DRAFT CUMULATIVE EFFECTS ANALYSIS OF THE DEWEY-BURDOCK URANIUM IN-SITU RECOVERY UNDERGROUND INJECTION CONTROL AREA PERMITS

1.0 EXECUTIVE SUMMARY

The EPA Region 8 Underground Injection Control (UIC) Program is proposing the issuance of two UIC Area Permits to Powertech (USA) Inc. (Powertech) for injection activities related to uranium recovery. One is a UIC Class III Area Permit for injection wells related to the In-Situ Recovery (ISR) of uranium; the second is a UIC Class V Area Permit for deep injection wells that will be used to dispose of ISR process waste fluids into the Minnelusa Formation after treatment to meet radioactive waste and hazardous waste standards. Powertech requested approval for the exemption of portions of the Inyan Kara aquifers containing uranium ore deposits in conjunction with the UIC Class III permit application.

The UIC regulation for Area Permits found at 40 Code of Federal Regulations (CFR) § 144.33(c)(3) requires the EPA to take into account the cumulative effects of drilling and operation of the additional injection wells proposed under an area permit during evaluation of the permit application. This document contains a discussion of the EPA's analysis of cumulative effects resulting from the drilling and operation of the Class III and Class V injection wells at the Dewey-Burdock site and the findings based on the analysis of each type of impact.

The Dewey-Burdock Project Area is located in southwestern Custer County and northwestern Fall River County in South Dakota on the Wyoming-South Dakota state line. The Dewey-Burdock Project Area is outlined in black line in Figure 1. Figure 2 shows the Dewey-Burdock Project Area with the ISR wellfield locations, the proposed locations for the deep injection wells and the aquifer exemption boundary requested by Powertech.

The Dewey-Burdock Project Area of Review proposed in Powertech's Class III Application is the area for which the EPA analyzed the cumulative effects from the drilling and operation of injection wells. The Area of Review includes the Dewey-Burdock Project Area and a buffer zone of 1.2 miles outside the Project Area boundary. The Area of Review is discussed in Section 4.0 of the UIC Class III Draft Area Permit Fact Sheet. Plate 3.1 of the Class III permit application shows the Area of Review boundary. This area corresponds to the same area investigated by the Nuclear Regulatory Commission (NRC) for impacts to groundwater discussed in the Dewey-Burdock Project Supplemental Environmental Impact Statement (SEIS) developed for the issuance of the source material license. The EPA expanded the boundary of investigation for the cumulative impacts to air to 20 miles beyond the Dewey-Burdock Project Boundary based on the predictive air models as discussed in Section 10 of this document, to include the predicted impacts on Wind Cave National Park.

As part of the review of the permit applications, the EPA has considered the cumulative effects to the environment of drilling and operation of the Class III and Class V injection wells as discussed in this document. As a result of permit application review in light of analyzing potential cumulative effects, the EPA has included several protective permit requirements in each of the two Area Permits. These extensive permit requirements take into account that: 1) the Dewey-Burdock Project Site is located in the southern Black Hills, an area of sacred and historic interest to a number of tribal nations and 2) the deep well injection zone is located just above the Madison Formation, which is a prolific aquifer in western South Dakota and serves as the source

