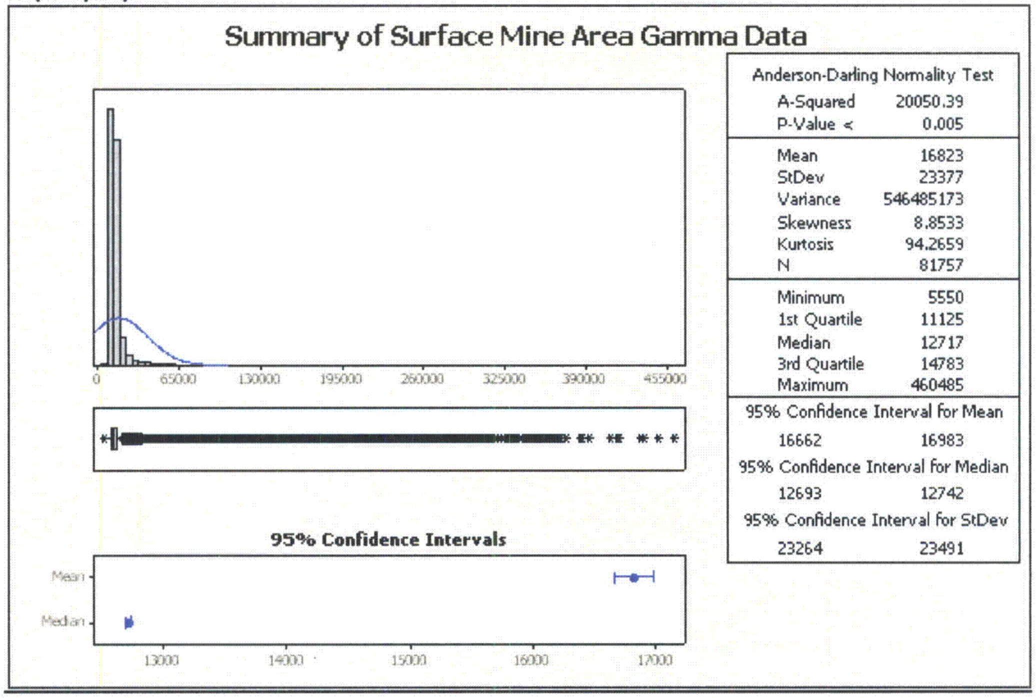


The normality test shows that the transformed data is not from a normal distribution.

Surface Mine Area

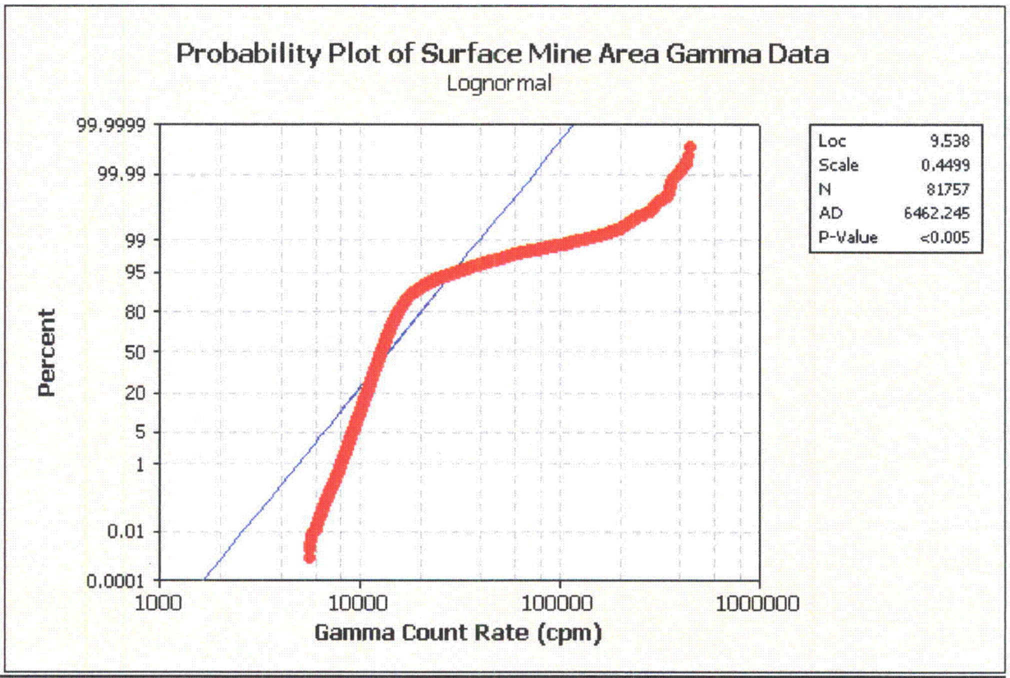
The gamma data from the Surface Mine Area was tested for a normal distribution. **TR_RAI- Figure 2.9-30(5)** displays the results of the test as well as a histogram of the data and its statistical summary.

TR_RAI- Figure 2.9-30(5): Summary of statistics and normality test of gamma data from the Surface Mine Area (in cpm).

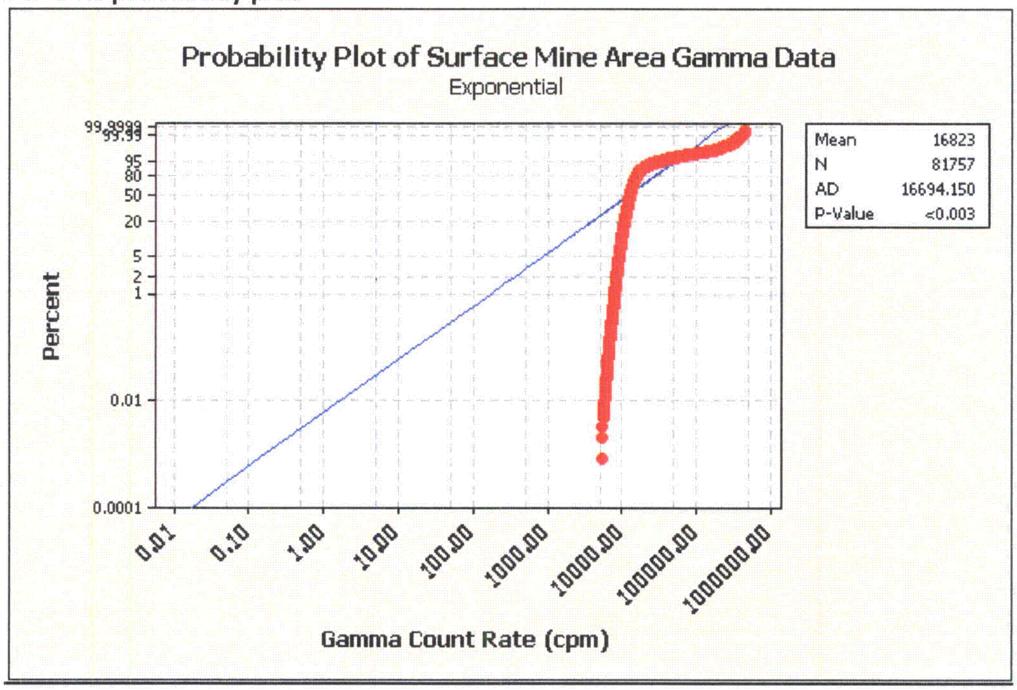


The normality test rejected the null hypothesis of a normal distribution. The data was then tested for lognormal and exponential distributions. **TR_RAI- Figure 2.9-30(6)** and **TR_RAI- Figure 2.9-30(7)** show the results of the tests for lognormal and exponential distributions along with their respective probability plots.

TR_RAI-Figure 2.9-30(6): Results of the test for lognormal distribution on the data from the Surface Mine Area and its probability plot.

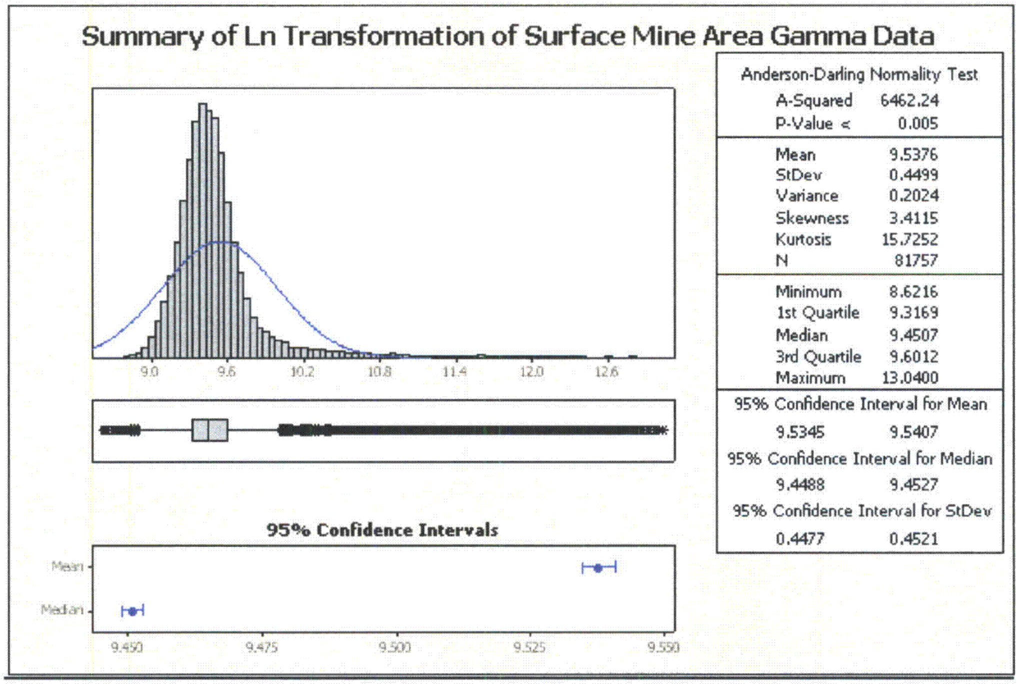


TR_RAI-Figure 2.9-30(7): Results of the test for exponential distribution on the data from the Surface Mine Area and its probability plot.



The tests rejected the null hypotheses of lognormal or exponential distributions. Each value in the set of data was transformed by taking its natural logarithm and the transformed data was tested for a normal distribution. Figure 8 displays the results of the test as well as a histogram of the transformed data and its statistical summary.

TR_RAI-Figure 2.9-30(8): Summary of statistics and normality test of transformed gamma data from the Surface Mine Area.

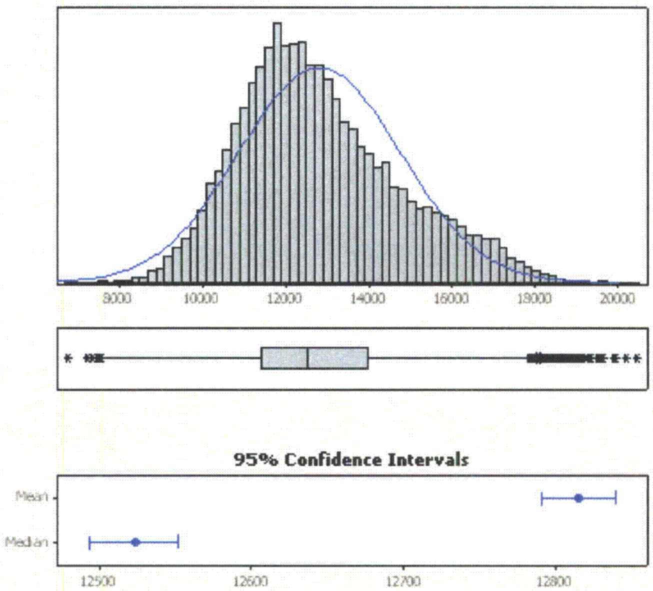


The normality test shows that the transformed data is not from a normal distribution.

Land Application Area – Dewey

The gamma data from the Land Application Area - Dewey was tested for a normal distribution. Figure TR_RAI-RC 2.9-30(9) displays the results of the test as well as a histogram of the data and its statistical summary.

