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POWERTECH (USA) INC.

Dewey-Burdock Project Supplement to Application for NRC Uranium Recovery License Dated February 2009

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Prepared for

U.S. Nuclear Regulatory Commission
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List of Acronyms and Abbreviations

°F	degrees Fahrenheit
AEB	aquifer exemption boundary
AOR	area of review
CFR	Code of Federal Regulations
cm/sec	centimeters per second
CPP	Central Processing Plant
DENR	Department of Environmental and Natural Resources
EPA	U.S. Environmental Protection Agency
ER	Environmental Report
ft	foot/feet
ft^2/day	square feet per day
ISL	in situ leach (In this document ISL is synonymous with ISR)
ISR	in situ recovery
IX	ion exchange
km	kilometer
lbs	pounds
m	meter
mi	mile(s)
MCL	maximum contaminate level
mph	miles per hour
NAAQS	National Ambient Air Quality Standards
NRC	Nuclear Regulatory Commission
PA	Proposed Action
PAA	Proposed Action Area
Powertech (USA)	Powertech (USA) Inc.
PVC	Polyvinyl Chloride
RESRAD	RESidual RADioactive
RO	reverse osmosis
SD	South Dakota
SDAR	South Dakota Administrative Rules
SERP	Safety and Environmental Review Panel
SF	satellite facility
SPAW	Soil-Plant-Atmosphere-Water
TDS	total dissolved solids
TEDE	total effective dose equivalent
TR	Technical Report
TVA	Tennessee Valley Authority
U-nat	natural uranium
UCL	upper control limits
UIC	underground injection control
USDW	underground source of drinking water
yr	year

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1.0 Introduction

Powertech (USA) Inc. (Powertech (USA}) submitted its application for the Dewey-Burdock Project, including the technical and environmental reports (TR and ER), to the U.S. Nuclear Regulatory Commission (NRC) February 26, 2009. The NRC contacted Powertech May 26, 2009 by telephone to discuss its completeness review of Powertech's application. The NRC requested additional data in order to complete its review and acceptance of the Dewey-Burdock application. The following five issues were deemed to be of insufficient clarity to allow the full review and acceptance of the project application. The five issues requiring additional data are described as follows:

Hydrogeology

NRC staff stated that the potential for breccia pipes and thinning of the Morrison formation (the Morrison) caused staff to question the adequacy of this formation as an underlying confining layer.

Location of Extraction Operations

NRC staff stated that a more complete discussion of uranium recovery locations within the proposed action area (PAA) is needed. For example, the staff was not able to locate information indicating precisely where well field operations would occur.

Liquid Waste Management

NRC staff stated that basic information regarding the proposed storage and radium settling ponds is needed for the review. This includes soil information, stability analysis and other information addressed in Regulatory Guide 3.11. Also, information addressing 10 CFR 20.2002 requirements regarding deep well disposal is needed.

Groundwater Protection

The company was requested to clarify the disposition of existing water wells within the PAA.

Operational Issues

NRC indicated that they needed clarification of engineering planning by Powertech rather than reliance on generic guidance. Items discussed included rationale for monitor well spacing and the planned use of specific materials for well construction.

Following the May 26, 2009 telephonic conference Powertech met with NRC staff at NRC's headquarters on June 11, 2009 for a follow-up meeting to discuss the five issues in further detail. The meeting was helpful in clarifying NRC's information requests as well as the company's submittal. The conclusion called for Powertech to notify NRC whether it would voluntarily withdraw the application in order to make the necessary changes, or if it preferred NRC to reject the application. Powertech chose to withdraw the application and provide additional data and to resubmit within 60 -90 days from withdrawal. Further, Powertech agreed to submit a list of information it planned to provide the NRC in its resubmitted application. In a letter dated July 9, 2009, the NRC provided a summary of the June 11, 2009 meeting.

NRC's letter of July 14, 2009 responded to Powertech's letter dated June 19, 2009 that included the list of additional information to be provided by Powertech. This latter letter included two options acceptable to NRC for the resubmission of the application. Option 1 allowed for the incorporation of all changes and additions into the current application. Option 2 allowed Powertech to include all supplemental information in a separate appendix (or appendices) with a detailed description (e.g., cross referencing) of where the supporting information fits in with the current application. Powertech has chosen Option 2.

This document provides supplemental information to the Uranium Recovery License Application, submitted by Powertech (USA) to NRC on February 26, 2009 with cross references provided in Table 1.1-1 to relevant sections of the previously submitted document

Table 1.1-1: Cross Reference

Supplemental Document Section	TR Cross References		ER Cross References	
	TR Section	TR Section Title	ER Section	ER Section Title
2.0 Hydrogeology	2.6	Geology	3.3	Geology, Soils, and Seismology
	2.7.2.1.7	Regional Hydraulic Connection of Aquifers	3.4.3.1.6	Minor Aquifers
	2.7.2.2.4	Morrison Formation Confining Unit	3.4.3.1.7	Regional Hydraulic Connection of Aquifers
	2.7.2.2.12	Summary of Previous Pump Test Results		
	2.7.2.2.13	2008 Pumping Tests		
	2.7.2.2.14	Burdock Project Area (pump test results and conclusions)		
	2.7.2.2.15	Dewey Project Area (pump test results and conclusions)		
	2.7.2.2.16	Hydraulic Connection of Aquifers at the Project Site		
	Appendix 2.7-B	2008 Pumping Tests: Results and Analysis		
3.0 Location of Extraction Operations	2.6.3	Ore Mineralogy and Geochemistry	1.1	Purpose and Need for the Proposed Action
	3.1.1	Orebody	1.2.4	Orebody
	3.1.3	Monitoring Well Layout and Design	1.2.5.2.1	Additional Construction Requirements
	5.2.3	Safety and Environmental Review Panel	1.2.6	Monitoring Well Layout and Design
	5.7.8	Groundwater and Surface Water Monitoring Programs	1.3	Proposed Operating Plans and Schedules
	6.1.7	Groundwater Restoration Monitoring	6.2.2.3	Well Field Hydrologic Data Package
	2.0	Site Characteristics		
	7.0	Potential Environmental Effects		
	8.0	Alternatives to Proposed Action		
	9.0	Cost-Benefit Analysis		
	Appendix 2.7-B	2008 Pumping Tests: Results and Analysis		

Table 1.1-1: Cross Reference

Supplemental Document Section	TR Cross References		ER Cross References	
	TR Section	TR Section Title	ER Section	ER Section Title
4.0 Liquid Waste Management	3.1.5	Pond Design and Land Application	4.15.2	Liquid Waste
	4.2.2	Liquid Waste Disposal		
5.0 Groundwater Protection	3.1.3	Monitoring Well Layout and Design	1.2.6	Monitoring Well Layout and Design
	6.1.1	Groundwater Restoration Criteria		
	6.1.9	Restoration Wastewater Disposal		
6.0 Operational Issues	3.1.2	Well Construction and Integrity Testing	1.2.5	Well Construction and Integrity Testing
	4.2.2	Liquid Waste Disposal	4.8	Potential Air Quality Impacts
	7.1.1	Potential Air Quality Effects of Construction	4.15.2	Liquid Waste
	7.2.1	Potential Air Quality Effects of Operations		
7.0 MILDOS Revision	7.3	Potential Radiological Effects	4.14.2	Potential Radiological Impacts

2.0 Hydrogeology

2.1 Geology Overview

This section provides additional information regarding the regional and site geology as presented in Section 2.6 of the Technical Report and Section 3.3 of the Environmental Report. In this section Powertech discusses the overall stratigraphy of the PAA and the distribution of host sandstone units with attendant confining shale sections.

The operating zone for in situ leach (ISL) development within the PAA is contained within the lower Cretaceous Inyan Kara Group of fluvial sandstones and intermittent interbedded shales with three confining units as identified by the high density of exploratory drill holes in the project area. The attached maps and cross sections more completely describe the detailed geology both regionally across the project and locally within the two initial, proposed well field outlines. The Inyan Kara Group consists of the Lakota and Fall River Formations separated by the uppermost Lakota-Fuson shale member. It is this entire Inyan Kara Group that contains all the uranium mineralization within the PAA and has been proposed for aquifer exemption to the U.S. Environmental Protection Agency (EPA) in the submission of the Underground Injection Control Permit Application for Class III wells. Because of the widespread nature of the uranium mineralization both horizontally and vertically within the Inyan Kara with additional extensions of uranium mineralization extending beyond the known calculated resources, a broad area surrounding potential well fields has been proposed. It can be seen from Supplemental Exhibit 2.1-1 that the positions of known roll fronts meander throughout the PAA. The proposed "Aquifer Exemption" boundary was established at a maximum of 1600 feet (ft), horizontally, from all identified and probable well field locations. The stratigraphic interval proposed for exemption includes the entire Inyan Kara from the base of the Graneros Group (Skull Creek) Shales as the overlying confining unit to the top of the Jurassic Morrison formation which is thick confining shale at the base of the Inyan Kara. Regional cross sections (Figures 2.1-1, 2.1-2 and 2.1-3) extending across the PAA show, with electric log data, the interpreted geologic section described above.