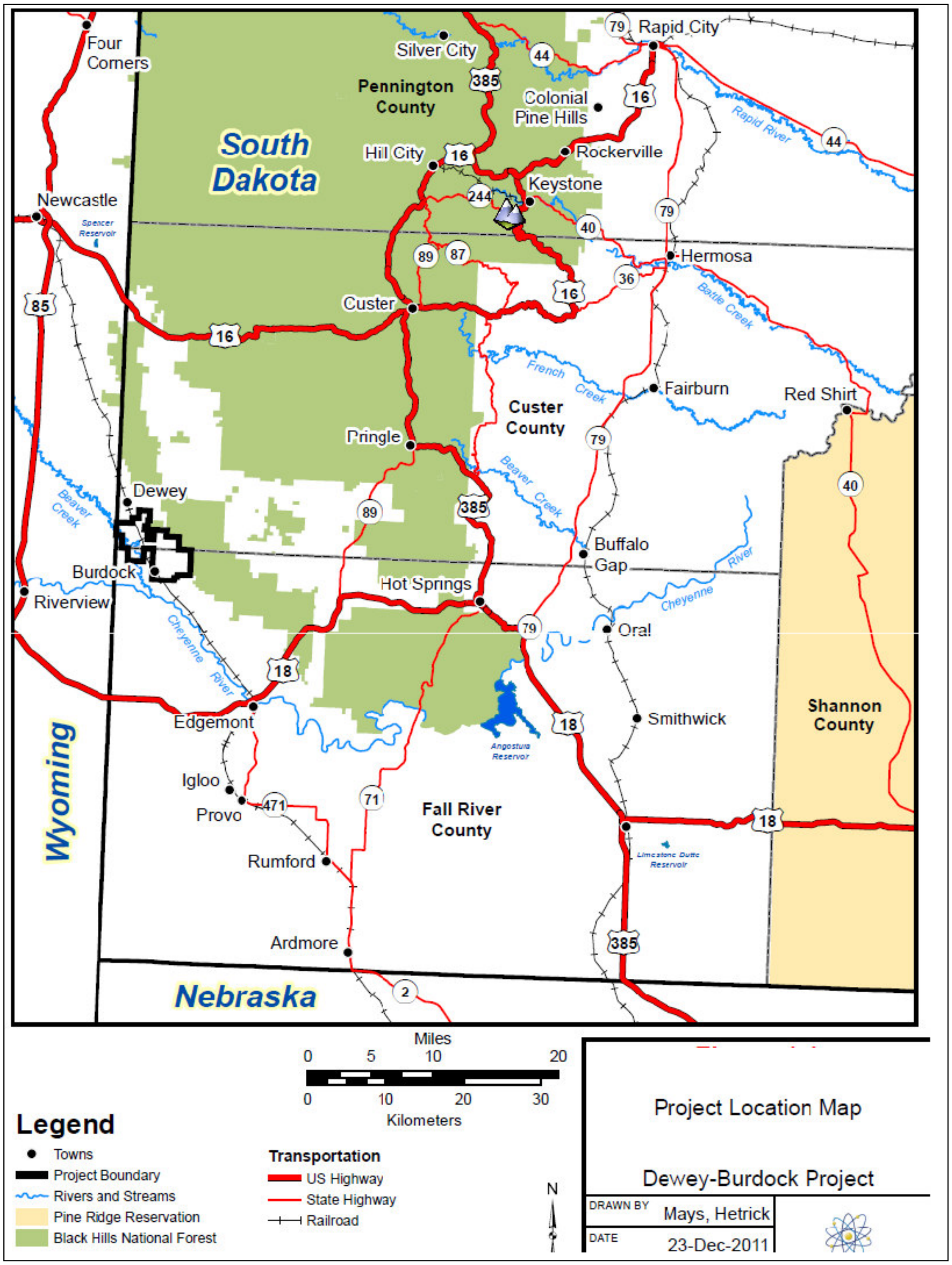

Figure 1. Location of Dewey-Burdock Project Area

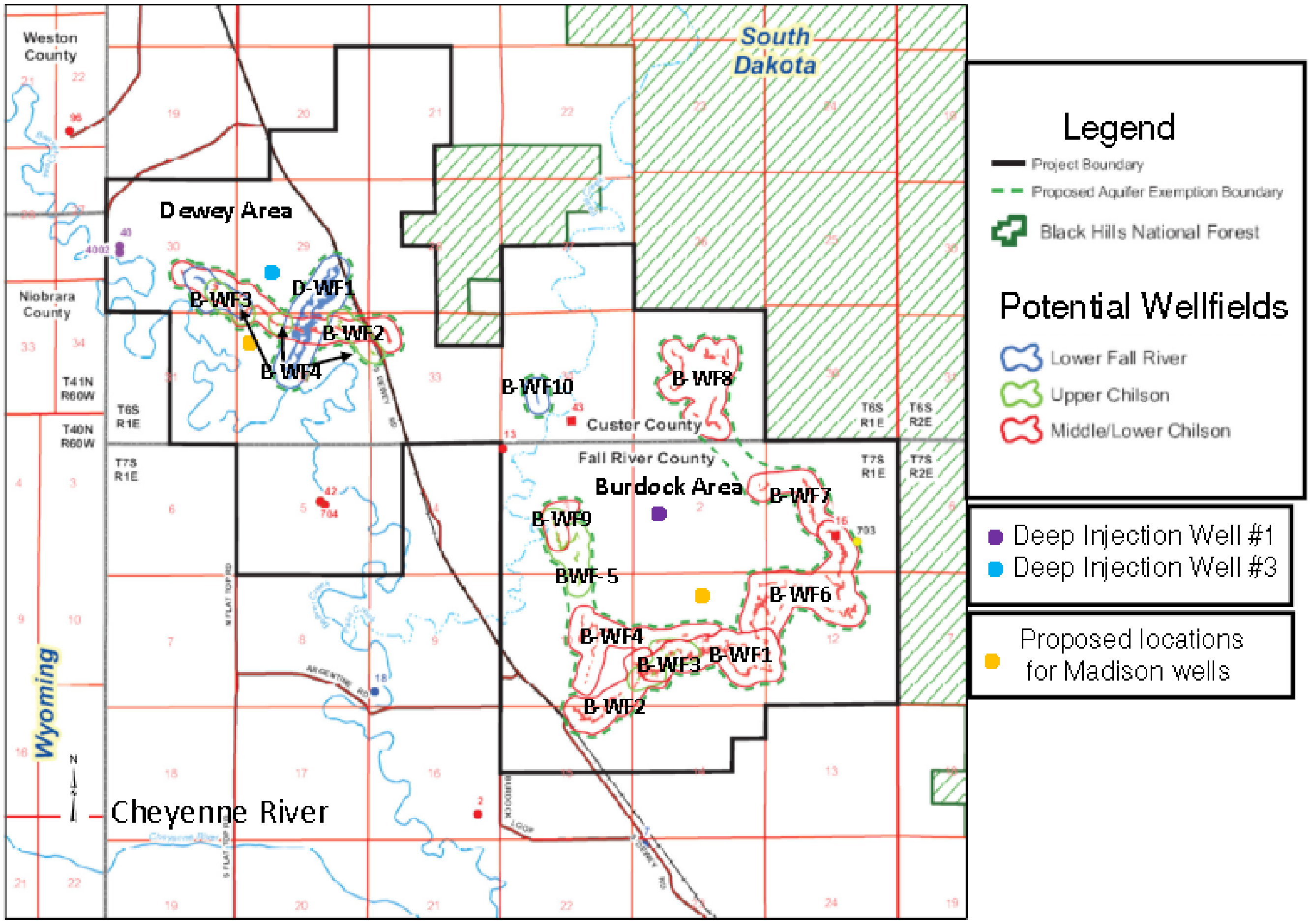

Figure 2. The Dewey-Burdock Project Area

for public drinking water systems. The cumulative effects analysis takes into account the protective permit requirements in each of the Area Permits that must be met before the EPA will authorize operation of the injection wells, including:

1. Extensive evaluation and characterization of injection zone and confining zone hydrogeologic conditions;
2. Protective construction and operating requirements for injection wells; and
3. Demonstration that extensive monitoring programs are in place that are designed to detect any threat to underground sources of drinking water (USDWs) in a timely manner enabling Powertech to implement mitigation measures before USDWs are actually impacted.

The EPA reviewed information in the NRC SEIS and the proposed South Dakota Department of Environment and Natural Resources (DENR) Large Scale Mine Permit. These were the two main documents containing information about cumulative effects. Table 1 includes the list of areas where cumulative effects were evaluated with references to sections in these two documents where information was reviewed. The EPA also reviewed the NRC Safety Evaluation Report, the Powertech water rights permit applications and associated DENR Water Rights Program reports and the DENR Air Program Statement of Basis. Powertech must also apply and obtain a National Pollutant Discharge Elimination System (NPDES) permit from the DENR. The EPA considered the monitoring and mitigation measures that will be required under this permit in evaluation of cumulative effects. In summary, the EPA considered the protective UIC Area Permit requirements, the NRC license requirements and DENR evaluations, permit requirements and mitigation measures as described in each section of this document. Based on evaluation of all this information, the EPA has determined that the environmental concerns related to the cumulative effects of the drilling and operation of the injection wells proposed under the UIC Area Permits are acceptable if Powertech implements the applicable proposed prevention, mitigation, remediation, reclamation or restoration procedures identified for each type of impact discussed. If Powertech does not implement the applicable proposed prevention, mitigation, remediation, reclamation or restoration procedures identified for each type of impact discussed in this document and the result is that environmental concerns resulting from the impact are no longer acceptable, the UIC Director may decide to modify the Class III and/or V Area Permits according to 40 CFR § 144.39 and § 124.5.