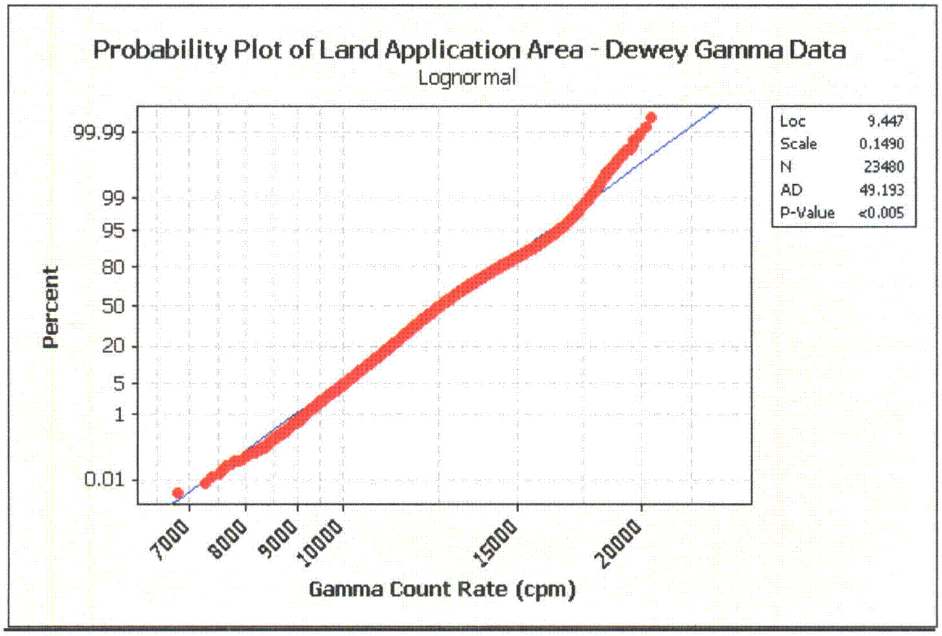
TR_RAI-Figure 2.9-30(9): Summary of statistics and normality test of gamma data from the Land Application Area - Dewey (in cpm).



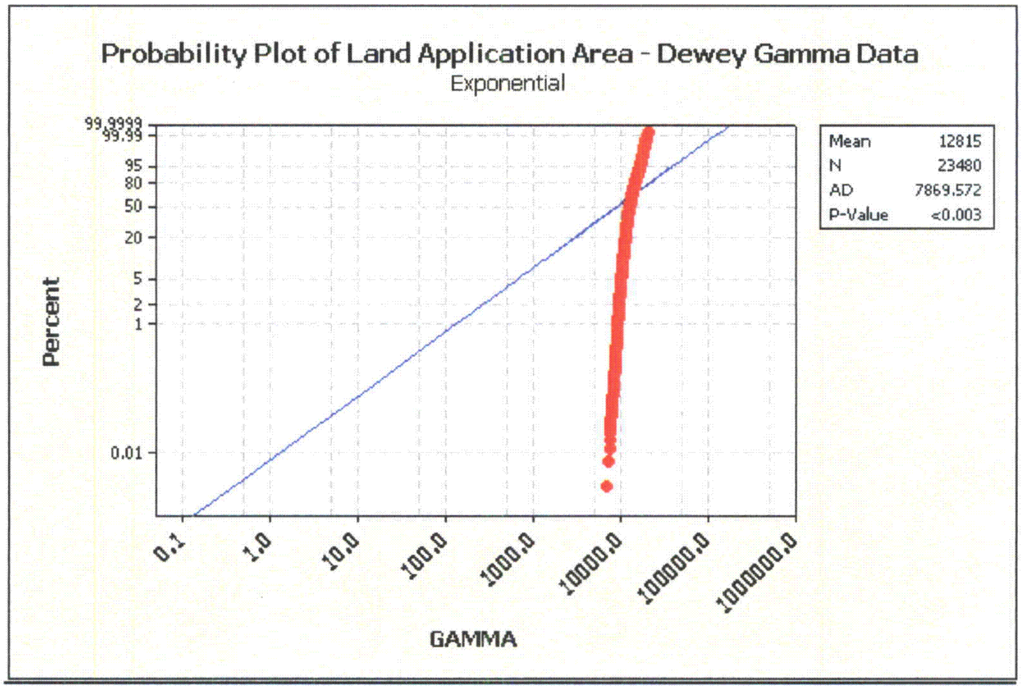
Anderson-Darling Normality Test	
A-Squared	180.08
P-Value <	0.005
Mean	12815
StDev	1940
Variance	3764314
Skewness	0.545065
Kurtosis	-0.050673
N	23480
Minimum	6798
1st Quartile	11437
Median	12523
3rd Quartile	13993
Maximum	20422
95% Confidence Interval for Mean	
12790	12840
95% Confidence Interval for Median	
12493	12551
95% Confidence Interval for StDev	
1923	1958

The normality test rejected the null hypothesis of a normal distribution. The data was then tested for lognormal and exponential distributions. **TR_RAI-Figure 2.9-30(10)** and **TR_RAI-Figure 2.9-30(11)** show the results of the tests for lognormal and exponential distributions along with their respective probability plots.

TR_RAI-Figure 2.9-30(10) Results of the test for lognormal distribution on the data from the Land Application Area - Dewey and its probability plot.

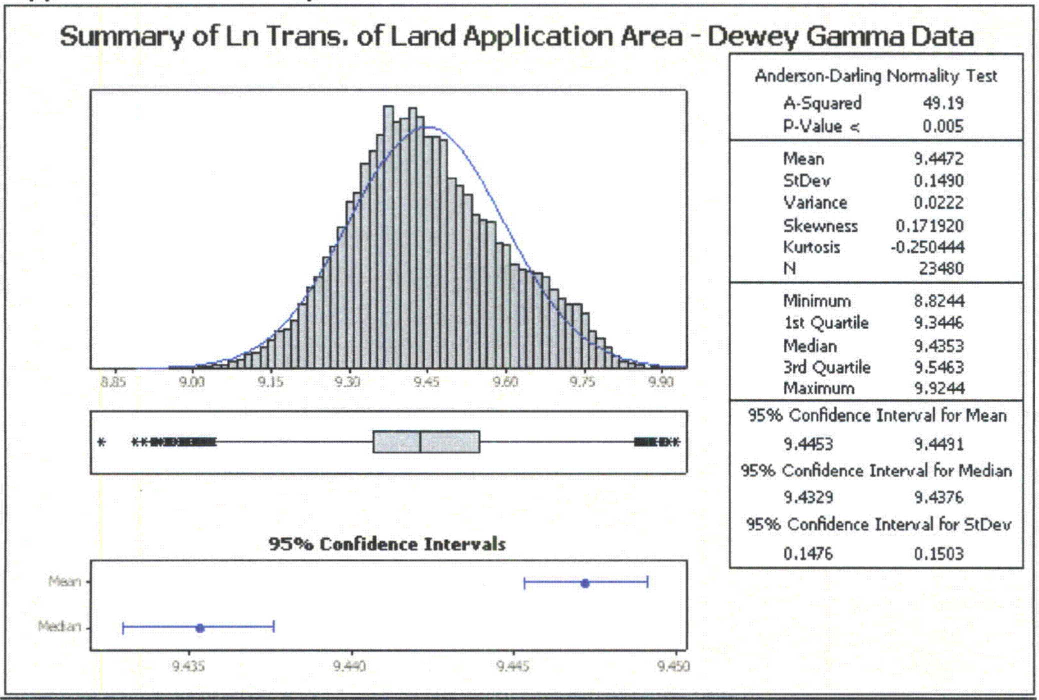


TR_RAI-Figure 2.9-30(11) Results of the test for exponential distribution on the data from the Land Application Area - Dewey and its probability plot.



The tests rejected the null hypotheses of lognormal or exponential distributions. Each value in the set of data was transformed by taking its natural logarithm and the transformed data was tested for a normal distribution. **TR_RAI-Figure 2.9-30(12)** displays the results of the test as well as a histogram of the transformed data and its statistical summary.

TR_RAI-Figure 2.9-30(12): Summary of statistics and normality test of transformed gamma data from the Land Application Area - Dewey.

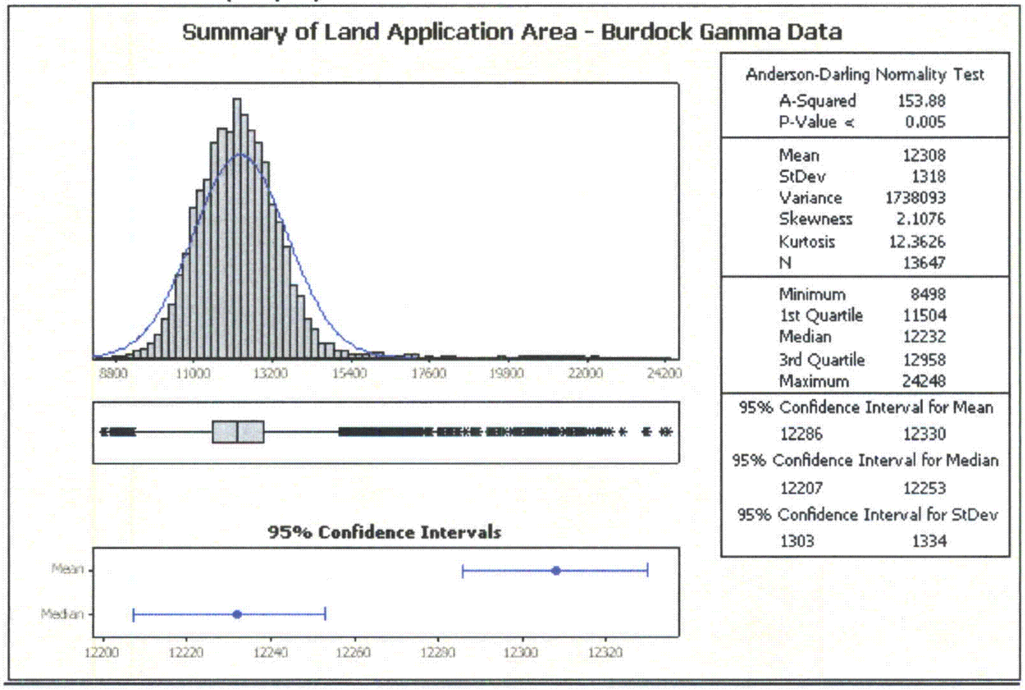


The normality test shows that the transformed data is not from a normal distribution.

Land Application Area – Burdock

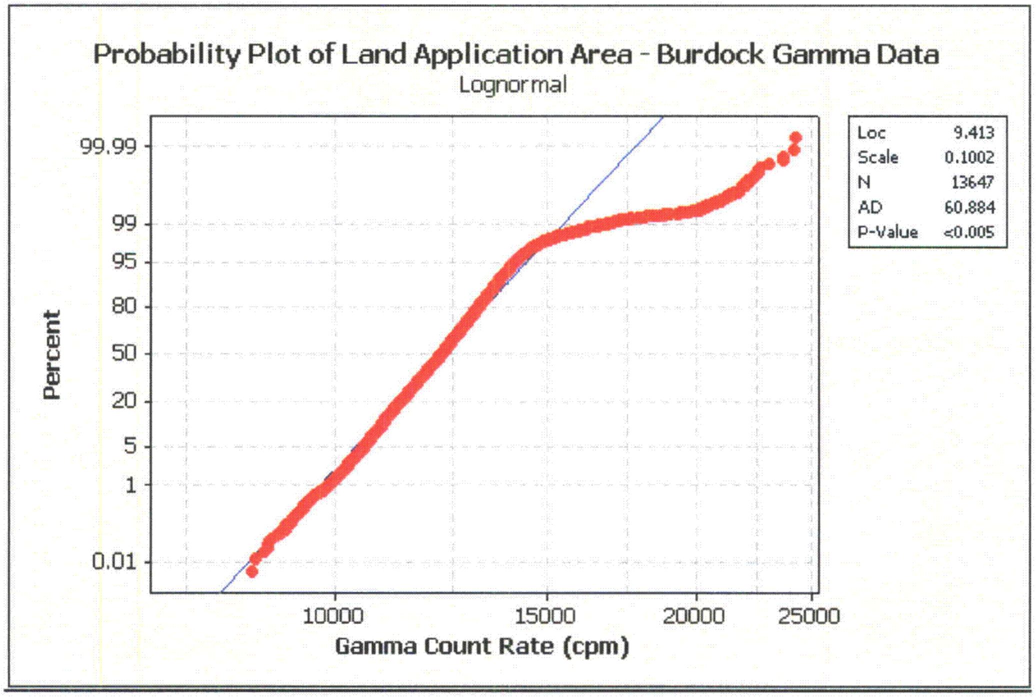
The gamma data from the Surface Mine Area was tested for a normal distribution. **TR_RAI-Figure 2.9-30(13)** displays the results of the test as well as a histogram of the data and its statistical summary.