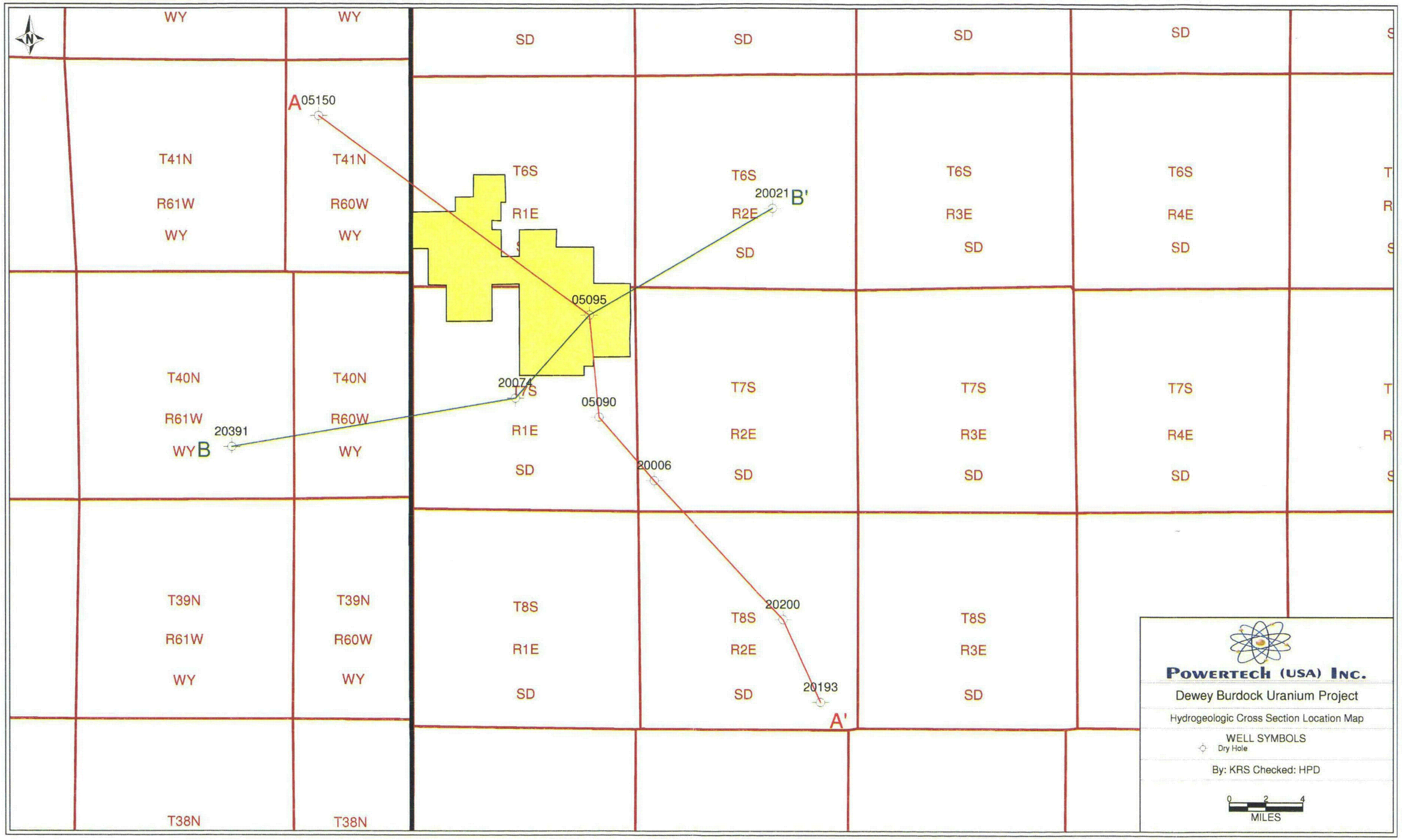

Figure 2.1-1: Hydrogeologic Cross Section Location Map

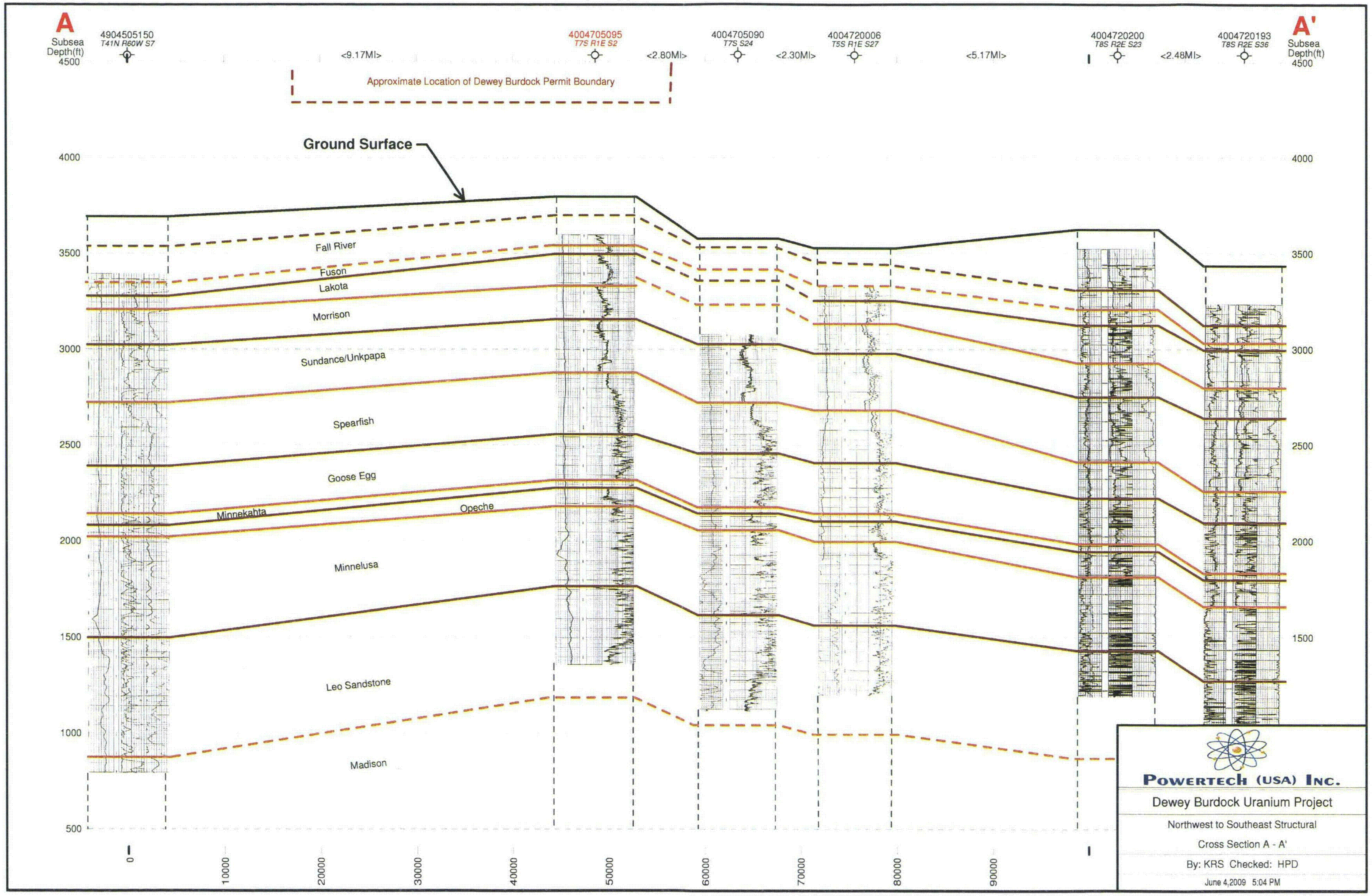

Figure 2.1-2: Northwest to Southeast Structural Cross Section A-A'