Table 1. Areas the EPA Evaluated for Cumulative Effects and References to Document Sections Reviewed

<table>
<tr><th>DENR Large Scale Mine Permit
Section 5.6 Potential Impacts and Mitigation</th><th>NRC SEIS
Section 4 Environmental Impacts</th></tr>
<tr><td>5.6.1 Land Use</td><td>4.2 Land Use Impacts</td></tr>
<tr><td></td><td>4.3 Transportation Impacts</td></tr>
<tr><td>5.6.2 Soils</td><td>4.4 Geology and Soils Impact</td></tr>
<tr><td>5.6.3 Groundwater</td><td>4.5.2 Groundwater Impacts</td></tr>
<tr><td>5.6.4 Surface Water</td><td>4.5.1 Surface Water Impacts</td></tr>
<tr><td>5.6.5 Spills and Leaks</td><td rowspan="2">4.13.1.1.2.2 Radiological Impacts From Accidents - deep well disposal method
4.13.1.2.2.2 Radiological Impacts From Accidents - land application disposal method</td></tr>
<tr><td>5.6.6 Potential Accidents</td></tr>
<tr><td>5.6.9 Potential Radiological Impacts and Effluent Control System</td><td>4.13 Public and Occupational Health and Safety Impacts</td></tr>
<tr><td>5.6.10 Air Quality</td><td>4.7 Air Quality Impacts</td></tr>
<tr><td>5.6.11 Ecological Resources</td><td>4.6 Ecological Resources Impacts</td></tr>
<tr><td></td><td>4.14 Waste Management Impacts</td></tr>
</table>

Although Powertech's current design for the treatment and storage of ISR waste fluids do not appear to meet the requirements under Clean Air Act regulations found out 40 CFR part 61, subpart W, the UIC Draft Area Permits require Powertech to submit information to the Region 8 Air Program for the EPA to determine the applicability of the subpart W regulations, and if necessary, receive construction approval from the EPA Air Program.

2.0 INTRODUCTION

The EPA Region 8 Underground Injection Control (UIC) Program is proposing the issuance of two UIC Area Permits to Powertech for injection activities related to uranium recovery and an accompanying aquifer exemption. One is a UIC Class III Area Permit for injection wells related to the ISR of uranium; the second is a UIC Class V Area Permit for deep injection wells that will be used to dispose of ISR process waste fluids into the Minnelusa Formation after treatment to meet radioactive waste and hazardous waste standards. The proposed aquifer exemption is associated with the Class III permit.

The UIC regulation for Area Permits found at 40 CFR § 144.33(c)(3) requires the EPA to take into account the cumulative effects of drilling and operation of the additional injection wells proposed under an area permit during evaluation of the permit application. This document contains a discussion of the analysis of cumulative effects resulting from the drilling and operation of the Class III and Class V injection wells at the Dewey-Burdock site.

The EPA analysis of the cumulative effects of the drilling and operation of the injection wells proposed under the UIC Area Permits includes review of information in: 1) the NRC SEIS, 2) the proposed South Dakota DENR Large Scale Mine Permit, 3) the NRC Safety Evaluation Report, 4) the Powertech water rights permit applications and DENR Water Rights Program reports, 5) the DENR Air Program Statement of Basis, and 6) additional references included in this document.