TR_RAI-Figure 2.9-30(13): Summary of statistics and normality test of gamma data from the Land Application Area - Burdock (in cpm).

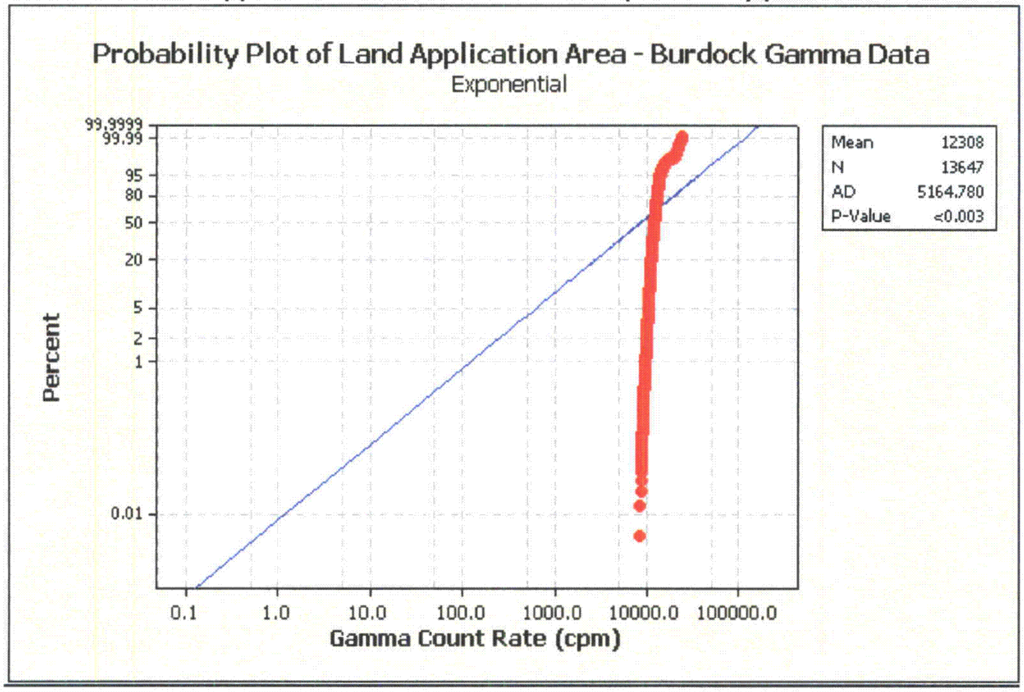


The normality test rejected the null hypothesis of a normal distribution. The data was then tested for lognormal and exponential distributions. **TR_RAI-Figure 2.9-30(14)** and **TR_RAI-Figure 2.9-30(14)** show the results of the tests for lognormal and exponential distributions along with their respective probability plots.

TR_RAI-Figure 2.9-30(14): Results of the test for lognormal distribution on the data from the Land Application Area - Burdock and its probability plot.

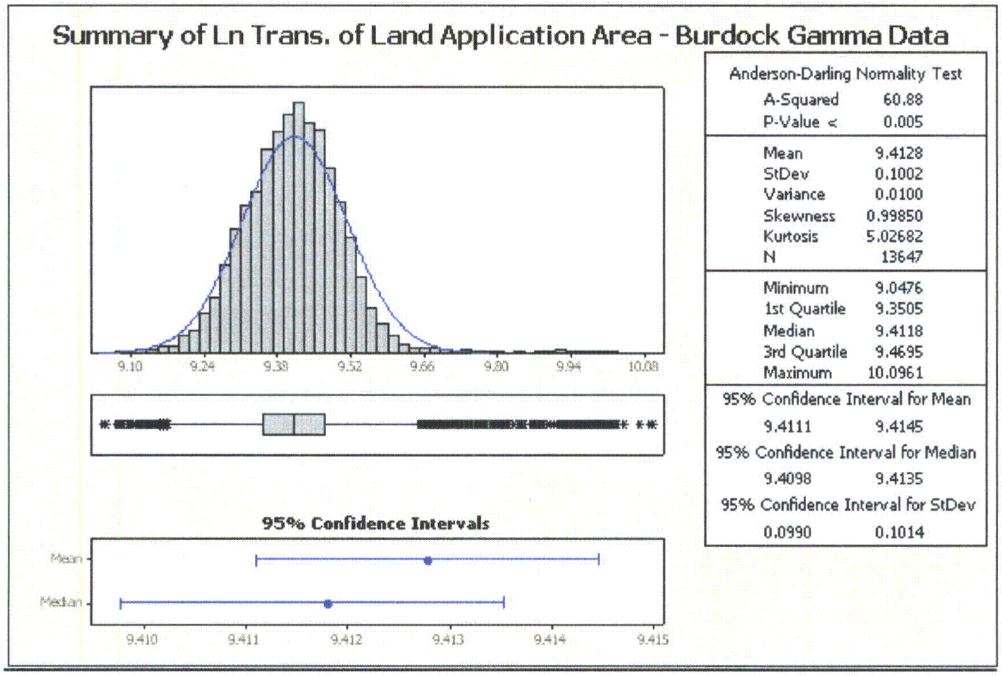


TR_RAI-Figure 2.9-30(15): Results of the test for exponential distribution on the data from the Land Application Area - Burdock and its probability plot.



The tests rejected the null hypotheses of lognormal or exponential distributions. Each value in the set of data was transformed by taking its natural logarithm and the transformed data was tested for a normal distribution. **TR_RAI-Figure 2.9-30(16)** displays the results of the test as well as a histogram of the transformed data and its statistical summary.

TR_RAI-Figure 2.9-30(16): Summary of statistics and normality test of transformed gamma data from the Land Application Area - Burdock.



The normality test shows that the transformed data is not from a normal distribution.

TR RAI-2.9-30(b)

In Section 2.9.2.2.1 of the TR and Section 3.2 of Appendix 2.9-A of the TR, the applicant discusses outliers in the gamma-ray count rate data. Regarding the identification of outliers, NRC staff has consulted the statistical reference cited by the applicant (Ott and Longnecker 2001) and has not found justification for using the interquartile range (IQR) method as a sole means of proving outliers. According to Ott and Longnecker (2001, p. 86), "...the IQR does not provide sufficient useful information about a single set of measurements, but can be quite useful when comparing the variabilities of two or more data sets." This approach is consistent with other statistical sources (e.g., NIST 2006). Further, in their discussion of boxplots, Ott and Longnecker (2001, p. 100) recommend carefully examining and checking the extreme values of the measurement. Lastly, NIST (2006) discusses nonnormal distributions that may be expected to have extreme values at larger rates than for a normal distribution. One example is the Cauchy distribution. Please provide the following:

b. Justification for utilizing the IQR as the sole means of proving outliers.

Response TR RAI-RC 2.9-30(b) (TR Section 2.9.2.2.1 and Appendix 2.9-A)

Several tools were used, prior to the decision to use IQRs to evaluate outliers, including histograms, distribution tests, and probability plots. The results of the IQR analyses were used only for informational purposes. As described in the responses to Items 85-86, the outliers defined by using the IQR were not removed nor discounted in the statistical analysis of the GPS gamma data.

TR RAI-2.9-31

In Section 2.9.2.2.1 of the TR and Section 3.2 of Appendix 2.9-A of the TR, the applicant discusses outliers in the gamma-ray count rate data. Please provide the following information:

TR RAI-2.9-31(a)

a. Discuss how these outliers were treated in the statistical analysis of gamma ray count rates.

Response TR RAI-2.9-31(a)

The outliers in the GPS gamma data were treated like the other GPS gamma data in the statistical analysis. The outliers were not rejected or otherwise discounted.

TR RAI-2.9-31(b)

In Section 2.9.2.2.1 of the TR and Section 3.2 of Appendix 2.9-A of the TR, the applicant discusses outliers in the gamma-ray count rate data. Please provide the following information:

b. If outliers were rejected from the final data set, please describe any investigations performed by the applicant to determine the cause of the outlying observations. Specifically, the applicant should demonstrate that the outlying data is either an extreme manifestation of the random variability inherent in the data or that it is the result of gross deviation from prescribed experimental procedure or error in calculating or recording the numerical value (ASTM 2002).

Response TR RAI-2.9-31(b)

None of the outliers were rejected from the final data set.

TR RAI-2.9-32

Please provide the following information related to the predicted site-wide exposure rates discussed in Section 2.9.2.2.2 of the TR:

Response TR RAI-2.9-32 (TR Section 2.9.2.2.2)

General: TR Figure 2.9-6 (Predicted Site-Wide Exposure Rates, Grid Block Averages) is intended for informational purposes only, to qualitatively evaluate the relative spatial distribution of exposure rates across the permit area.

TR RAI-2.9-32(a)

Please provide the following information related to the predicted site-wide exposure rates discussed in Section 2.9.2.2.2 of the TR:

a. Input parameters to, and results obtained from, ArcView GIS.

Response TR RAI-2.9-32(a) (TR Section 2.9.2.2.2)

The input parameters to ArcView GIS are gross gamma-ray count rates, in counts per minute (cpm), measured using matched sodium iodide detectors and recorded during the GPS-based survey. The results obtained from ArcView GIS are the predicted exposure rates, in μR/hr, calculated by using the equation given in Section 2.9.2.2.2, (*Exposure Rate = 0.0007 x Gamma Count Rate + 2.02).* Using a minimum count rate cutoff of 5500 cpm and the maximum observed gamma count rate of 460,485 cpm, the minimum and maximum exposure rates of 5.9 to 324 μR/hr were calculated.

TR RAI-2.9-32(b)

Please provide the following information related to the predicted site-wide exposure rates discussed in Section 2.9.2.2.2 of the TR:

- ***b. A description of the ArcView GIS interpolation scheme used, including the parameters to control how the scheme is applied.***

Response TR RAI-2.9-32(b) (TR Section 2.9.2.2.2)

No interpolation of the data was performed. The grid block exposure rates presented in Figure 2.9-6 reflect the average of all predicted exposure rates, as calculated from the gross gamma-ray count rates that fall spatially within each 700- by 700-foot grid block boundary. In one aspect, this figure is unintentionally misleading. With a large gamma survey spacing throughout most of the site, approximately 40 percent of the grid blocks have no gamma readings from which to calculate an exposure rate. The GIS analysis of these grid blocks interpreted no gamma-ray count rates as a zero value instead of a null value. With a zero value used in the figure a dark green colored grid block (less than 12 μR/hr) was displayed, though this was not the intent.

TR RAI-2.9-32(c)

Please provide the following information related to the predicted site-wide exposure rates discussed in Section 2.9.2.2.2 of the TR:

c. ***Error estimates of the data presented in Figure 2.9-6, Predicted Site-Wide Exposure Rates, Grid Block Averages, in the TR.***

Response TR RAI-2.9-32(c) (TR Section 2.9.2.2.2)

Please refer to TR Appendix 2.9-A, Sections 3 and 9, including Tables 3-1 and 3-2.

TR RAI-2.9-33

Regulatory Guide 4.14 recommends an LLD of 2E-7 µCi/g for Pb-210 in soil. However, in Sections 2.9.3.2.1 of the TR and 4.6.2 of Appendix 2.9-A of the TR, the applicant reported that the LLD for Pb-210 in the LAN (land application area north (Dewey)) and LAS (land application south (Burdock)) soil samples ranged from 1.9E-6 to 3.8E-6 µCi/g. The applicant also reported that all values were below their LLDs. The applicant recognized that guidance was not followed but did not provide a justification for the different LLDs. Please demonstrate that the reported data is consistent with Regulatory Guide 4.14 or justification for a higher LLD for Pb-210 in soil.