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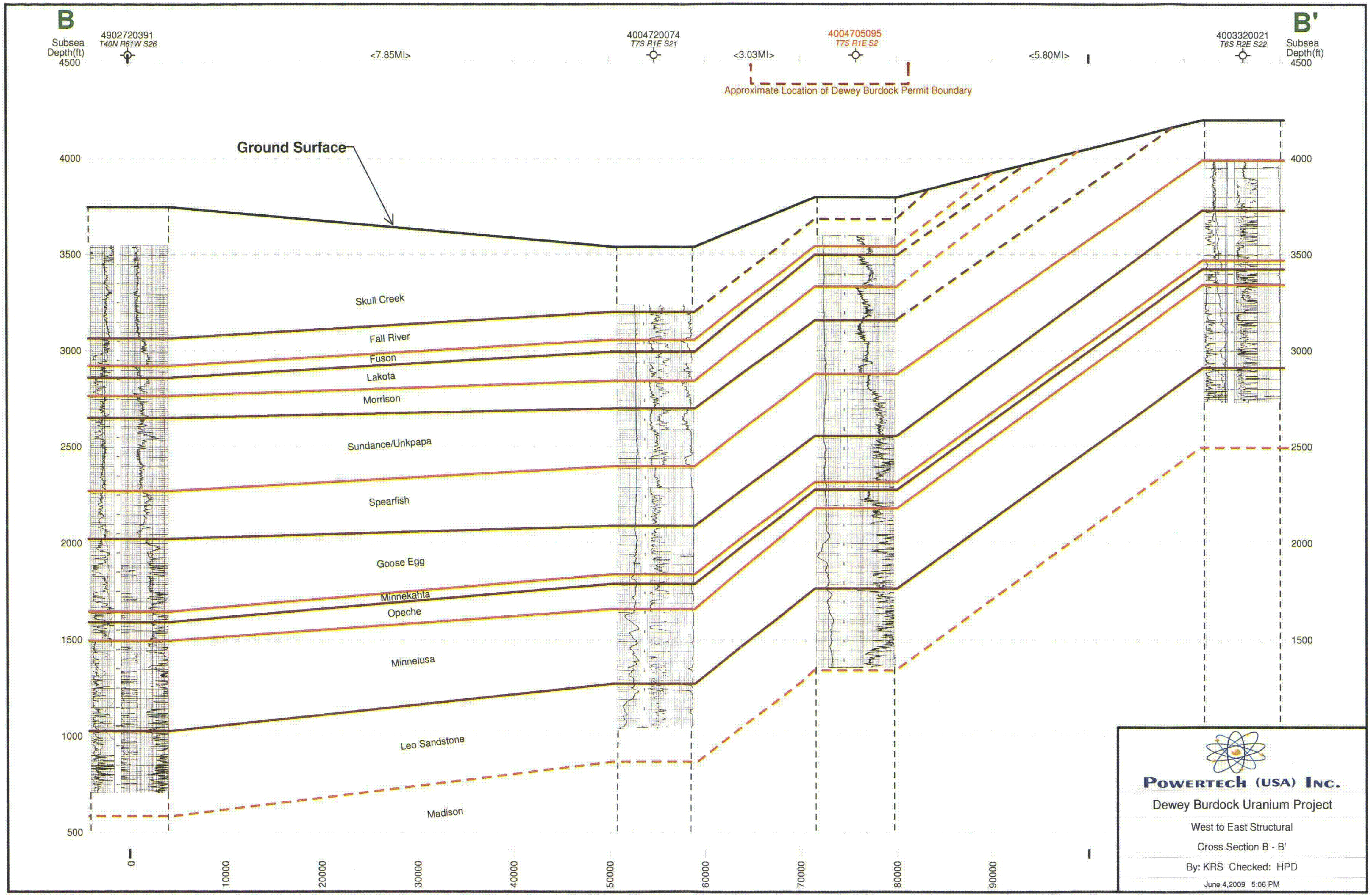

Figure 2.1-3: West to East Structural Cross Section B-B'

In the initial submission, Powertech provided a number of regional maps and cross sections; however, the plates appended to this report provide additional clarifying information Table 2.1-1 provides cross reference to the list of plates used in the original application. All regional maps used in this submission and the original submittal, are based on data from over 1000 electric logs that Powertech was able to secure from the Tennessee Valley Authority (TVA) data base.

Table 2.1-1: List of Plates from Original Application

Plate Number Technical Report	Plate Number- Environmental Report	Plate Title
2.6-2	3.3-2	Structure Map – Fall River
2.6-3	3.3-3	Structure Map – Chilson Member of the Lakota Formation
2.6-4	3.3-4	Fall River Top of the Unkpapa
2.6-5	3.3-5	Generalized Cross-Section
2.6-6	3.3-6	Isopach Map – Chilson Member of the Lakota Formation
2.6-7	3.3-7	Isopach Map – Fuson Member Lakota Formation
2.6-8	3.3-8	Isopach Map – Fall River
2.6-9	3.3-9	Isopach Map –Overlying Aquitard (Mowry & Skull Creek Shales)
2.6-10	3.3-10	Cross Section Index
2.6-11	3.3-11	Ore Cross Section A-A'
2.6-12	3.3-12	Ore Cross Section F-F'
2.6-13	3.3-13	Plate 3.3-13 Ore Cross Section H-H'
2.6-14	3.3-14	Ore Cross Section J-J'

The additional structure maps, isopachs and cross sections present in detail, the geology within the two initial production well field areas. These supplemental exhibits demonstrate the current availability of electric log and mapped data that Powertech has in its possession for interpreting the first planned well fields. However, as stated in the operations discussion, the company plans to add significantly to the database through conducting delineation drilling before emplacement of the well field injection and extraction wells, including the appropriate monitoring wells at the 400 ft perimeter as well as any shallow or deeper monitor wells as dictated by the detailed drilling program. Further discussion of well field planning and monitor well spacing is included in this supplemental submission.

2.2 Site-wide Hydrogeology

Several site-wide geologic maps are presented in order to clarify the geologic setting at Dewey-Burdock with respect to the location of Powertech's two proposed initial well fields. Supplemental Exhibit 3.2-2, a structure contour map showing contours of sea level elevations for on the top of the Chilson Member of the Lakota Formation (base of the Fuson) is the first of these. This map shows the overall structure based on over a thousand (1,000) drill holes from which a number of drill logs were selected that appeared most representative of the high density of drilling present within the PAA . This map illustrates a gently sloping surface, with a north to northwest trend (strike) and corresponding dip to the west and southwest. There appear to be no faults or linear displacement at any point across the gently dipping plane, demonstrating a lack of structural deformation. The unit mapped is the base of the Fuson shale member of the Lakota Formation. Within the units present in the proposed PAA, the most appropriate control unit for mapping structure is the base of the Fuson aggrading shale unit. The rationale of using this surface as a time line is determined from the character of the unit. It is clear from the isopach map of the Fuson member of the Lakota, Supplemental Exhibit 3.2-3, that the shale was deposited during a period of quiescence at the end of the Lakota sand deposition. Therefore, the selection of the base of the Fuson is an appropriate marker horizon for mapping regional structure. Supplemental Exhibits 3.2-4 and 3.2-5 are isopach maps of the two hosts sand units for the Dewey-Burdock Project – the Fall River and the Lakota. These isopach maps present contours showing equal rock thickness for each sand unit. These contours indicate that while thicknesses vary, both sands have been consistently deposited across the project area. This variation in thickness reflects general changes in the depositional environment of the sediments, with the thicker sequences correlating to accumulations of thicker sand deposits. In general, the uranium deposits associated with these fluvial sand units are observed to occur within or along the flanks of the major sand accumulations.

An isopach map of the previously described Fuson Member of Lakota is presented in Supplemental Exhibit 3.2-3. The Fuson is a sequence of low-permeability clays and siltstones that forms a competent confining layer between sands of the Fall River Formation and the Lakota Formation. These contours indicate that the Fuson has been consistently deposited across the area with an average thickness of approximately 50 ft.

Supplemental Exhibit 2.1-2 is an isopach map of the Morrison Formation. The Morrison Formation represents the underlying confining clay unit for the Inyan Kara Group. These contours show a consistent thickness of 100-110 ft deposited across the area. The Morrison was

deposited as a marine shale, which accounts for its consistency in both thickness and lithology (rock type).

Several new cross sections are presented in this supplement. The cross sections have been detailed and incorporate the electric logs as interpreted by the Powertech geologists and reviewed by the geological supervisors that are registered Professional Geologists. The differences between the revised cross sections and those previously submitted include both a different vertical exaggeration in order to more clearly describe the continuity of sand and shale horizons, formation boundaries, and location of uranium mineralization relative to the dominant sandstone units.

The cross sections have been constructed with vertical exaggerations of 5:1. This presentation was chosen to show detail in the subsurface geology, while not causing undo distortion. Individual drill holes along the cross section line have also been added to the section to illustrate the source of the technical data used to develop subsurface geologic interpretations.

Supplemental Exhibit 3.2-6, Cross Section H-H'', illustrates the relatively flat topography, as well as a gentle dip of the formations from east to west across the project area. Also shown are the locations of the proposed initial well fields in the Dewey and the Burdock areas.

Cross Section J-J', Supplemental Exhibit 3.2-7, is located in the southeast portion of the project area where sands of the Fall River Formation are exposed on the surface, resulting in more surface topography. This Burdock-area cross section demonstrates how drill hole data is used to interpret and correlate geologic units in the subsurface and to illustrate remaining uranium resources in Lakota sands beneath areas of past surface mining:

2.3 Hydrology/Site Characterization

2.3.1 Breccia Pipes

The following is intended to provide clarifying information regarding the issue of breccia pipes as referenced in Section 2.7.2.1.7 of the Technical Report and Section 3.4.3.1.6 of the Environmental Report. The USGS Gott report (Gott, 1974) described the location of a number of breccia pipes formed from solution collapse of the underlying evaporative sequences along the flank of the Black Hills uplift. The NRC expressed concerns that these breccia pipes may extend into the operating area potentially allowing solution migration away from the operating Aquifer Exemption horizon into underlying underground sources of drinking water (USDWs). Powertech has reviewed the location of the identified breccia pipes and their origin and offers the following observations and conclusions about the probability of this occurrence.