The EPA NEPA program reviewed the NRC SEIS and gave the draft SEIS a rating of EC-2. The *EC (Environmental Concerns)* rating indicates the EPA review identified environmental impacts that should be avoided in order to fully protect the environment. Corrective measures may require changes to the preferred alternative or application of mitigation measures that can reduce the environmental impact. The numerical *Category 2 - Insufficient Information* rating indicates the draft EIS does not contain sufficient information to fully assess environmental impacts that should be avoided in order to fully protect the environment, or the reviewer has identified new reasonably available alternatives that are within the spectrum of alternatives analyzed in the draft EIS, which could reduce the environmental impacts of the proposal. The identified additional information, data, analyses, or discussion should be included in the final EIS. Some of these concerns were addressed in the Final SEIS. However, the EPA review letter for the Final SEIS included discussion of some remaining concerns and suggestions for how to address them.

The EPA review of the cumulative effects of the drilling and operation of the injection wells proposed under the UIC Area Permits for each impact discussed includes corrective measures or mitigation measures as applicable to reduce the potential environmental impacts identified and, in some cases, includes additional information, data, analyses or discussion. The EPA findings for each impact area are based on both the NEPA paradigm that evaluates prevention and mitigation measures to reduce environmental impacts and the UIC paradigm under 144.33(c)(3) which states that the UIC Director must find the cumulative effects of the drilling and operation of the additional wells proposed under an area permit to be acceptable in order to issue the area permit.

The scope of this analysis is similar to the NRC analysis included in SEIS Section 4, *Environmental Impacts of Construction, Operations, Aquifer Restoration, and Decommissioning Activities and Mitigative Actions*, which evaluates the potential impacts from the proposed project. In contrast, SEIS Section 5, *Cumulative Impacts*, considers the impacts of other past, present, and reasonably foreseeable future actions in addition to the proposed project impacts. The other actions evaluated include other uranium recovery sites, coal mining, oil and gas production, wind power, transportation projects and other mining activities. The purpose of this cumulative effects analysis is to consider the effects of the drilling and operation of the multiple injection wells authorized under the two UIC Area Permits.

3.0 IMPACTS TO USDWs

Potential impacts to USDWs include groundwater consumption, water level drawdown in nearby water supply wells, potential groundwater quality impacts and potential for subsidence. Each of these topics is discussed below.

3.1 Potential Groundwater Consumption

The EPA reviewed the information Powertech provided in UIC Class III Permit Application related to injection flow rates, the information Powertech submitted to the South Dakota DENR Water Rights Program in the water rights permit applications for the Inyan Kara Aquifers[1] and Madison Aquifer[2] and the Reports to the Chief Engineer[3,4] containing analyses and recommendations for each water rights permit application written by DENR Water Rights Program staff. This information is summarized in Section 9.3 of the Class III Area Permit Fact Sheet and Section 7.7.1 of the Class V Area Permit Fact Sheet. After reviewing the information discussed below, the EPA concludes that Powertech's proposed consumptive use of the Inyan Kara and Madison aquifers, as it relates to the drilling and operations of the injection wells proposed under the UIC area permits, should not affect the availability of groundwater for other users of these aquifers.

3.1.1 Inyan Kara Aquifers

The ISR process of injection and pumping from production wells circulates significant quantities of water through the ore zone, but only a small fraction of that water is withdrawn and not reinjected back into the aquifer. Most of the groundwater extracted from the production wells as uranium-bearing lixiviant is reinjected back into the wellfield as barren lixiviant. During groundwater restoration, contaminated water is pumped from the wellfield injection interval, treated with reverse osmosis, and most of the clean permeate from the reverse osmosis treatment process is reinjected. Class III Area Permit requires that Powertech maintain hydraulic control of each wellfield by injecting a lower volume of fluids into the wellfield than the production wells are pumping out of the wellfield. The difference between the fluid volume being pumped out of the wellfield and the fluid volume being injected is the wellfield *bleed*. *Bleed* is defined as excess ISR operation or restoration solution withdrawn to maintain a cone of depression so native groundwater continually flows toward the center of the wellfield. The wellfield *bleed* is an additional waste fluid from the ISR operation as described in the Fact Sheet for the UIC Class V Area Permit under Section 7.8 *Approved Injectate and Injectate Permit Limits*. This bleed constitutes the net water withdrawal from the Inyan Kara aquifer. Nominal bleed rates of 0.5 to 1% are planned over the life of the project, with a design average bleed rate of 0.875%. Instantaneous ISR operational bleed may vary in the range of 0.5 to 3% for short durations, from days to months. If necessary, additional groundwater restoration bleed (up to 17%) will be used briefly during groundwater restoration to recover additional solutions and draw a greater influx of water into the ore zone from the surrounding Inyan Kara aquifer. This process is known as groundwater sweep.