Response TR RAI-2.9-33 (Sections 2.9.3.2.1 of the TR and 4.6.2 of Appendix 2.9-A)

The LLDs were 1.9E-6 to 3.8E-6 µCi/g, but only for the land application samples. The LLD for lead-210 in the bulk of the data set, i.e., in samples collected from the Main Permit, Northeast, Roll Front and Surface Mine Areas was 1E-7 µCi/g. The Land Application sample results were not used in the statistical analysis of the permit area surface soils, as reflected in our response to RAI TR-2.9-35 (Items 92-94).

There 80 sample locations for which all the recommended LLDs in RG 4.14 are met for Pb-210.

In the Land Application Area, radium-226 will be the most sensitive radionuclide by which to assess operational impacts to surface soils. Regardless, future operational surface soil data will be collected with appropriate LLDs.

TR RAI-2.9-34

Regarding soil sample collection, the applicant stated in Section 2.9.3.1.1 of the TR that NUREG-1569 suggests the collection of samples at 0 to 15 cm. The applicant recognized the 0 to 5 cm collection depth specified in Regulatory Guide 4.14 and chose to collect surface soil samples at 0 to15 cm. However, NUREG-1569 (Acceptance Criterion 2.9.3(2)) recommends that soil sampling be conducted at both a 5-cm (2-inch) depth as described in Regulatory Guide 4.14 and 15-cm (6-inch) for background decommissioning data. Please provide data that is consistent with Regulatory Guide 4.14 and NUREG-1569 or justification for an alternate methodology.

Response TR RAI-2.9-34 (TR Section 2.9.3.1.1)

Section 2.9.3.1.1 describes our general soil sampling strategy at the Dewey Burdock site. Section 2.9.3.1.1 does not clearly identify that soil samples from a 0-5 cm depth were also collected at the AMS (Air Monitoring Station) locations. These samples were analyzed for natural uranium, thorium-230, radium-226, and lead-210. These parameters and locations are consistent with the guidance contained in RG 4.14. The data from these soil samples are provided in Table 2.9-5 of the TR.

Powertech (USA) chose to collect more samples from 0-15 cm because this is the depth at which the background radium-226 soil concentration in the cleanup standards contained in 10 CFR 40, Appendix A are defined. There are no comparable soil cleanup standards for a soil depth of 0 to 5 cm. Therefore, Powertech (USA) chose to focus the soil sampling effort on a soil depth that is applicable to a standard.

We recognize that the 0 to 5 cm soil depth is more sensitive to potential particulate depositional events resulting from facility operations. Considering this, the 0 to 5 cm soil samples were co-located with the air monitoring station locations, which were placed in areas most sensitive to airborne emissions from the facility. This is consistent with RG 4.14 recommendations. In addition, these locations will be included in the operational soil monitoring program.

The total number of surface soil sample locations (87: 80 to 15 cm and 7 to 5 cm) at Dewey-Burdock is consistent with that suggested by NUREG-1569 and RG 4.14.

TR RAI-2.9-35

Regarding the Ra-226 soil sampling results, please provide the following information:

TR RAI-2.9-35(a)

a. **Documentation for all statistical analyses (histograms, data transformations, calculated p-values, etc.) performed on the Ra-226 soil sampling results, including outputs from statistical software packages, or indicate where these can be found in the application.**

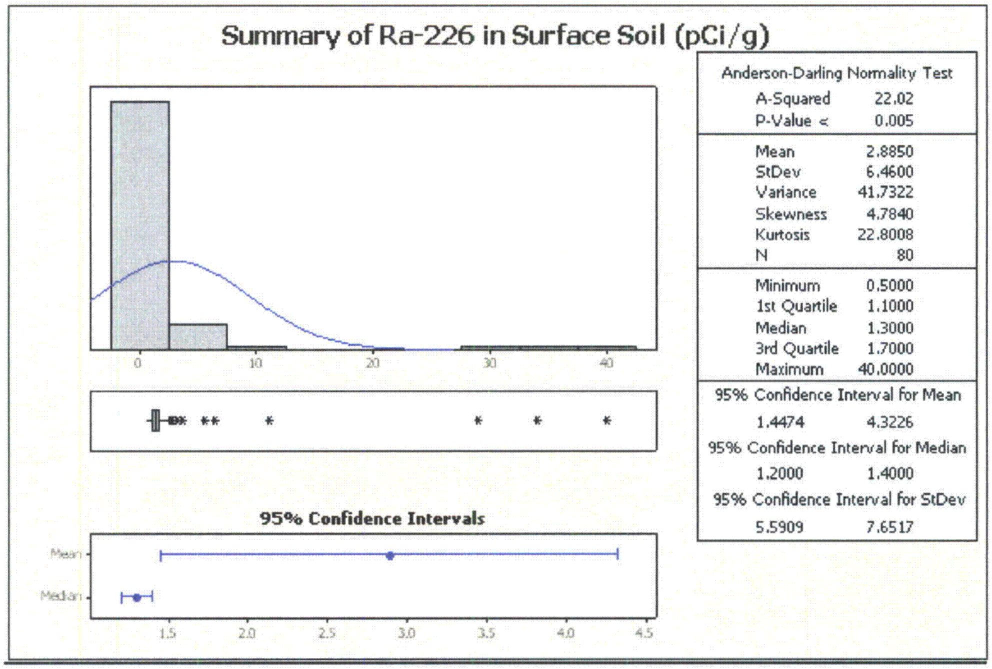
Response TR RAI-2.9-35(a) (TR Section 2.9.3.2)

The Ra-226 soil sampling results were analyzed with the statistical software package Minitab, version 15.1.1.0.

First Set of 80 Locations

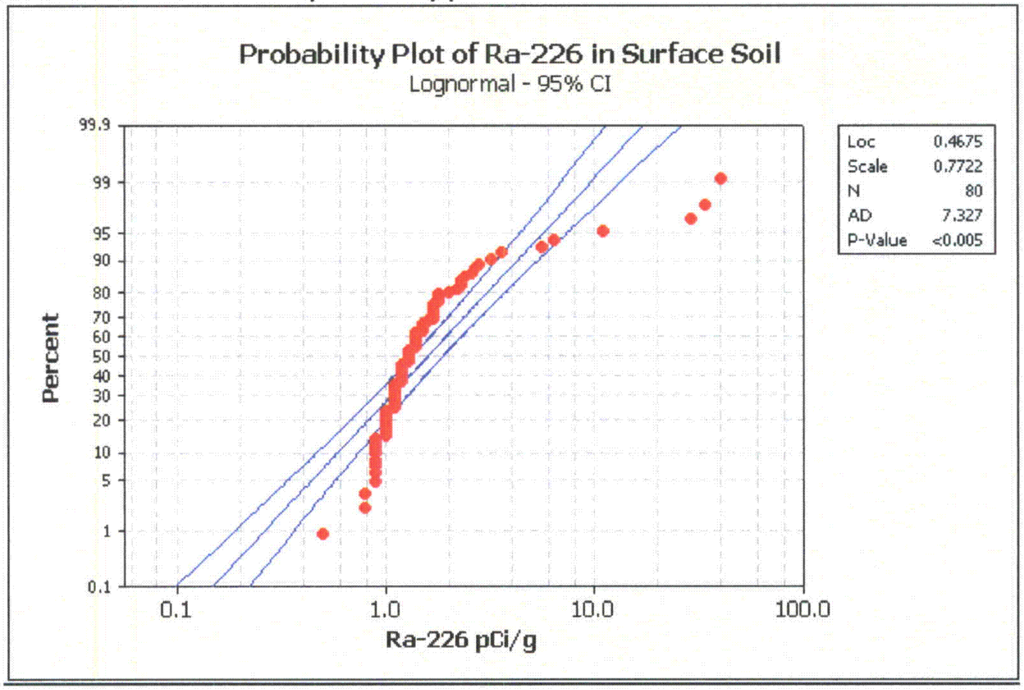
The Ra-226 soil sampling results from the first set of 80 locations were tested for a normal distribution. **TR_RAI- Figure 2.9-35(1)** displays the results of the test as well as a histogram of the data and its statistical summary.

TR_RAI- Figure 2.9-35(1): Summary of statistics and normality test of Ra-226 soil sampling results in the first set of 80 locations (in cpm).



The normality test rejected the null hypothesis of a normal distribution. The data was then tested for a lognormal distribution. **TR_RAI- Figure 2.9-35(2)** shows the results of the test along with its respective probability plot.

TR_RAI- Figure 2.9-35(2): Results of the test for lognormal distribution Ra-226 soil sampling results in the first set of 80 locations and its probability plot.

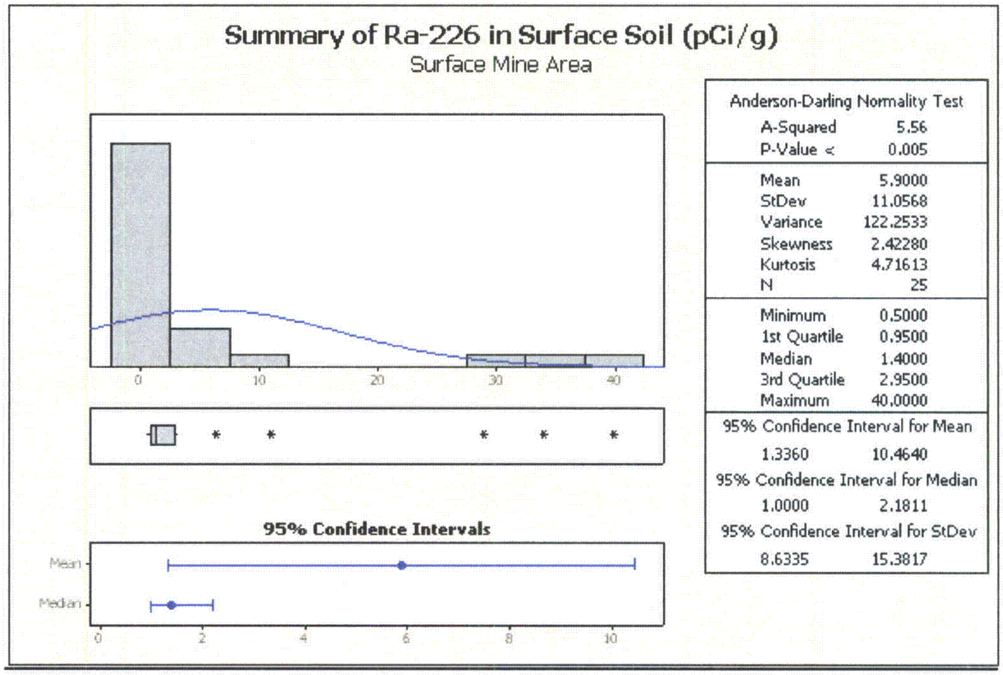


The test rejected the null hypothesis of a lognormal distribution.

Surface Mine Area

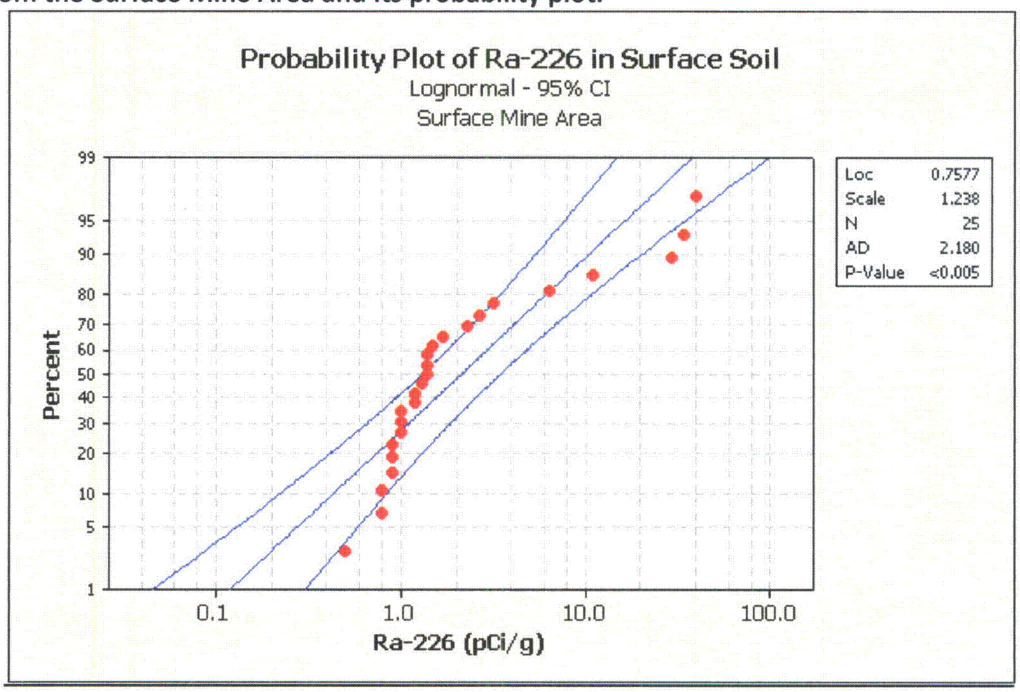
The Ra-226 soil sampling results from the Surface Mine Area were tested for normal and lognormal distributions. **TR_RAI- Figure 2.9-35(3)** displays the results of the normality test as well as a histogram of the data and its statistical summary.