In reviewing the location of the breccia pipes, the majority of the locations are associated with the Dewey Fault zone that occurs to the north of the Project Area boundary (Supplemental Exhibit 2.2-1, Breccia Pipe Map) These breccia pipes are associated with dissolution within the Minnelusa Formation. The Minnelusa Formation in the Southern Black Hills contains thick sequences of evaporites, such as anhydrite and gypsum. These units are believed to form breccia pipes where structural deformation allows migration of dissolving solutions into the evaporite sequence.

The detailed geology mapped throughout the proposed operating areas demonstrates that there are no structural displacements found within the PAA boundary, and the probability of unknown breccia pipes being present within the PAA from the creation of solution caverns is highly unlikely. Without the fracture permeability formed along major fault systems trending downdip from the uplift, it is highly unlikely that dissolving solutions would penetrate through the evaporative units in such a quantity that caverns would develop.

The large number of exploration drill holes (over 4000) within the PAA without any indication of brecciation lends credence to the hypothesis that no solubilizing solutions penetrated the underlying evaporative strata to such an extent that caverns were created that disrupted the operating zone. If the possibility of brecciation occurred within the PAA, evidence of their presence would be observed in the correlation of the electric logs or from the structure maps based on the Fuson Shale aquitard at the top of the Lakota sequence. See Supplemental Exhibits 2.2-2 (Fall River) and 2.2-3 (Fuson).

Pumping tests performed by Powertech within the initial operating areas, at Dewey and Burdock, show strong aquitard character for the Fuson Shale. The three day pumping tests would have readily discovered the presence of a collapse feature or a conduit for fluids within the confining unit. None was shown during Powertech's tests, which again confirms there is no indication of the presence of breccia pipes as a conduit for operating solutions to migrate away from the Aquifer Exemption Boundary and the presence of such is highly unlikely, if not totally disproven.

2.3.2 Pressure Differential between Inyan Kara and the Unkpapa/Sundance Formations and Integrity of the Morrison Shale Unit

Sections 2.7.2.2.14.1 and 2.7.2.2.15.1 of the Technical Report provide summaries of the pumping test results conducted at the Dewey and Burdock sites. The supplemental information provided below provides more detailed analysis of the integrity of the Morrison as a confining

layer during the 2008 pumping tests due to pressure differentials in the Unkpapa/Sundance aquifer and Inyan Kara Formation aquifers. Also included is a detailed analysis of the hydrologic data presented as an attachment (Appendix A) to this discussion.

Figure 2.5 in Appendix 2.7-B of the Technical Report provides a potentiometric surface map of the Unkpapa/Sundance aquifer below the Inyan Kara group, based on measurements made in 2008 at four locations. The potentiometric surface in the Unkpapa/Sundance aquifer indicates groundwater flow direction to the southwest with locally more southerly components. Overall gradient is about 100 ft per 3 miles (mi), which corresponds to an average gradient of about 0.006 ft/ft. Comparing to Figures 2.4 and 2.3 in Appendix 2.7-B of the Technical Report, the potentiometric surface elevation is generally about 50 to 100 ft higher than in both the overlying Lakota and Fall River Formation aquifers. This indicates vertical upward gradients between the Unkpapa/Sundance aquifer, the intervening clay-shale Members of the Morrison Formation and the Inyan Kara Group. The Morrison Formation thus appears to function as an effective aquitard throughout the project area.

Specific vertical gradient measurements at each of the two aquifer test areas in 2008 are described in detail below. Following the vertical gradient information is a synopsis of the pumping test results that pertain to the effectiveness of Morrison Formation clay-shale confining beds separating the Inyan Kara aquifers from the underlying Unkpapa/Sundance sandstone aquifer in the test areas.

2.3.3 Permeabilities and Core Tests of Operating Horizons

Table 2.7-16 in the Technical Report contains all laboratory analyses obtained to date for core collected at the site. The following description of core tests and permeabilities in both operating horizon sand overlying and underlying confining units is taken and modified slightly from Section 6 in Appendix 2.7-B of the Technical Report.

2.3.3.1 Background

Selected core samples were sent to Core Laboratories by Powertech for measurement of intrinsic permeability to assess the differences in the less permeable Skull Creek shale, Fuson shale, Morrison shale, and interbedded units of the Dewey (Fall River) and Burdock (Lakota) sandstone units. The intrinsic permeability data were converted to hydraulic conductivity values as shown in Table 6.1 (Appendix 2.7-B of the Technical Report).

2.3.3.2 Conversion from Intrinsic Permeability to Hydraulic Conductivity

Intrinsic permeability is a property of the core material (rock) only and does not include any fluid properties. The core intrinsic permeability was measured by moving air through the core under confining pressure in the laboratory which resulted in the measurement of both porosity (from the bulk density and particle density of the core) and intrinsic permeability in milliDarcys (mD) as shown in Table 6.1 (Appendix 2.7-B of the Technical Report). The footnotes at the bottom of Table 6.1 show the constants assumed for the conversion from intrinsic permeability to hydraulic conductivity at the prevailing temperatures of the laboratory, assumed to be 70 ^{o}F, and the site groundwater (average of 52.8 ^{o}F from field measurements. It is well known that the units of intrinsic permeability can be changed from mD to cm^2 by using equations shown in Table 6.1 (Appendix 2.7-B of the Technical Report). The intrinsic permeability is multiplied by the fluid properties of water density times the gravitational constant divided by the dynamic viscosity (both temperature dependent) of the site groundwater to obtain the hydraulic conductivity.

Analyses of core data in Table 6.1 (Appendix 2.7-B of the Technical Report) indicate that the horizontal hydraulic conductivity of the Skull Creek shale is approximately 6.0 x 10^{-8} centimeters per second (cm/s). The horizontal hydraulic conductivity of the Fuson Shale ranges from 8.0 x 10^{-7} to 3.2 x 10^{-8} cm/s, and for the Morrison between 7.7 x 10^{-7} and 3.1 x 10^{-9} cm/s. Vertical hydraulic conductivities of the Skull Creek and Morrison shales, and the Fuson shale from the Dewey project area, are typically one-tenth to one-twentieth the horizontal values. The vertical hydraulic conductivities for all the above shale units range from about 5.4 to 6.1 x 10^{-9} cm/s.

The average vertical hydraulic conductivity for the two core samples from the Fuson shale from the Burdock project area is considerably more permeable (9.8 x 10^{-8} cm/sec), at roughly 25 percent the horizontal value.

In contrast, the core units of the Burdock Lakota sandstone unit have an average horizontal hydraulic conductivity of 2.6 x 10^{-3} cm/s (7.4 ft/day), ranging from 2.1 x 10^{-3} to 3.2 x 10^{-3} cm/s. Core from the Dewey Fall River sandstone unit has a horizontal hydraulic conductivity of 2.2 x 10^{-3} cm/s (6.1 ft/day). The ratio of horizontal to vertical hydraulic conductivity (K_h:K_v) for the Burdock sandstone units is 2.4:1, and for the Dewey sandstone unit it is 4.5:1, based on the core data shown in Table 6.1 (Appendix 2.7-B of the Technical Report).

2.3.3.3 Interpretations of the Laboratory Core Data

Comparison of horizontal hydraulic conductivity of the Dewey and Burdock sandstone samples in Table 6.1 with the conductivity calculated from pumping test transmissivity (Tables 4.3 and 5.3 in Appendix 2.7-B of the Technical Report) can be made as follows:

- Dewey Transmissivity 255 square feet per day (ft^2/d) divided by 15 ft screen length = 17 ft/day
- Dewey Transmissivity 255 ft^2/d divided by 165 ft formation thickness = 1.5 ft/day
- Burdock Transmissivity 150 ft^2/d divided by 10 ft screen length = 15.0 ft/day
- Burdock Transmissivity 150 ft^2/d divided by 170 ft formation thickness = 0.9 ft/day

The most commonly used procedure when converting test results is to use the screen length of the pumping well as the divisor. The above analysis indicates that the pumping test data may be interpreted to yield up to two to three times greater higher hydraulic conductivity than core data.

However, the above analysis also indicates that the hydraulic conductivities calculated from the pumping test transmissivities and the overall formation thicknesses bracket the core data at the lower end of ranges in hydraulic conductivity, with the core falling in the middle of the range. The core data can be considered to be generally consistent with, and therefore independently confirming, the pumping test results.

2.3.3.4 Conclusions

The first conclusion from the core analyses is that the major shale aquitards (Fuson, Skull Creek, Morrison formations) have hydraulic conductivities several orders of magnitude lower than hydraulic conductivities of either the Fall River or Lakota sandstone units. Using the vertical hydraulic conductivities as a measure of degree of confinement, at the Burdock project area Table 6.1 (Appendix 2.7-B of the Technical Report) indicates that the shales in the Fuson overlying the Lakota formation (K_h = 7.4 ft/day) have an average vertical permeability of about 2.7×10^{-4} ft/day and the underlying Morrison formation 6.0×10^{-5} ft/day. At the Dewey project area, shales in the Fuson formation underlying the Fall River formation (K_h = 6.6 ft/day) have an average vertical permeability of 1.8×10^{-5} ft/day, and shale in the single sample of overlying Skull Creek shale has a vertical permeability of 1.5×10^{-5} ft/day.