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[1] *Dewey-Burdock Project Report to Accompany Inyan Kara Water Right Permit Application Custer and Fall River Counties, South Dakota*, prepared by Powertech (USA), Inc. for the South Dakota Department of Environment and Natural Resources, Water Rights Program, June 2012.

[2] *Dewey-Burdock Project Report to Accompany Madison Water Right Permit Application Custer and Fall River Counties, South Dakota*, prepared by Powertech (USA), Inc. for the South Dakota Department of Environment and Natural Resources, Water Rights Program, June 2012.

[3] Report to the Chief Engineer on Water Permit Application No. 2685-2, Powertech (USA) Inc., November 2, 2012. [for Madison aquifer]

[4] Report to the Chief Engineer on Water Permit Application No. 2686-2, Powertech (USA) Inc., November 2, 2012. [for Inyan Kara aquifer]

Table 18 in Section 9.3 of the Class III Area Permit Fact Sheet shows the anticipated project-wide flow rate that will occur during uranium recovery, groundwater restoration and concurrent uranium recovery and groundwater restoration and is included here as Table 2. The water balance is discussed in more detail in the Class III Area Permit Fact Sheet Section 9.3.

Table 2. Anticipated Project-Wide Injection Flow Rates Corresponding to Maximum Anticipated Gross Pumping Rates and Bleed Rates (without Groundwater Sweep)

Operation Phase	Extraction Flow Rate (gpm)	Bleed (%)	Injection Flow Rate (gpm)	Bleed (gpm)
Uranium Recovery	8,000	0.875%	7,930	70
Groundwater restoration	500	1.0%	495	5
Concurrent Uranium Recovery and Groundwater restoration	8,500	0.88%	8,425	75

Table 3 summarizes the resulting anticipated Inyan Kara water usage for the Dewey-Burdock Project. During uranium recovery (ISR operations), Powertech proposes to pump up to 8,000 gallons per minute (gpm) from the Inyan Kara aquifer. The expected ISR operational bleed rate will be 0.875%. Therefore, the net ISR operational withdrawal is expected to be up to 70 gpm. During groundwater restoration, Powertech proposes to pump up to 500 gpm from the Inyan Kara aquifer. The restoration bleed will vary from about 1% to 17%. Therefore, the net groundwater restoration withdrawal will be up to 85 gpm. During concurrent ISR operation and restoration, the anticipated maximum gross and net usage from the Inyan Kara (on an annual average basis) will be 8,500 gpm and 155 gpm, respectively. The net usage of the Inyan Kara aquifer groundwater, which is the amount lost from the aquifer, is a small amount and within the requirements of the South Dakota law, as discussed below. To put these groundwater usage rates into perspective, a center-pivot irrigation system with 100% efficiency, pumping 24 hours a day, seven days a week at 155 gpm would irrigate a 125.6-acre circular area within a quarter section, applying 0.457 inch of water per week.

Table 3. Anticipated Inyan Kara Aquifer Water Usage (in gpm) during Concurrent Operation and Restoration (from Table 5.6-1: Typical Inyan Kara Water Usage in the Large Scale Mine Permit Application)

Usage	Amount
Production Only	
Gross Inyan Kara Pumping, gpm	8,000
Net Inyan Kara Usage (0.875% bleed), gpm	70
Aquifer Restoration Only	
Gross Inyan Kara Pumping, gpm	500
Net Inyan Kara Usage (1% bleed), gpm	5
Net Inyan Kara Usage (17% bleed), gpm	85
Concurrent Production and Restoration	
Gross Inyan Kara Pumping, gpm	8,500
Net Inyan Kara Usage (1% aquifer restoration bleed), gpm	75
Net Inyan Kara Usage (17% aquifer restoration bleed), gpm	155