TR_RAI- Figure 2.9-35(3): Summary of statistics and normality test of the Ra-226 soil sampling results from the Surface Mine Area.



The normality test rejected the null hypothesis of a normal distribution. The data was then tested for a lognormal distribution. **TR_RAI- Figure 2.9-35(4)** shows the results of the test for a lognormal distribution along with its probability plot.

TR_RAI- Figure 2.9-35(4): Results of the test for lognormal distribution of the Ra-226 soil sampling results from the Surface Mine Area and its probability plot.

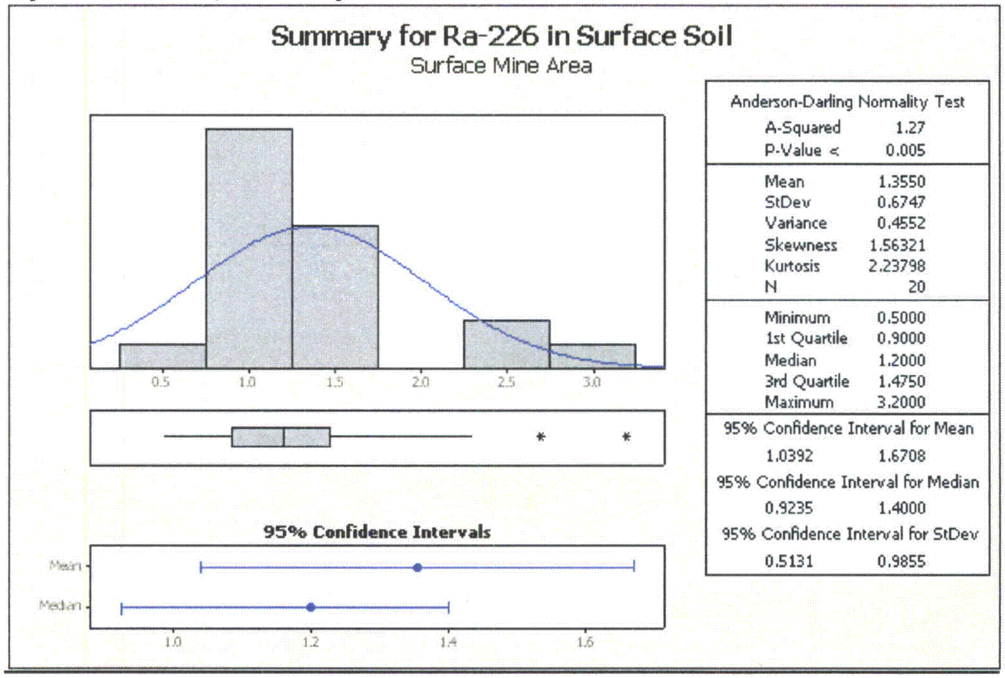


The test rejected the null hypothesis of a lognormal distribution.

The box plot in Figure 3 shows five potential outliers (defined with *). The box plot marks any data beyond the range (Q1 – 1.5*IQR, Q3 + 1.5*IQR) as potential outliers. The five potential outlier sample locations were biased, based on an evaluation of the gamma survey results, and intended to capture the upper limit of radium-226 soil concentrations.

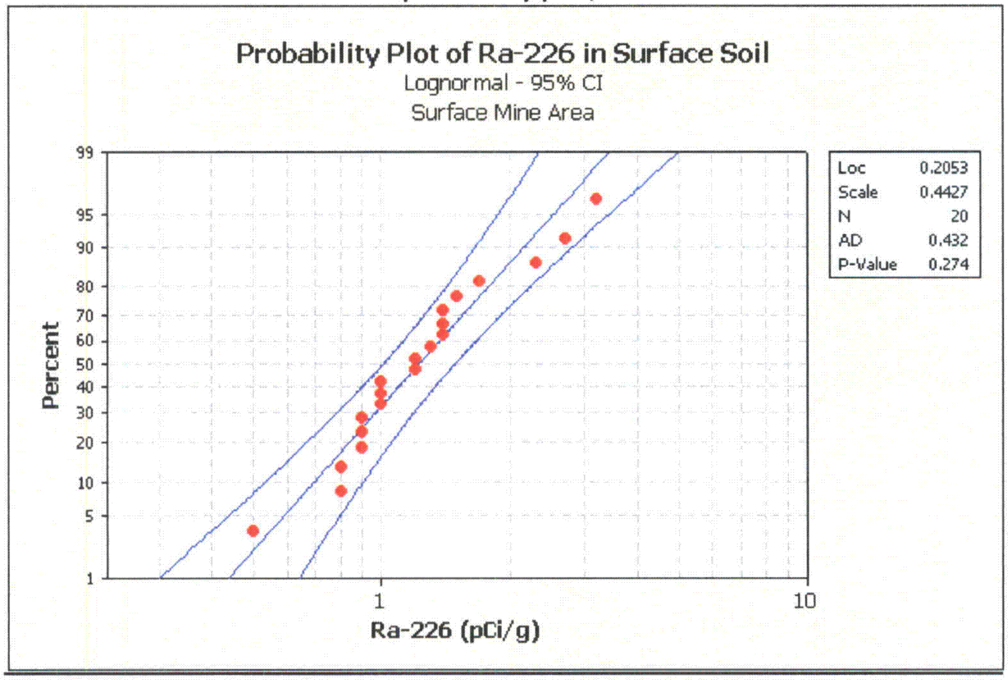
The test for a normal distribution was repeated with the outliers removed from the data. **TR_RAI- Figure 2.9-35(5)** displays the results of the test as well as a histogram of the data and its statistical summary.

TR_RAI- Figure 2.9-35(5): ***Summary of statistics and normality test of the Ra-226 soil sampling results from the Surface Mine Area, with the five outliers removed.***



The test rejected the null hypothesis of a normal distribution. The data was then tested for a lognormal distribution. **TR_RAI- Figure 2.9-35(6)** shows the results of the test for a lognormal distribution along with its probability plot.

TR_RAI- Figure 2.9-35(6): Results of the test for lognormal distribution of the Ra-226 soil sampling results from the Surface Mine Area and its probability plot, with the five outliers removed.

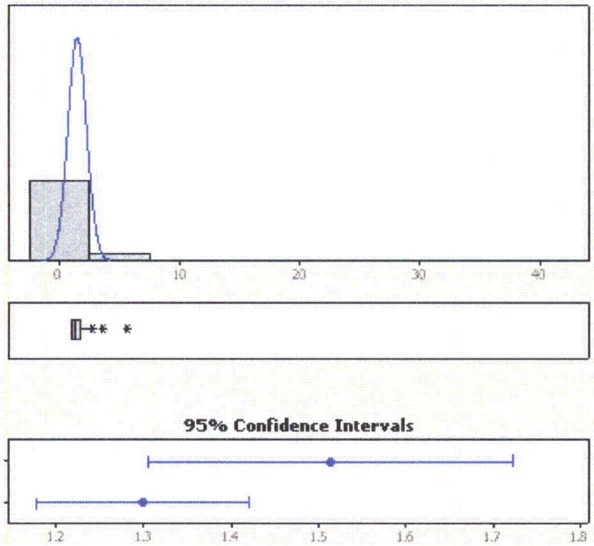


The test failed to reject the null hypothesis of a lognormal distribution, indicating that the data is adequately described by a lognormal distribution.

Main Permit Area

The Ra-226 soil sampling results from the Main Permit Area were tested for normal and lognormal distributions. **TR_RAI- Figure 2.9-35(7)** displays the results of the normality test as well as a histogram of the data and its statistical summary.

TR_RAI- Figure 2.9-35(7): Summary of statistics and normality test of the Ra-226 soil sampling results from the Main Permit Area.

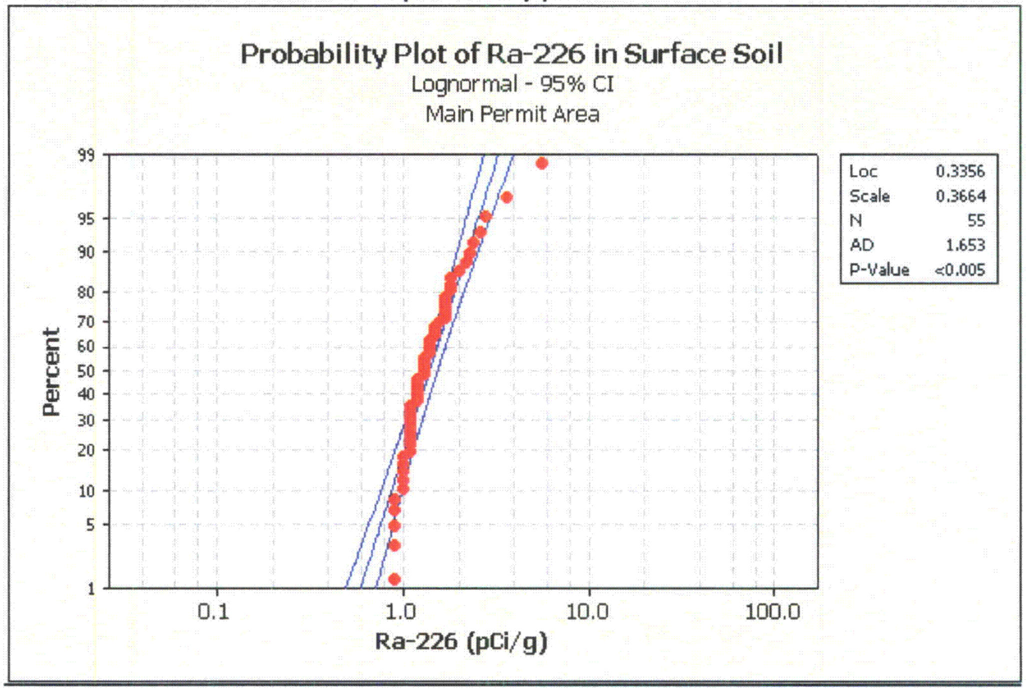


Anderson-Darling Normality Test		
A-Squared	4.77	
P-Value <	0.005	
Mean	1.5145	
StDev	0.7723	
Variance	0.5965	
Skewness	3.3202	
Kurtosis	14.5309	
N	55	
Minimum	0.9000	
1st Quartile	1.1000	
Median	1.3000	
3rd Quartile	1.7000	
Maximum	5.6000	
95% Confidence Interval for Mean		
	1.3058	1.7233
95% Confidence Interval for Median		
	1.1786	1.4214
95% Confidence Interval for StDev		
	0.6502	0.9514

The normality test rejected the null hypothesis of a normal distribution. The data was then tested for a lognormal distribution. **TR_RAI- Figure 2.9-35(8)** shows the results of the test for a lognormal distribution along with its probability plot.

Powertech (USA) Inc.