The second conclusion is that core data from the sandstones are within the range of hydraulic conductivities determinable from test transmissivities, specifically 1.5 to 17 ft/day at the Dewey

project area and 0.9 to 15 ft/day at the Burdock project area. This is also an appropriate range of uncertainty for converting the test results to hydraulic conductivity. Using the usual procedure for determining hydraulic conductivity from pumping test transmissivity, the sandstone core results may have two to three times smaller hydraulic conductivities than those estimated from the pumping tests, perhaps due to slightly different lithologies between the core and screened intervals. Overall, there is reasonable agreement between the laboratory and field hydraulic tests considering typically order-of-magnitude differences in hydraulic conductivity determinations.

3.0 Location of Extraction Operations

The following provides supplemental information to Sections 3.1.1, 3.1.3 and 5.2.3 of the Technical Report and Sections 1.2.4, 1.2.6, and 6.2.2.3 of the Environmental Report.

Geologic Setting

3.1 Operations Site Maps

The initial proposed operational units are depicted in Supplemental Exhibit 3.2-1; this map shows the proposed location of the first two well fields, the Central Processing Plant (CPP) and the SF within the township, section and range. The following listed supplemental exhibits show the initial operating areas in increasing detail.

Supplemental Exhibit 3.1-2 shows the proposed Land Application Area for excess water disposal.

Supplemental Exhibit 3.1-3 shows the Deep Disposal Well infrastructure and proposed locations. The surface expression of mineralized areas as determined by exploratory drilling is also depicted on this map.

Future well field proposed locations are anticipated and shown on Supplemental Exhibit 3.1-4 along with the first two well fields, Dewey 1 and Burdock 1. Supplemental Exhibit 3.1-1 demonstrates the locations of all known water wells, their position relative to the mineralized trends and use. The drilled TVA and Powertech monitor and testing wells are also shown on the map with the project boundary, proposed Aquifer Exemption and Area of Review.

Supplemental Exhibit 3.1-4 also shows the proposed monitor well rings at Dewey and Burdock with the locations of previously drilled exploration holes.

The lines of the cross sections are located on the Cross Section Index Map, Supplemental Exhibit 3.1-5.

Supplemental Exhibits 2.1-3 and 2.1-4 contain the cross sections for the planned well field areas.

Well field development detail is presented as a series of maps for both Dewey and Burdock that demonstrate plots of 100 foot square well field grid covering known mineralization, (Supplemental Exhibits 3.1-6 through 3.1-9).

The proposed infrastructure, including surface facilities, is mapped at this same scale and includes: header houses, collection and distribution lines, topsoil stockpile areas and existing roads.

Supplemental Exhibit 3.1-10 presents a close up view within the location within the Burdock area of the historical mines and associated overburden piles. Importance in presenting this view deals with future well field planning.

3.2 Planning of Future Well Fields

In the ISL licensing process, descriptions are provided of the proposed activities, the potential impact of the proposed operations and the proposed means to control, mitigate and remediate the potential impact of the proposed activities. A study is undertaken of the existing "baseline" conditions in respect to those items and areas that are expected to impact. These investigations are undertaken according to the guidelines as established by the NRC and several state agencies with regulatory authority over well field design and operation. The rules and guidelines that ISL operations follow have evolved over the past 30 years, via the interaction between the experienced regulating community, and experienced industry experts within several states including Texas, Wyoming and Nebraska. These rules and guidelines have been promulgated via NUREGs, Brochures, Conference Proceedings, Publications prepared by NRC staff or contractors, and publications prepared resulting from International Agreements. Through the process, industry personnel have assisted regulators by interacting in the process of development and amending these rules over time to make them functional. Powertech's management has extensive experience with the permitting process and has participated in developing rules and has implemented these procedures in several ISL mining operations. The license and the permits that are initially granted are a designed to serve as a framework for the principles and actions that regulate the proposed activities. The "baseline" existing conditions are a general description of the environment within and adjacent to the permit area. As such they are not sufficiently detailed for a site specific demonstration of how the operations are controlled, but are a general description of the aspects of the permit area that are pertinent to preventing adverse impact on the environment; see sections 2.0, 7.0, 8.0 and 9.0 of the Technical Report. The NRC tasked the Center for Nuclear Waste Regulatory Analyses (CNWRA) with developing a Risk-Informed, Performance-Based foundation for regulating ISL facilities. NUREG 6733 presents the commonly accepted practices for hazard identification, consequence analysis, and risk assessment used to define risks associated with ISL facility operations. The report examines operations for extracting and processing uranium into yellowcake, restoring groundwater quality

subsequent to ore extracting and health and environmental hazards and risks. The CNWRA staff utilized in this effort experts in dose assessment, health physics, process engineering, groundwater science, geochemistry and systems analysis and risk assessment; probabilistic and statistical analysis; identification, analysis, management and evaluation of risk. The NRC regulation of source and 11e.(2) byproduct material was utilized and the CNWRA staff collaborated closely with NRC staff experienced in ISL facility licensing in order to develop this initiative. The NUREG 6733, 2001 is just one of the documents Powertech utilized during the development of this license application.

Because it is not feasible to completely describe and define an in situ mine prior to development due to the extensive nature of the resources involved, Powertech uses an economically and environmentally prudent management system for the planning and implementation of the various phases of development and operation. After the required license and permits are received, Powertech will drill the initial well fields to better define the ore location in relation to grade, thickness and production capability on a very site specific and localized basis. This "Delineation Drilling" is more closely spaced and localized and is used to define the ore body locally in order to design the production well spacing, size and depth of the well screen intervals for each well, location of any flow problems caused by clay stringers, and important parameters about the ore for production control and estimation purposes. After the first production area has been drilled with "Delineation Drilling" and the information gathered has been analyzed and the productive ore zone has been mapped in three dimensions, the well field then will be planned in detail. A minimum of eight baseline water quality wells will be installed in the ore zone in the planned well field area. These wells will provide eight samples of ore zone water quality to represent pre-mining baseline. In addition, perimeter monitor wells and overlying and underlying monitor wells will be installed and sampled. These analyses establish the baseline water quality for non-ore zone water within the production zone and for overlying aquifer and underlying aquifer water quality directly above and below the well field. These multiple analyses are necessary because water quality changes significantly in a short distance laterally in all aquifers, especially in the mineralized zone as it tends to be in equilibrium with the rock matrix of the aquifer formation. These analyses establish site specific baseline water data for restoration standards and to establish Upper Control Limit (UCL) action levels. Powertech will pump an ore zone production baseline well and demonstrate, with the pump test, that the production zone is connected to the perimeter monitor wells and NOT connected to the overlying and underlying monitor wells. This establishes the integrity in the monitor well system for managing and controlling excursions. The baseline water quality data and the pumping test data on each well field will be

submitted to the appropriate regulatory agencies for their concurrence and administrative authorization for start up of the well field operations. This authorization will be required prior to injection of any chemicals into the ground water.

The discussion of the location of the proposed well fields follows the criteria set out in the preceding section. The well fields and operations are placed over the known mineralization such that production from the facilities can reach design capacity of a nominal one million pounds (lbs) per year.

As described previously in section 2.6.3 in the Technical Report, the initial Dewey well field is located within mineralization contained within the Fall River Formation and the Burdock initial operation is located over and within the Lakota mineralization. The regional map showing the location of concentration of exploratory drill holes indicates the dominant area of planned well fields. Planning of future well field areas within the PAA will require additional exploratory drilling to establish adequate resources to design operations.

As shown on Supplemental Exhibit 3.1-10, existing mine waste overburden from historical open pit mines remains over portions of the eastern side of the known mineralization. It was stated at the June 2009 meeting between Powertech management and the NRC, Powertech does not plan to conduct operations through the mine waste at this time due to the potential of increased liability associated with future possible reclamation on waste having no relationship to ISL production. However, Powertech recognizes that the good quality of the mineralization will require further review and planning. At this time Powertech plans future well fields to be placed within these areas. It is expected that clarification on future liability will precede development. In any event, the same control and protection standards will be used for in situ mining, should these areas be developed in the future.

3.2.1 Well Field Development

The original application apparently needs some clarification about Powertech's plans for the initial mine areas and the follow up areas for planned expansion. The general locations of the first well fields in the Dewey and Burdock ore areas are shown on Supplemental Exhibit 3.2-1. The company will systematically and consistently add well fields in discrete blocks of wells following the procedures described in section 3.1.1.1 of the Technical Report, for testing each monitor well ring as mining progresses along the ore trends with delineation drilling followed by well field testing and development. For the purpose of this application to the NRC and other agencies, pumping tests were performed at both the Dewey and Burdock operational areas to

demonstrate flow continuity and competency of aquitards. The Dewey well field is planned as a satellite facility (SF) with transport of loaded resin from the northwest portion of the project area to the Central Processing Plant (CPP) that will be located at Burdock. Supplemental Exhibit 3.1-1 shows the entire project area with the proposed initial well field depicted in its approximate location. For purposes of additional clarity Powertech has included with this supplement several detail maps depicting the theoretical well fields drilled as five spot patterns with 100 ft between injector wells at the corners of the patterns and the extraction well placed in the center of the five spot (Supplemental Exhibits 3.1-6 and 3.1-7). Other geometric configurations may be used depending on the final ore configuration as it is mapped from delineation exploration holes prior to final pattern design. However, it is expected from the high density of drilling data acquired from the prior operators that few alterations will be required from the plan presented. Most likely, in certain areas, Powertech may decide that spacing as narrow as 50 ft centers between like wells may prove to be more efficient, thereby increasing the number of wells overall.

A larger scale of the proposed well field dimensions and the location of the perimeter monitor well ring surrounding the operating area are depicted in Supplemental Exhibits 3.1-6 and 3.1-8 for Dewey; Supplemental Exhibits 3.1-7 and 3.1-9 for Burdock.

3.2.2 Additional Pumping Tests

At commencement of the development of Dewey-Burdock PA, Powertech will drill detailed delineation holes into the horizon shown by previous drilling to contain ore mineralization. This detailed delineation is necessary for designing and locating the injection wells and extraction wells. These wells will be completed only within actual ore in order that communication of the paired wells will maintain efficient flow through the ore bearing sand unit and minimize solutions entering non ore bearing portions of the ore horizon. The rationale behind this careful emplacement is twofold. First, if injection solutions are not controlled within ore containing horizons, the recovery solutions become more dilute in uranium recovered, thereby making the operation less economic. Second, the closer the solutions are controlled within the ore bearing zone the less restoration pumping that will be required to return the character of the water within the operating area back to native conditions. While the NRC may not be concerned about the economics of the operation, Powertech knows from experience within the ISL uranium industry that this increased operational efficiency is a critical element of environmental efficiency.

Hydrogeology of Initial Mining Areas – The following structure contour maps, isopachs and cross sections describe the location and the detail of the geologic setting within the two initial production well field areas.

3.2.3 Dewey Well Field Geology

Dewey – The initial proposed well fields in the Dewey Area are developed are in uranium deposits hosted in the sands of the Fall River Formation. The outline of the initial Dewey well field has been shown on previous site-wide maps and is identified in more detail in Supplemental Exhibit 2.1-3. There is one longitudinal cross section through the entire initial Dewey well field and three cross sections perpendicular to the longitudinal section. These cross sections illustrate the flat topography, as well as the subsurface geology in the Dewey Area. Drill holes (data points) in the Dewey area are shown in the Cross Section Index and individual drill holes are displayed on each cross section. The sections have been drawn with a 2:1 vertical exaggeration in order to show some degree of detail in the subsurface geologic setting. A 400-ft thick sequence of the upper confining unit (Graneros Group) is shown overlying the host Fall River sands. Immediately underlying the mineralized sands is the Fuson shale confining unit and one drill hole on the cross sections identifies the location of the lower Morrison Formation confining unit.

Supplemental Exhibit 3.2-8 is a structural contour map of the top of the Chilson Member of the Lakota Formation in the Dewey area. This structure contour map represents a more detailed view of the initial Dewey well field, as opposed to the project-wide structure contour map of the Lakota presented in Supplemental Exhibit 3.2-2. On this map, the top of the Lakota Sand is observed to dip gently to the west, approximately 120 ft in a mile - which calculates to be 1½ degrees. Irregularities in the detailed contour lines reflect a fluvial depositional environment and are believed to outline small channel sands in the upper Lakota sands.

An isopach of the host Fall River sands is presented in Supplemental Exhibit 3.2-9. The contours on this isopach map show a thickness varying from 120-170 ft, with the thicker portions corresponding to sand accumulations along a northeasterly trending channel system. The uranium deposits are aligned parallel to the axis of this channel system. A second isopach of the Fuson Member is presented in Supplemental Exhibit 3.2-10. The average thickness of the Fuson below the initial Dewey well field is approximately 50 ft. As shown in these maps, cross

sections through the project and results of permeability testing from cores, the Fuson provides an effective barrier between the Fall River and Lakota aquifers.

To further illustrate the effectiveness of the confining units described in the Dewey area, there are some pump test results presented on the cross sections of Supplemental Exhibit 2.1-3. Calculated water levels from Fall River, Lakota and Unkpapa/Sundance aquifers are plotted on the cross sections. The separate and distinct water levels for each aquifer are strong evidence that the confining units are also effectively preventing communication between these aquifers.

The Dewey well field is planned as a satellite facility hauling loaded resin from the northwest portion of the project area to the Central Processing Plant (CPP) that will be located at Burdock. Supplemental Exhibit 3.2-1 shows the entire project area with proposed initial well field depicted in its approximate location. For purposes of additional clarity Powertech has included with this supplement several maps showing the proposed well field dimensions and the location of the perimeter monitor well ring surrounding the operating area. See Supplemental Exhibits 3.1-6 and 3.1-8.

Burdock - The initial proposed well fields in the Burdock area to be developed are in uranium deposits hosted in the sands of the Lakota Formation. The outline of the initial Burdock well field has been shown on previous site-wide maps and is identified in more detail in Supplemental Exhibit 2.1-4. Again, there is one longitudinal cross section through the entire initial Burdock well field and three cross sections perpendicular to the longitudinal section. These cross sections illustrate the relatively flat topography of the Burdock Area, as well as the subsurface geology. Drill holes (data points) in the Burdock area are shown in the Cross Section Index and individual drill holes are displayed on each cross section and the sections have been drawn with a 2:1 vertical exaggeration. The upper confining unit (Graneros Group) ranges from 200 ft thick in the western portion of the area to nothing in the east, where is has been eroded. Where the Graneros Group has been eroded, there is still a consistent thickness of the Fuson shale, to act as an upper confining unit to the host Lakota sands. Again, there is one drill hole on the cross sections that identifies the location of the lower Morrison Formation confining unit.

Supplemental Exhibit 3.2-11 is structural contour map on the top of the Chilson Member of the Lakota Formation in the Burdock area. This structure contour map represents a more detailed view of the initial Burdock well field, and shows the Lakota sand dipping to the west at about 2½ degree, or approximately 260 ft in a mile. As previously described in the Dewey area,

irregularities in the detailed contour lines are typical of fluvial depositional environments and are believed to represent small channel sands in the upper Lakota sands.

An isopach of the host Lakota sands in the Burdock area is presented in Supplemental Exhibit 3.2-12. The contours on this isopach map vary from 120-220 ft, with the thicker portions corresponding to multiple sand channel systems. The uranium deposits are found within and along the flanks of these channel sands. Supplemental Exhibit 3.2-13 is an isopach map of the Fuson above the initial Burdock well field, indicating an average thickness of this upper confining unit of approximately 40-50 ft.

3.2.4 Authorizing of New Well Fields

As development progresses in future well fields, site specific information will be developed and reviewed by the Safety and Environmental Review Panel (SERP) prior to injection of chemicals into each new well field. In the event that major changes to Powertech's operating plan are proposed, the company will consult all appropriate agencies prior to injection. As described in Section 2.2.2 of this supplemental report and in Appendix 2.7-B of the Technical Report, Powertech placed wells in all horizons in order to measure communication between operational layers and the lack of permeability and extent of aquitards. Powertech believes that the pumping tests clearly showed the hydrologic character of the planned operations. As well field delineation phases are implemented, the same type of characterization will be performed on a more exact and specified scale as to assess the particular characteristics of the aquifer(s) before the design phase of each well field. The SERP will be closely collaborated with during each phase of the well field development process.

4.0 Liquid Waste Management

The following provides additional information to supplement Section 4.2.2 of the Technical Report and Section 4.15.2 of the Environmental Report.

4.1 Out of State Disposal

Powertech originally proposed that one method of liquid waste disposal would be to pipeline liquid waste from Dewey-Burdock to a deep well injection site(s) located in Wyoming. A second potential method of liquid waste disposal was to truck concentrated liquid waste to licensed disposal wells in Wyoming or Nebraska. In Powertech's discussion with both states, it has been determined that neither state is willing to accept liquid waste from an adjacent state. Therefore, the proposed options described in Section 4.2.2.2 of the Technical Report and Section 4.15.2.4.1 of the Environmental Report, are not viable at this time and are hereby withdrawn.

4.2 Deep Disposal Well Option

Powertech has determined that Class I (Hazardous Waste) deep injection wells are prohibited within South Dakota, and in fact, the probability of discovering a horizon that has no possibility of a USDW horizon beneath the injection zone is remote. The nearest Class I disposal well site associated with a licensed facility is at Crowe Butte Resources in Nebraska, approximately 97 miles from the proposed action (PA).