TR_RAI- Figure 2.9-35(8): **Results of the test for lognormal distribution of the Ra-226 soil sampling results from the Main Permit Area and its probability plot.**

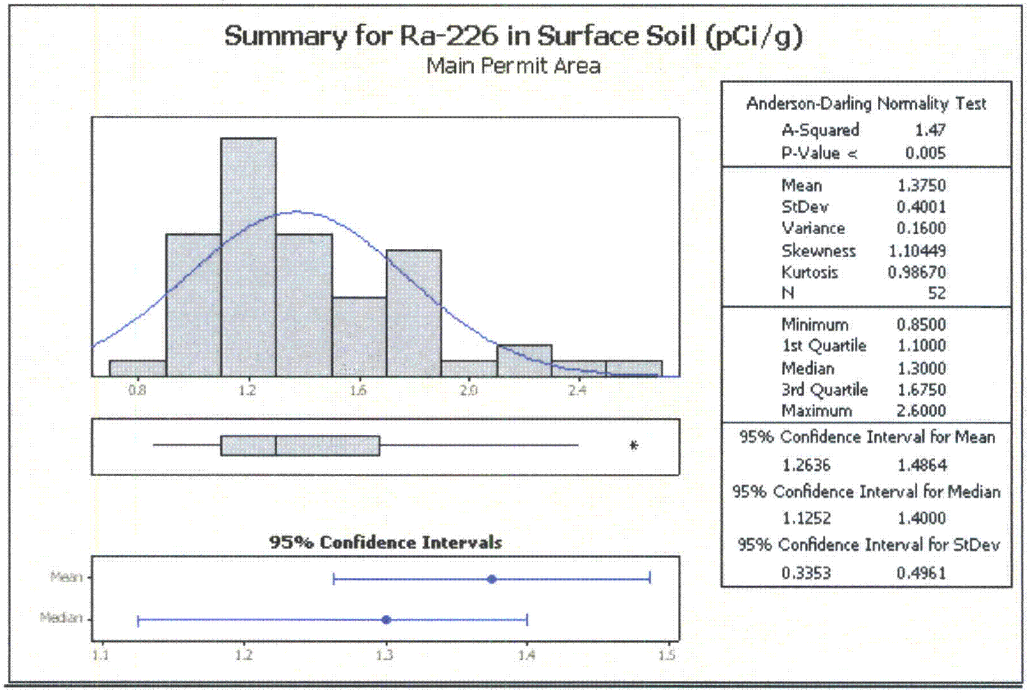


The test rejected the null hypothesis of a lognormal distribution.

The box plot in Figure 7 shows three potential outliers (defined with *). The box plot marks any data beyond the range (Q1 – 1.5*IQR, Q3 + 1.5*IQR) as potential outliers. No errors were found associated with these potential outliers. The three potential outliers make up about five percent of the entire data set, therefore it was determined that their relatively high values were due to random measurement variability.

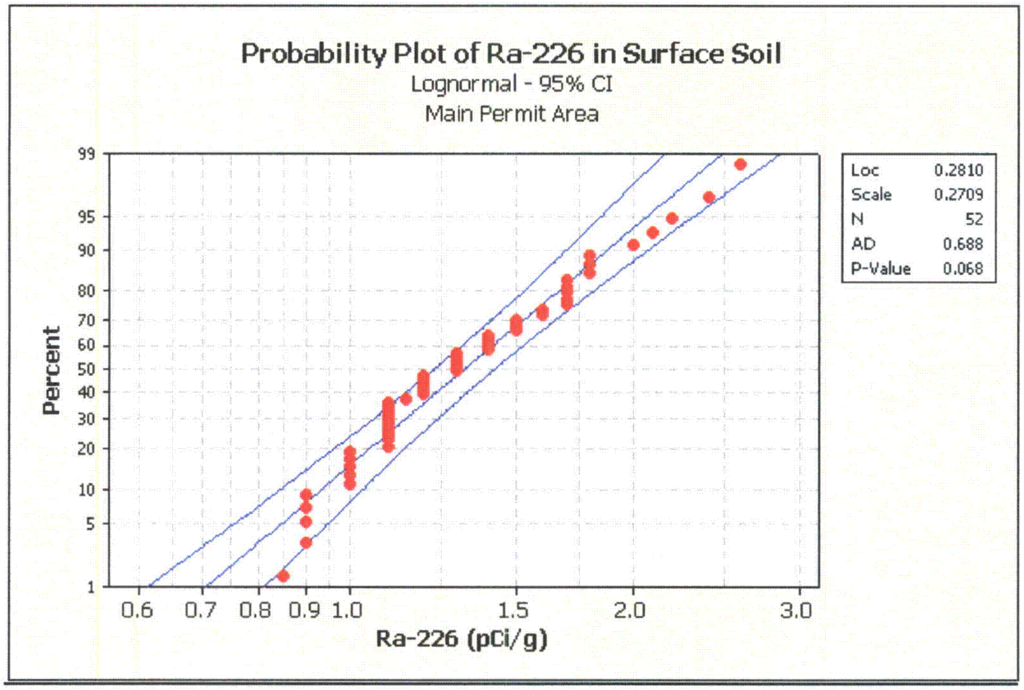
The test for a normal distribution was repeated with the outliers removed from the data. **TR_RAI- Figure 2.9-35(9)** displays the results of the test as well as a histogram of the data and its statistical summary.

TR_RAI- Figure 2.9-35(9): Summary of statistics and normality test of the Ra-226 soil sampling results from the Main Permit Area, with the three outliers removed.



The test rejected the null hypothesis of a normal distribution. The data was then tested for a lognormal distribution. **TR_RAI- Figure 2.9-35(10)** shows the results of the test for a lognormal distribution along with its probability plot.

TR_RAI- Figure 2.9-35(10): Results of the test for lognormal distribution of the Ra-226 soil sampling results from the Surface Mine Area and its probability plot, with the three outliers removed.



The test failed to reject the null hypothesis of a lognormal distribution, indicating that the data is adequately described by a lognormal distribution.

North Section of Main Permit Area and Land Application Areas

The Ra-226 soil sampling results from the north section of the Main Permit Area and the land application areas were not analyzed statistically.

TR RAI-2.9-35(b)

Regarding the Ra-226 soil sampling results, please provide the following information:

b. **Justification for utilizing the IQR as the sole means of proving outliers. See related RAI regarding Direct Radiation given above for further explanation.**

Response TR RAI-2.9-35(b)

Several tools were used, prior to the decision to use IQRs to evaluate outliers, including histograms, distribution tests, and probability plots. The set of the data from the Main Permit Area was initially found to be non-parametric. The IQR was used to help identify any potential outliers non-parametrically. The potential outliers found with the IQR test were not due to analytical errors and because of their small proportion of the data set (5%); they were considered outliers due to random measurement variability.

TR RAI-2.9-35(c)

Regarding the Ra-226 soil sampling results, please provide the following information:

c. **For outliers that were rejected from the final data set; please describe any investigations performed by the applicant to determine the cause of the outlying observations. Specifically, the applicant should demonstrate that the outlying data is either an extreme manifestation of the random variability inherent in the data, or that it is the result of gross deviation from prescribed experimental procedure or error in calculating or recording the numerical value (ASTM 2002).**

Response TR RAI-2.9-35(c)

The outliers in the data from the Surface Mine Area were biased samples, as described above.

Outliers in the data obtained in the Main Permit Area were due to random measurement variability, because they constituted a small portion of the data set (5%) and no analytical errors were associated with them.

TR RAI-2.9-36

Regarding the soil sampling strategy described in section 2.9.3.1.1 of the TR, please provide input parameters to, and results obtained from, Visual Sampling Plan.

Response TR RAI-2.9-36 (TR Section 2.9.3.1.1)

Visual Sampling Plan (VSP) was used to establish random sampling points. The input parameters were the shape files of the proposed permit boundary, Surface Mine and Land Application Areas; and the proposed number of samples for each area. The output of VSP was the coordinates for the samples.

TR RAI-2.9-37

The following questions pertain to the analytical methods described in 2.9.3.1.1 of the TR:

TR RAI-2.9-37(a)

a. ***Consistent with Regulatory Guide 4.14, please provide the references for procedures used to convert the soil samples to a water matrix in order for the Environmental Protection Agency (EPA) drinking water testing methods to be used.***

Response TR RAI-2.9-37(a) (TR Section 2.9.3.1.1)

EPA Method 3050B "Acid Digestion of Sediments, Sludges, and Soils" was used "convert" the soil into an aqueous matrix (EPA, 1996). This procedure is provided in **Appendix TR_ 2.9-37** and listed in the references at the end of this section.

TR RAI-2.9-37(b)

The following questions pertain to the analytical methods described in 2.9.3.1.1 of the TR:

b. ***NRC staff cannot verify that analytical method 909.0M is included in the EPA document Prescribed Procedures for Measurement of Radioactivity in Drinking Water (EPA-600/4-80-032), 1980. Consistent with Regulatory Guide 4.14, please indicate where this analytical method can be found in the EPA document and a justification for its use.***

Response TR RAI-2.9-37(b) (TR Section 2.9.3.1.1)

EPA Method 909 "Determination of Lead-210 in Drinking Water" has been provided in **Appendix TR_ 2.9-37** (EPA, 1982). As in EPA Method 6020A, EPA Method 3050B was used to "convert" from soil to aqueous matrix.

TR RAI-2.9-37(c)

The following questions pertain to the analytical methods described in 2.9.3.1.1 of the TR:

c. The applicant indicates that Method 6020A of EPA Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods (SW-846) was used for analyzing natural uranium in soil samples. Section 1.2 of Method 6020A of SW-846 does not specifically list uranium as an acceptable analyte for inductively coupled plasma-mass spectrometry (ICP-MS). Consistent with Regulatory Guide 4.14, please provide the demonstration of performance discussed in Section 1.3 of Method 6020A of SW-846 as it applies to uranium in the matrix evaluated.

Response TR RAI-2.9-37(c) (TR Section 2.9.3.1.1)

A laboratory performance evaluation for uranium in a soil matrix using EPA Method 6020A has been provided in **Appendix TR_ 2.9-37.**

TR RAI-2.9-37(d)

The following questions pertain to the analytical methods described in 2.9.3.1.1 of the TR:

d. ***Laboratory analytical reports for Ra-226 soil sample analyses are located in Appendix 2.9-A of the TR. It is not clear what type of gamma analysis was performed on the soil samples to determine the Ra-226 concentration. For example, the testing method for sample R07100004-003 (SMA-B03) is annotated as "Gross Gamma" on the Analytical Summary Report, but the results are listed as "Ra-226 Gamma" on the Laboratory Analytical Report. Consistent with Regulatory Guide 4.14, please provide laboratory documentation that specifies the photopeak energies used to determine the Ra-226 activity of the soil samples as reported in the Laboratory Analytical Report.***

Response TR RAI-2.9-37(d) (TR Appendix 2.9-A)

Type of gamma analysis performed on the soil samples to determine the Ra-226 concentration was closed can gamma analysis per a three inch can filled with ~ 150-200 grams of soil. The soil is dried, ground, split, canned and taped (EPA Method 901.1).

The results are listed as radium 226 gamma which is ascertained by measuring the 609 kev peak of bismuth 214. Far and away the best photo peak to use since its branching ratio (relative strength) is higher than any other pertinent energies. The radium 226 photo peak cannot be used due to its overlap with the uranium 235 photo peak. Lead 214 has two quantifiable energies at 295 and 352 kev that are used by some, but bismuth 214 is cleaner with less background issues relating to Compton scatter.

Relevant laboratory documentation is provided in **Appendix TR_ 2.9-37.**

TR RAI-2.9-38

The following questions pertain to deriving the gamma-ray count rate-soil Ra-226 correlation:

TR RAI-2.9-38(a)

a. ***Considering the variations in expected gamma dose rates during different times of the year, please explain how combining gamma surveys performed at different times during the year affect the statistics for deriving the gamma ray count rate-soil Ra-226 correlation and the predicted Ra-226 concentrations over the permit area.***

Response TR RAI-2.9-38(a) (TR Section 2.9.2.2.3)

It is well known that high soil moisture and snow cover are the two most influential factors that contribute to reducing the exposure rate from radionuclides in the soil.

The use of a correlation to predict the Ra-226 in soil requires that all data, including the gamma survey and correlation data, be collected under similar soil moisture conditions. All data were gathered in fair weather during the late summers of 2007 and 2008 under similar soil moisture conditions.

TR RAI-2.9-38(b)

The following questions pertain to deriving the gamma-ray count rate-soil Ra-226 correlation:

b. In Section 2.9.2.2.3, the applicant stated that the linear regression formula for the gamma-ray count rate-soil Ra-226 correlation, after removing five outliers, is Radium-226 = 1.9*10-4 x Gamma-Ray Count Rate – 1.04, where the radium-226 concentration is in pCi/g and the gamma-ray count rate is in gross cpm. The applicant also stated in Section 5 of Appendix 2.9-A of the TR that this model has an R2 (coefficient of determination) value of 0.43, denoting a poor fit. NRC staff agrees with this assessment. In addition, work done by the authors previously cited by the applicant (Ott and Longnecker 2001) indicate that, based on this model, the gamma count rate is not a good indicator of Ra-226 concentration in soil. Please provide justification for utilizing a regression model that exhibits such a "poor fit" to predict Ra-226 concentrations in the Permit area.