Therefore, Powertech intends to apply for a Class V (Non Hazardous) deep injection permit for disposal of liquid wastes generated from the project through a permitting process with USEPA. The permit would encompass the proposed action permit boundary in an area type permit application. It is proposed that two wells will be installed; one near the Dewey SF site and one near the Burdock CPP site. Ideally these will be located within approximately ¼ mile of each plant site.

The proposed locations of the wells are presented in Supplemental Exhibit 3.1-3. Regional geology and measurements of water character value within the Minnelusa horizon of Permian Age shows that the horizon has sufficient permeability and sufficiently low water quality that deep well injection would be viable for disposal of process liquid waste with removal of hazardous constituents (Figure 4.2-1 Regional Total Dissolved Solids [TDS] Concentrations).

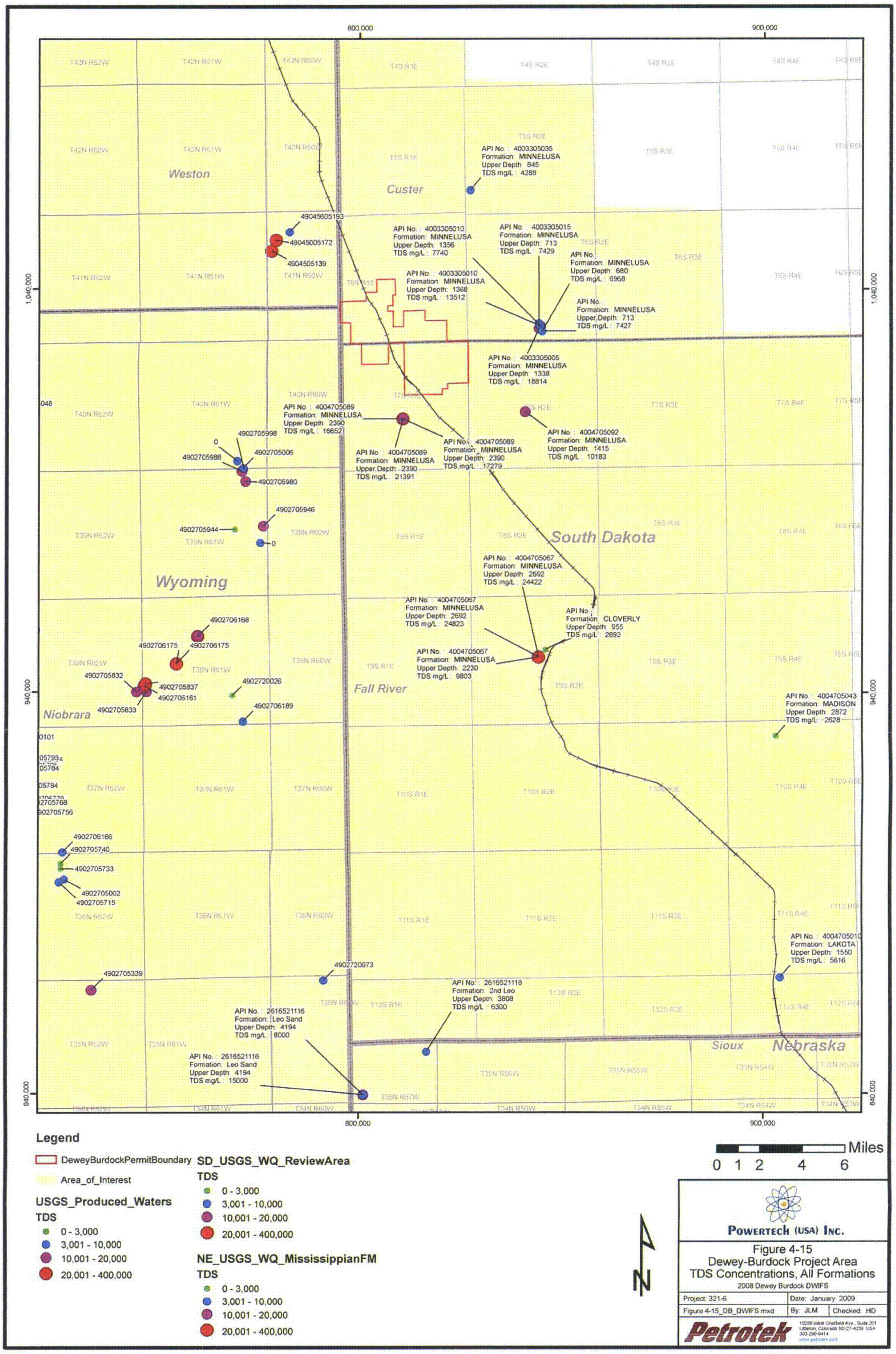

Figure 4.2-1: Dewey-Burdock Project Area TDS Concentrations, All Formations

The injection zone for each well is intended to be determined from deep exploratory drilling and collection of fluid sample data from multiple injection target zones. The expected targeted zones consist of the Minnelusa formation or deeper. Formations in consideration are the Minnelusa, Leo Sandstone, Madison, and Deadwood. Regional cross sections (Figures 2.1-2 and 2.1-3) including existing geophysical data which typically ends in the lower portion of the Leo formation and upper Madison formation. Current data does not include the Deadwood formation which is a potential target below the Madison formation. Results of the exploratory sampling prior to installing the wells, will allow proper selection location of the injection activity based upon the determination of water quality throughout all of these formations,

Existing water quality data from oil gas exploration and development in the area is presented in Figure 4.2-1. Several analyses indicate TDS concentrations above 10,000 ppm meeting the underground injection control (UIC) program criteria for suitability for injection.

The proposed ponds for extraction of radium are shown on Supplemental Exhibit 3.1-3 as Radium Settling Ponds. Should water quality standards and the geological subsurface characteristics meet the UIC criteria for disposal of all constituents within the waste water, radium settling ponds would not be utilized.

Waste will consist primarily of the bleed streams from production and restoration operations. Typically these streams will be concentrated by reverse osmosis (RO) to minimize waste volume. In addition, these streams will also be combined with lesser amount of fluid generated by the central processing plant and consisting of waste brine from the elution process. The combined waste stream will fall under the classification of non-hazardous, 11(e)2 waste suitable for deep injection well disposal under EPA Class V regulations.

4.2.1 Disposal Well Design

Figures 2.1-2 and 2.1-3 depict the section that will be proposed for permitting. It is clear from these cross sections that the depth and character of the horizon is of sufficient thickness to support the application for a Class V permit.

Well construction will meet EPA requirements; the general construction details are described in Figure 4.2-2. The general description of the design consists of a cemented steel casing from total depth to surface, an internal tubing string, and a packer sealing the casing just above the point of

injection. Injection is performed through the tubing and through the packer to the perforations below. The annulus between the tubing and well casing will be continuously monitored to prevent any potential leakage of the injected waste fluid into overlying formations. Operational procedures also include a mechanical integrity testing of the casing to additionally insure against well leakage, with results submitted to all appropriate agencies for approval of injection of non-hazardous waste water with appropriate controls.