Response TR RAI-2.9-38(b)(TR Appendix 2.9-A)

The presentation was unfortunately misleading in that an R^2 should not have been presented since the data were not randomly selected over the concentration range, a basic requirement for the R^2 value to be meaningful. That being said, Figure 5-2 of Appendix 2.9-A of the TR clearly shows that within the range of concentrations that include natural background, the data support the least-squares-fit line although there is significant scatter. In determining the *average* Ra-226 concentration, we believe that the Central Limit Theorem applies in that while each data point will have a significant error associated with it, the mean concentration in an area, as determined by averaging many values, will have a much greater accuracy.

The uranium industry decommissioning programs have relied on gamma-ray count rate/Ra-226 correlations for several decades to identify Ra-226 contaminated soils requiring removal. High density gamma surveys are used along with the correlation to define contaminated areas exceeding cleanup criteria. Again, it is the Central Limit Theorem that allows a correlation with high scatter to be used to accurately characterize the average contamination in a land parcel. We therefore do not agree with the cited author that concluded that the gamma count rate is not a good indicator of Ra-226 concentration in soil.

TR RAI-2.9-39

The following questions pertain to the gamma/Ra-226 correlation grids discussed in Section 2.9.2.1.3 of the TR:

a. ***Please provide input parameters and results obtained from Arc View GIS.***

b. ***Please provide a description of the Arc View GIS interpolation scheme used, including the parameters to control how the scheme is applied.***

Response TR RAI-2.9-39(a) and (b) (TR Section 2.9.2.1.3)

Please refer to our response to TR 2.9-32 (a) and (b) above. The gamma/Ra-226 correlation grids were developed using the same methods therein.

TR RAI-2.9-39(c)

The following questions pertain to the gamma/Ra-226 correlation grids discussed in Section 2.9.2.1.3 of the TR:

c. ***Please provide error estimates of the data presented in Figure 2.9-7, Predicted Site-Wide Radium-226 Concentrations, Grid Block Averages, in the TR. In the response, include a discussion of the various sources of error (e.g., seasonal variability in gamma dose rates, using a regression model with an R2 (coefficient of determination) value of 0.43, etc.)***

Response TR RAI-2.9-39(c) (TR Section 2.9.2.1.3)

Regarding error estimates for the data presented in Figure 2.9-7, please refer to our response to TR 2.9-32 (c), and TR-2.9-38 b.

<u>*TR RAI-2.9-40*</u>

In Section 2.9.3 of the TR, the applicant describes its soil sampling program. Figures 2.9-9 and 2.9-10 of the TR provide sampling locations from the Main Permit Area and land application areas respectively. Table 2.9-5 of the TR provides radionuclide concentrations for all soil samples. Comparing the aforementioned soil sampling data with Supplemental Exhibit 3.1-2, Proposed Facilities and Well Fields Land Application Option, NRC staff has the following questions to understand site-wide radiological variations in areas expected to be impacted by operations and evaluating compliance with 10 CFR 40, Appendix A, Criterion 7.

a. Please demonstrate that a sufficient number of samples have been obtained in the Dewey area. It appears that very few radium samples have been obtained in the proposed area of the satellite processing plant and well field that could be impacted by operations. It also appears that no uranium or Th-230 samples were obtained in areas that could be impacted by operations.

b. Please demonstrate that a sufficient number of samples have been obtained in the Burdock area. While the applicant took more total samples in this area, it is not clear how many are in the area expected to be impacted by the central processing plant and the well field. In addition, it appears that very few uranium and Th-230 samples were obtained in these areas.

<u>Response TR RAI-2.9-40(a) and (b)</u>

RG 4.14 recommends collecting soil samples at 0 to 5 cm on 300-meter intervals in each of eight compass directions from the center of the milling area. In the case of the Powertech (USA) permit area, the recommendation results in 40 provisional sample locations. NUREG 1569 suggests soil samples be collected from 0 to 15 cm, assuming the same spatial distribution recommended in RG 4.14 results in an additional 40, totaling 80 sample locations. We have collected surface soil samples at 80 locations and supplemented the effort with the GPS-based gamma survey and correlation between radium-226 concentrations and gamma count rates. In addition, 18 samples were collected to further describe radionuclide concentrations in the Land Application Areas. We have met the intent, based on numbers of soil sample locations, described in RG 4.14 and NUREG 1569.

NUREG/CR-5849, *Manual for Conducting Radiological Surveys in Support of License Termination* (NRC, 1992) describes a method to determine an adequate sample size (N), where *t* is the t-statistic, *r* is the relative fractional error, and *cv* is the coefficient of variation.

$$N > \left(\frac{t}{r}cv\right)^2$$

A 95% confidence level with the degrees of freedom approaching infinity yields a t statistic of 1.645. **Figure TR_RAI-2.9-40(1)** shows the plot of this equation for a relative fraction error of 10 and 20 percent for various values of coefficients of variation.

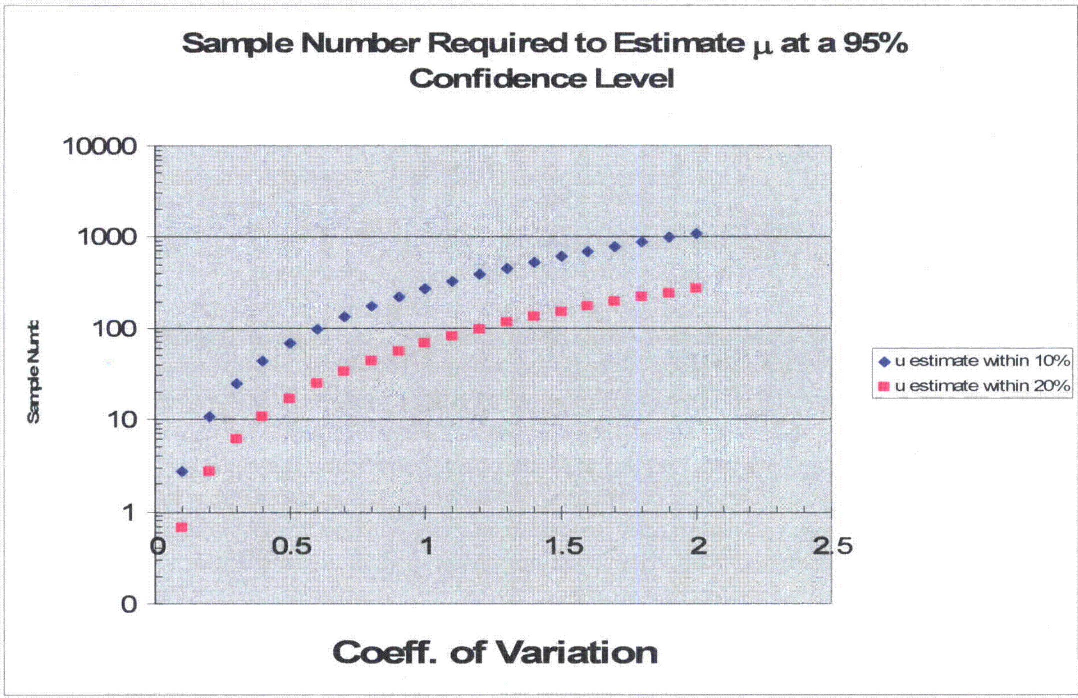
The mean and standard deviation of the radium-226 concentrations in the 55 samples collected in the Main Permit Area are 1.51 and 0.77 pCi/g, respectively. The coefficient of variation for the samples is

0.77/1.51=0.5. Inspection of the plot in Figure 1 indicates that about 20 and 70 samples are sufficient for collection for relative fraction errors of 10 and 20 percent, respectively. The collection of 55 samples is acceptably within this range. Therefore, we have adequately described the radium-226 concentration in the entire permit area.

The frequency at which the other radionuclides (thorium-230, lead-210, and natural uranium) were analyzed is consistent with the recommendations of RG 4.14.

Eighteen surface soil samples were collected in the Dewey and Burdock Land Application Areas, as shown in Figure 2.9-10 of the TR. All of these samples were analyzed for the radium-226, thorium-230, lead-210, and natural uranium.

TR_RAI- Figure 2.9-40(1): Plot of the equation used to determine an adequate sample size



TR RAI-2.9-40(c)

In Section 2.9.3 of the TR, the applicant describes its soil sampling program. Figures 2.9-9 and 2.9-10 of the TR provide sampling locations from the Main Permit Area and land application areas respectively. Table 2.9-5 of the TR provides radionuclide concentrations for all soil samples. Comparing the aforementioned soil sampling data with Supplemental Exhibit 3.1-2, Proposed Facilities and Well Fields Land Application Option, NRC staff has the following questions to understand site-wide radiological variations in areas expected to be impacted by operations and evaluating compliance with 10 CFR 40, Appendix A, Criterion 7.

c. ***There appears to be no soil sampling data for the area between Dewey and Burdock. Please demonstrate that sufficient information has been obtained on the background soil levels to characterize expected transportation routes between these areas.***

Response TR RAI-2.9-40(c)

Please refer to our response to TR-2.9-40 (a) and (b) above. The area between Dewey and Burdock, including the county road, has been sufficiently characterized by way of GPS-based gamma surveys and correlation between gamma count rates and radium-226 concentrations in soil.

TR RAI-RC-2.9-41

NRC Staff notes that in section 2.9.4.3 (page 2-349) the applicant refers to PSC02 as the downstream location of Pass Creek. This is not consistent with Table 2.7-20 (pg2-185) that refers to PSC02 as the upstream location of Pass Creek. Please address this inconsistency.

Response TR RAI-2.9-41 (TR Section 2.9.4.3)

PSC02 is considered the upstream site on Pass Creek; site PSC01 is downstream. Table 2.7-20 and Plate 2.5-1 are correct. The text in Sec 2.9.4.3 is corrected below:

"Radionuclide concentrations in sediment at downstream locations of Pass Creek (PSC01) and Cheyenne River (CHR05) are elevated compared to upstream locations for the same surface water bodies indicating potential impacts from mineralized areas on and adjacent to the site."

TR RAI-2.9-42

The staff could not locate laboratory reports for sediment samples. Please provide these reports or specify where these can be found in the application.

Response TR RAI-2.9-42

Laboratory reports are submitted within this package as TR_RAI 2.9-42 Laboratory Results (sediment) on a separate divider tab.

TR RAI-2.9-43

10 CFR 40, Appendix A, Criterion 7, requires a preoperational monitoring program to provide complete baseline data on a milling site and its environs. RG 4.14 provides guidance on surface water sampling, including impoundments and surface waters passing through the mill site. Regarding the applicant's preoperational surface water monitoring program, please address the following issues.

For these issues, the applicant should analyze all surface water features in accordance with Regulatory Guide 4.14 criteria, including offsite water features that could be impacted from operations, or provide a justification for an alternate methodology that complies with 10 CFR 40, Appendix A, Criterion 7.

TR RAI-2.9-43(a)

a. In Section 2.7.3.1 of the TR, the applicant identified 48 surface water impoundments. In Section 2.7.3.1 of the TR the applicant stated that it chose surface water sampling locations based on Regulatory Guide 4.14. However, the applicant only sampled a "representative" number of impoundments resulting in including only 11 impoundments in its preoperational surface water monitoring program as shown on Table 2.7-20 of the TR.

Response TR RAI-2.9-43(a) (TR Section 2.7.3.1)

a. See Response: to TR_RAI-2.7-18; this addresses the quantity of impoundments verified.

Due to the number of impoundments, their relatively small drainage basin, and the tendency of many to be dry after substantial rainfall, sampling a representative subset of the water impoundments was proposed. Impoundments were selected based on the presence of water, drainage area, and location. Eleven surface water impoundments were selected to construct a representative sampling group for the Dewey-Burdock Permit Area.

TR RAI-2.9-43(b)

10 CFR 40, Appendix A, Criterion 7, requires a preoperational monitoring program to provide complete baseline data on a milling site and its environs. RG 4.14 provides guidance on surface water sampling, including impoundments and surface waters passing through the mill site. Regarding the applicant's preoperational surface water monitoring program, please address the following issues.

For these issues, the applicant should analyze all surface water features in accordance with Regulatory Guide 4.14 criteria, including offsite water features that could be impacted from operations, or provide a justification for an alternate methodology that complies with 10 CFR 40, Appendix A, Criterion 7.

- ***b. It appears that the applicant also used this "representative" approach with other surface water features as well. For example, grid 14 on Plate 2.5-1 appears to have three separate drainages exiting the Permit Area, yet they were not sampled.***

Response TR RAI-2.9-43(b) (TR Section 2.7.3.1)

Referring to Plate 2.5-1 "Sampling Locations" within Sec.14, T7S, R1E there are three drainage features passing through this section. However, all three contain impoundments, i.e. SUB10 located downstream of the PAA and on the eastern most drainage feature within Section 23; SUB08 and SUB09 located within the PAA on Section 14. All three Sub impoundments were examined and the drainage features associated with these impoundments were observed as dry during each quarterly sampling event. The only drainages with reportable flow were Pass Creek, Beaver Creek and Cheyenne River during the baseline data collection period.

As many of the drainages and impoundments were dry during the baseline data collection period, Powertech (USA) commits to sampling such surface water features following a measureable precipitation event and prior to operations.

TR RAI-2.9-44

The NRC staff could not locate BVC04, CHR05, and BEN01 on Plate 2.5-1 of the TR as stated by the applicant, but they are listed in Table 2.7-20. Please provide the locations of the above monitoring stations on Plate 2.5-1 of the TR or correct the text to incorporate the correct reference.

Response TR RAI-2.9-44 (TR Figure 2.9-11)

Locations for surface water sampling stations BVC04, CHR05 and BEN01 are located in the TR on Figure 2.9-11.

TR RAI-2.9-45

The staff could not locate PSCO1 on Plate 2.5-1 of the TR. However there is a PS-1 sampling location. Please verify whether these two monitoring stations are the same or not.

Response TR RAI-2.9-45 (TR Section 2.7.3.1)

These sites are not the same sites. Site PSC01 is a surface water quality sampling site for the Dewey-Burdock baseline study and is located in Sec. 3, T7S, R1E. Site PS-1 is a site that was used in the Cheyenne River TMDL project and is located in Sec. 9, T7S, R1E. This site and other similar sites do not pertain to this project and should not have been included on the sampling map. Plate 2.5-1 was submitted to the NRC as "Plate 2.5-1 Revised" in TR RAI Response Dec 2010.

TR RAI-2.9-46

Regulatory Guide 4.14 recommends sampling at the site boundary or at a location immediately downstream of the area of potential influence. BVC01 (Beaver Creek downstream) and UNT01 (Unnamed Tributary) do not appear to comport with this recommendation. Please demonstrate that these sampling sites are consistent with Regulatory Guide 4.14.

Response TR RAI-2.9-46 (TR Section 2.7.3.1)

Several considerations went into developing the water quality sampling program for baseline characterization; some factors that went into the decisions for example consisted of the following:

- Water bodies of concern
- Location accessibility
- Changes in water source (i.e., the convergence of two or more creeks, the effects of Sub impoundments)
- Seasonal conditions of flow

The BVC01 site location, while it is not located at the site boundary as recommended in Regulatory Guide 4.14, does best characterize the water quality directly below the site where the Pass Creek/Beaver Creek confluence is located. Beaver Creek is perennial with ephemeral tributaries present and therefore just below the confluence with Pass Creek served best for obtaining a representative water quality sample that may be indicative of the highest concentrations of potential pollutants that may be present in runoff from the site at any given time.

The UNT01 location was chosen as the most suitable location due to drainage formation and accessibility for purposes of installing a passive sampler. One flow event was captured on the night of a flood event recorded on July 18, 2008.

Surface water sampling locations were selected based on site-specific considerations in coordination with guidance from RG 4.14, therefore sampling efforts were conducted to obtain the most complete and representative baseline data as described in 10 CFR 40 and consistent with RG 4.14.

TR RAI-2.9-47

The NRC staff did not find data for Pb-210 and Po-210 (Appendix 2.7-F) for sampling locations PSC01 and UNT01. Please provide the data or a justification of why the current data set is consistent with Regulatory Guide 4.14.

Response TR RAI-2.9-47 (TR Section 2.7.3.1)

Samples collected at both PSC01 and PSCO2 on 7/19/2007 were not analyzed for Pb-210 or Po-210. At the time, the list of constituents to be analyzed had not been finalized and did not include Pb-210 or Po-210. By September 2007 the analysis list was finalized and future samples included these constituents. Additionally, samples collected via passive samplers were also not analyzed for Pb-210, Po-210, and other constituents for the fact that the holding time had been exceeded.

TR RAI-2.9-48

The NRC staff noted missing monthly data for Ra-226, Th-230 and uranium for sampling location BVC01. Provide data for Ra-226, Th-230 and uranium for sampling location BVC01 or a justification of why the data set is consistent with RG 4.14

Response TR RAI-2.9-48 (TR Section 2.7.3.1)

Ra-226 total and U total were measured, however, Th-230 had not been added to the list of analytes at the time of the July 2007 sampling event. The August 2007 sample analysis included U suspended and U total which U dissolve can be derived from. Ra-226 total was also measured for the August 2007 sample and reported as non detectible at a RL of 0.2At that time, the list of constituents was in the process of modification between the suggested list identified in RG 4.14 and the preoperational baseline constituents identified in NUREG 1569 and for this reason did not include Th-230 as an analyte. Shortly thereafter, the analysis list was finalized and future samples included these constituents. The sample collected on November 19, 2007 is missing a value for Ra-226 (dissolved) in the TR appendix; this sample had a non-detected value of Ra-226 (dissolved) or a value of <0.2 pCi/L.

TR RAI-2.9-49

NRC staff could not locate quarterly or semiannual sample results for several of the impoundments. Examples by impoundment locations are given below.

SUB01 - missing quarterly samples for Ra-226, Th-230 and uranium, missing semiannual samples for Pb-210, Po-210.

SUB03 - missing quarterly samples for Ra-226, Th-230 and uranium.

SUB04 - missing quarterly samples for Ra-226, Th-230 and uranium.

SUB05 - missing all sampling data.

SUB06 - missing quarterly sample for Ra-226 (dissolved).

SUB08 - missing quarterly samples for Ra-226 (dissolved).

SUB09 - missing quarterly samples for Ra-226, Th-230 and uranium, missing semiannual data for Po-21, Pb-210.

SUB10 - missing quarterly samples for Ra-226, Th-230 and uranium, missing semiannual data for Po-21 , Pb-210.

SUB11 - missing quarterly samples for Ra-226 (dissolved).

Please review all data submitted for impoundments and provide missing data or a justification of why the current data set is consistent with Regulatory Guide 4.14.

Response TR RAI-2.9-49 (TR Section 2.7.3.1)

SUB01 – missing quarterly samples for Ra-226, Th-230, and uranium; also missing semiannual samples for Pb-210 and Po-210

SUB01 was visited quarterly from June 2007 through June 2008. During this time, SUB01 was visited in September 2007, November 2007, March 2008, and June 2008. The sub impoundment, or stock pond, was dry in both September 2007 and November 2007; hence no sample was able to be collected at those times and thus explaining the missing quarterly samples. For Po-210 and Pb-210, these two constituents were only required to be sampled semiannually; during the sampling period, Po-210 and Pb-210 were analyzed for in every quarter except the winter of 2008 (January through March 2008). One of the two samples (June 2008) that were collected at SUB01 includes data for Po-210 and Pb-210. The other sample collected in March 2008 was collected during that period in which Po-210 and Pb-210 were not analyzed.

SUB03 – missing quarterly samples for Ra-226, Th-230, and uranium.

SUB03 was visited quarterly from June 2007 through June 2008. During this time, SUB03 was visited in September 2007, November 2007, February 2008, and June 2008. The sub impoundment, or stock pond, was dry in both September 2007 and February 2008; hence no sample was able to be collected at those times and thus explaining the missing quarterly samples.

SUB04 – missing quarterly samples for Ra-226, Th-230, and uranium.

SUB04 was visited quarterly from June 2007 through June 2008. During this time, SUB04 was visited in September 2007, November 2007, February 2008, and June 2008. The sub impoundment, or stock pond, was dry in both September 2007 and February 2008; hence no sample was able to be collected at those times and thus explaining the missing quarterly samples.

SUB05 – missing all sampling data.

SUB05 is a detention pond below the Darrow Pit mines and was visited quarterly from June 2007 through June 2008 and was determined to be dry on each of the quarterly sampling dates. Dates of visits include 9/27/07, 11/27/07, 3/24/08, and 6/18/08 [Krantz and Lambert, 2008]. Note, a staff gage was installed at this site on 10/27/07. On the date the gage was installed, quarterly samples were not scheduled and the field technician did not have the necessary equipment to collect a sample from the puddle. Upon the next visit to this site, the impoundment was again dry.

SUB06 – missing quarterly samples for Ra-226 (dissolved).

Ra-226 (dissolved) for the sample collected at SUB06 on 11/27/2007 has a value of 2.0 pCi/L. Total Ra-226 was not calculated by the laboratory in September 2007 for an unknown reason.

SUB08 – missing quarterly samples for Ra-226 (dissolved).

Radium-226 (dissolved) data is not in the TR or geodatabase for 11/27/2007. Upon reviewing the lab report, the missing radium-226 data for SUB08 on 11/27/2007 has a value of 0.5 pCi/L.

SUB09 – missing quarterly samples for Ra-226, Th-230, and uranium; also missing semiannual data for Po-210 and Pb-210.

SUB09 was visited quarterly from June 2007 through June 2008. During this time, SUB09 was visited in September 2007, November 2007, March 2008, and June 2008. The subimpoundment, or stock pond, was dry in both September 2007 and November 2007; hence no sample was able to be collected at those times and thus explaining the missing quarterly samples. For Po-210 and Pb-210, these two constituents were only required to be sampled semiannually; during the sampling period, Po-210 and Pb-210 were analyzed for in every quarter except the winter of 2008 (January through March 2008). One of the two samples (June 2008) that were collected at SUB09 includes data for Po-210 and Pb-210. The other sample collected in March 2008 was collected during that period in which Po-210 and Pb-210 were not analyzed.

SUB10 – missing quarterly samples for Ra-226, Th-230, and uranium; also missing semiannual data for Po-210 and Pb-210

Like other subimpoundments, SUB10 was visited quarterly from June 2007 through June 2008. During this time, SUB10 was visited in September 2007, November 2007, March 2008, and June 2008. The subimpoundment, or stock pond, was dry in both September 2007 and November 2007; hence no sample was able to be collected at those times and thus explaining the missing quarterly samples. For Po-210 and Pb-210, these two constituents were only required to be sampled semiannually; during the sampling period, Po-210 and Pb-210 were analyzed for in every quarter except the winter of 2008 (January through March 2008). One of the two samples (June 2008) that were collected at SUB10 includes data for Po-210 and Pb-210. The other sample collected in March 2008 was collected during that period in which Po-210 and Pb-210 were not analyzed.

SUB11 – missing quarterly samples for Ra-226 (dissolved)

Radium-226 (dissolved) data is not in TR or geodatabase for 11/27/2007. Upon reviewing the lab report, the missing radium-226 data for SUB11 on 11/27/2007 is a non-detect with the reporting limit of 0.2 pCi/L.

TR_RAI-2.9-50

Consistent with Regulatory Guide 4.14, provide the value of the Lower Limit of Detection (LLD) along with a description of the calculation of the LLD for surface water measurements.

Response TR_RAI-2.9-50 (TR Section 2.7.3.1.1)

The LLD (lower limit of detection) or PQL (practical quantitation limit) as reported by Energy Laboratories is available in the TR; Section 2.7.3.1.1 Table 2.7-24 "Number of Surface Water Samples Collected, Analytical Method, and PQL by Constituent".

For the description of the calculation see Response: TR_RAI-RI-4 *"Description and Basis for Analytical Results and Reporting for LLD and Error".*