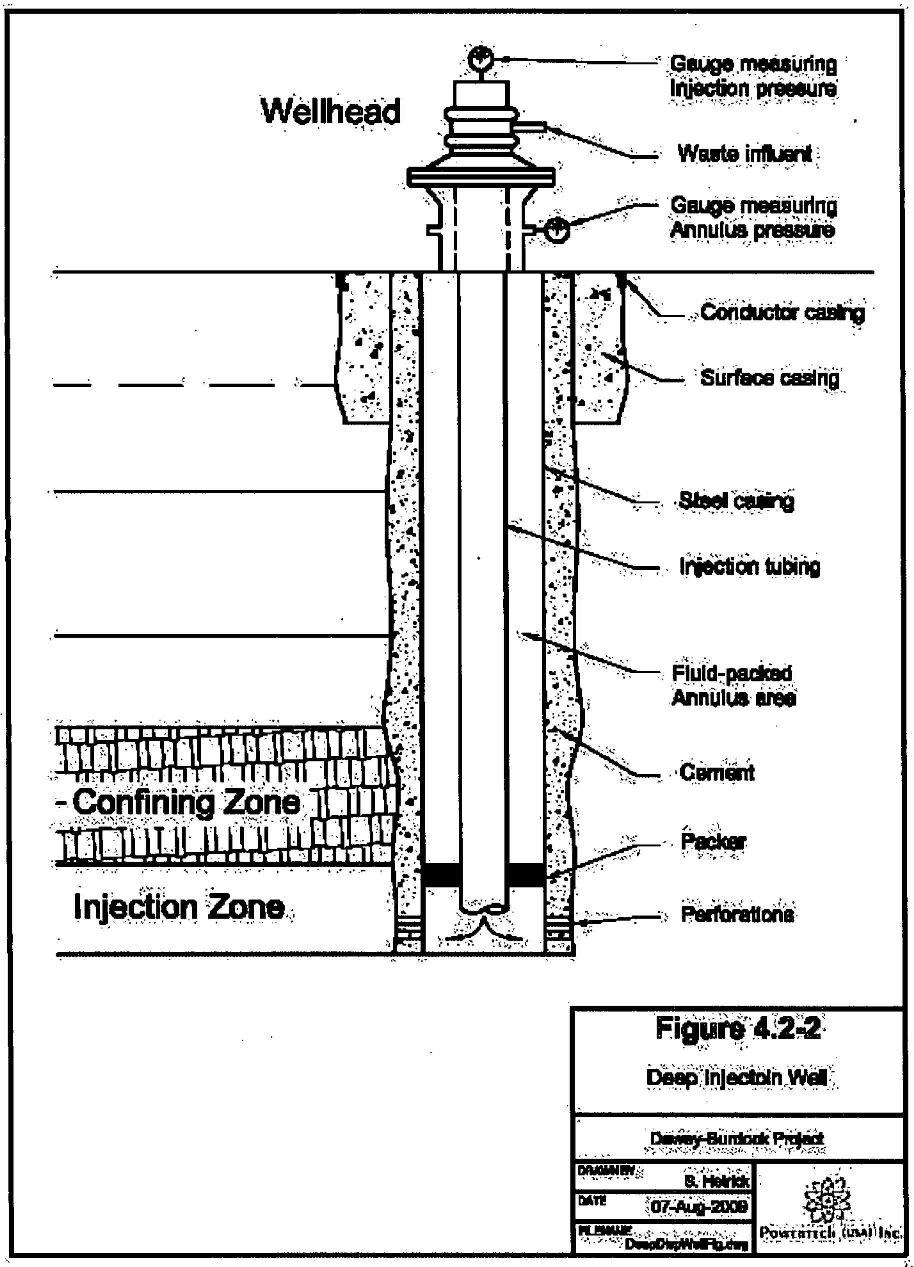

Figure 4.2-2: Deep Injection Well

4.2.1.1 Radon Releases

As required by 10 CFR Part 20.2002, the option of deep well disposal of treated process water has also been considered and the offsite dose resulting from periodic maintenance of the deep well has to be considered. The locations of the proposed deep wells correspond to the CPP and

the Satellite Facility as presented in Supplemental Exhibit 3.1-3. Ten percent of the radon-222 contained in the production fluid is assumed to be released in the well field and another 10 percent released at the processing facilities. The same fractional releases are assumed for the restoration fluids. The deep well will be used to dispose the restoration and production fluid bleed which is estimated to be 3 percent of the respective production flow and restoration flow rates. The release of radon-222 from this bleed is incorporated into the assumed 10 percent releases calculated for production and restoration at the Central Processing Plant and Satellite Facility. These release estimates are shown in Table 3.2-1. Off-site doses resulting from period maintenance of the deep well has been accounted for in this dose assessment.

Table 4.2-1: Estimated Releases (Ci y-1) of Radon-222 from the Dewey-Burdock Site

Location	X (km)	Y (km)	Production	Restoration	Drilling	Resin Transfer	Land Application	Total
Production Mine Unit (5)	-3.86	3.48	212	26.5	3.6E-05	0	0	238.5
Production Mine Unit (2)	1.83	-0.56	212	26.5	3.6E-05	0	0	238.5
SF	-5.00	3.54	134	16.7	0	0.523	0	
SF Deep Well	-5.00	3.54	57	7.1	0	0	0	
Total SF			191	23.8		0.523		215.3
CPP	0	0	134	16.7	0	0	0	
CPP Deep Well	0	0	57	7.1	0	0	0	
Total CPP			191	23.8	0	0	0	214.8
Land Application - Dewey	-6.02	3.80	0	0	0	0	6.08	6.08
Land Application - Burdock	-1.09	0.99	0	0	0	0	7.49	7.49
Total			806	100.6	7.2E-05	0.523	14.0	921

In the event that deep well disposal cannot be accomplished, Powertech proposes an alternative method of disposal of liquid wastes. The Land Application Option is discussed below.

4.3 Land Application Option

Supplemental Exhibit 3.1-2 describes the proposed location of the Radium Settling Ponds that would be used prior to land application. In addition to the Radium Settling Ponds, wastewater holding ponds would be necessary for land application due to the lower evaporation rate in winter time. Powertech proposes the use of irrigation pivots to apply non hazardous waste water that meets the effluent discharge standards to the surface in order to grow grasses for cattle forage. This method was used regularly at Hobson, Mount Lucas and Highlands with no deleterious effect on the environment.

4.4 Pond Design

This Section provides further information regarding pond design as discussed in Section 3.1.5 of the Technical Report.

It is proposed that depending on the method of disposal ultimately selected, that all final data and design of as-built ponds will be submitted to the NRC and all appropriate agencies. The complete package will include design under the strictest engineering standards and will be designed and signed off by certified professional engineers.

The following information is to supplement Section 3.1.5 Pond Design and Land Application of the Technical Report. Revised pond and water application designs for the land application option and pond designs for the deep well disposal option are presented in the Pond Design Report provided in Appendix B. These designs have been completed following NRC Regulatory Guide 3.11-Rev. 1, NUREG 1569, 10 CFR Part 40, Appendix A, Criterion 5 and State of South Dakota Administrative Rule 74:29:11:23. A summary of the designs for both liquid waste disposal options is provided below.

4.4.1 Land Application Ponds

The land application option includes 6 categories of ponds:

- Radium settling ponds containing bleed and restoration water and used to settle radium out of solution.
- Outlet ponds used to intercept treated water from the radium settling ponds and to store storm water falling on the radium settling ponds.
- Storage ponds used to store treated water during the non-irrigation season.
- A central plant pond containing brine produced at the Burdock Plant site.

- A spare pond used for emergency containment should the radium settling or central plant ponds fail.
- A spare storage pond used for emergency containment should any of the storage ponds fail or portions of the land application system become temporarily inoperable.

The design of the land application ponds includes the following:

- Two radium settling ponds, one each at the Dewey and Burdock, having a storage capacity of 39.4 acre-ft each.
- Two outlet ponds, one each at the Dewey and Burdock sites having a storage capacity of 4.9 acre-ft each.
- Two sets of storage ponds:
  - A system of 4 ponds constructed at the Dewey Site each having a storage capacity of 63.8 acre-ft.
  - A system of 4 ponds constructed at the Burdock Site each having a capacity of 63.8 acre-ft.
- Two spare storage ponds, one each at Dewey and Burdock sites having a storage capacity of 63.8 acre-ft.
- A central plant pond at the Burdock Site having a capacity of 36.2 acre-ft.
- Two spare ponds, one each at Dewey and Burdock sites having a capacity of 39.4 acre-ft.

4.4.2 Deep Well Disposal Ponds

The deep well disposal option includes five categories of ponds:

- Radium settling ponds, containing bleed water and restoration water and used to settle radium out of solution.
- Outlet ponds used to intercept treated water from the radium settling ponds and to store storm water falling on the radium settling ponds.
- A surge pond, containing water that has been treated and which is to be pumped to the disposal wells.
- A spare pond used for emergency containment should a liner on any of the ponds fail.
- A central plant pond containing brine produced at the Burdock Plant Site.

The design of the deep disposal well ponds includes the following:

- Two radium settling ponds, one each at the Dewey and Burdock having a storage capacity of 15.9 acre-ft each.
- Two outlet ponds, one each at the Dewey and Burdock sites having a storage capacity of 5.1 acre-ft each.
- Two surge ponds, one each at the Dewey and Burdock sites having a storage capacity of 8.4 acre-ft each.
- A central plant pond at the Burdock site having a capacity of 15.9 acre-ft.
- Two spare ponds, one each at the Dewey and Burdock sites having a capacity of 15.9 acre-ft.

All ponds have been designed to store water reporting to them while maintaining 3 ft of freeboard. The geometry and storage characteristics of the radium settling ponds have also been checked to verify that they will allow the efficient removal of radium from solution.

The radium settling, spare and central plant ponds will be provided with the following lining system:

- An 80-mil-HDPE primary liner
- A 60-mil-HDPE secondary liner
- A 1-ft-thick clay liner below the secondary liner
- A geonet drainage layer sandwiched between the primary and secondary HDPE liners
- A leak detection sump and access port system.

All other ponds will contain treated water that is either to be used for land application or deep well disposal. These ponds will include a single 40-mil-HDPE liner underlain by a 1-ft-thick clay liner.

The results of the stability analyses calculated for the embankments using three different methods of analysis; Bishop Method, Janbu Method and Morgenstern-Price Method indicate that the slopes are stable under both static and MCE seismic loading conditions.

Precipitation falling in the land application areas will be contained within those areas and in evaporation pans located adjacent to them, from where it will evaporate. The Soil Plant Air Water (SPAW) modeling indicates that there will be no percolation beyond the base of the soil profile from the land application system and therefore no potential impact to groundwater. Also the underlying Graneros Group provides a low permeability barrier to any potential seepage from land application.

The ponds provided for the land application design all have larger storage volumes than the ponds provided for the deep well disposal option, which is discussed in Section 4.0 of Appendix B. Therefore, the land application ponds would also operate satisfactorily for deep well disposal.