Table 4 (Table 2-1 in Powertech's Report to Accompany Inyan Kara Water Right Permit Application) shows the same information that is shown in Table 3 along with the proposed appropriation, or water quantity, that Powertech is requesting from the South Dakota Water Rights Program shown in both gpm and acre-feet per year. Powertech estimates that a maximum net withdrawal rate of 170 gpm will be required to achieve production goals. This equates to about 0.38 cubic feet per second (cfs) or, if sustained for an entire year, 274.2 ac-ft. This net withdrawal represents about 2% of the gross withdrawal, with the other 98% being recirculated through the wellfield. Powertech's Application for a Permit to Appropriate Water from the Inyan Kara is for the gross withdrawal rate of up to 8,500 gpm, which equates to 18.938 cfs or 13,710.6 ac-ft per year. Powertech will not exceed this maximum withdrawal rate at any time during the life of the project. Powertech proposes to minimize groundwater use during operations by limiting ISR operational and restoration bleed to the minimum amount needed to ensure hydraulic wellfield control. Powertech also proposes selecting restoration methods that will minimize water consumption during groundwater restoration.

Table 4. Maximum Estimated Inyan Kara Usage (in gpm) and Requested Appropriation Volume (in gpm) (from Table 2-1 in Powertech's *Report to Accompany Inyan Kara Water Right Permit Application*)

Usage	Amount
Production Only	
Gross Inyan Kara Pumping, gpm	8,000
Net Inyan Kara Usage (0.875% bleed), gpm	70
Aquifer Restoration Only	
Gross Inyan Kara Pumping, gpm	500
Net Inyan Kara Usage (1% bleed), gpm	5
Net Inyan Kara Usage (17% bleed), gpm	85
Concurrent Production and Restoration	
Gross Inyan Kara Pumping, gpm	8,500
Net Inyan Kara Usage (1% aquifer restoration bleed), gpm	75
Net Inyan Kara Usage (17% aquifer restoration bleed), gpm	155
Proposed Maximum Annual Average Gross Pumping Rate, gpm	8,500
Proposed Maximum Annual Average Net Withdrawal Rate, gpm	170
Proposed Appropriation Amount (Gross), ac-ft/yr	13,710.6
Proposed Appropriation Amount (Net), ac-ft/yr	274.2

South Dakota Codified Law 46-6-3.1 stipulates that "No application to appropriate groundwater may be approved if, according to the best information reasonable available, it is probable that the quantity of water withdrawn annually from a groundwater source will exceed the quantity of the average estimated annual recharge of water to the groundwater source." South Dakota DENR Water Rights Program staff reviewed the available information on the Inyan Kara aquifer and concluded that the approval of Powertech's application will not result in average annual withdrawal from the Inyan Kara aquifer to exceed the average annual recharge to the aquifer and the proposed diversions can be developed without unlawful impairment of existing water rights.

The proposed DENR Inyan Kara water rights permit will require Powertech to control withdrawals from the Inyan Kara wells so there is not a reduction of needed water supplies in adequately constructed domestic wells or in adequately constructed wells having prior rights. The wells to which this requirement applies during operations are the wells located outside the Dewey-Burdock Project Boundary. As discussed later in Section 3.2.1.1, during operations, Powertech will take over control of all Inyan Kara wells located inside the project boundary. This is a necessary step to prevent these wells from being used during ISR operations, because pumping water from these wells may interfere with maintaining the inward hydraulic gradient at an ISR wellfield that is operating or being restored. Powertech may have to plug and abandon some of these private Inyan Kara wells inside the project boundary, if any are located close to an ISR wellfield and cause a breach in a confining zone. Powertech will provide an alternative water source to well owners by installing a Madison water supply well, as discussed in Section 3.2.1.1. After the project site has been decommissioned, the potentiometric surface of the Inyan Kara aquifers will return to pre-ISR conditions. Any Inyan Kara wells located within the project area that have not been plugged and abandoned will be available to their owners for use. However, the well owners may prefer to continue using the Madison water supply, because the water quality of the Madison aquifer is better than the water quality of the Inyan Kara aquifers.

The EPA reviewed Powertech's report entitled *Dewey-Burdock Project Report to Accompany Inyan Kara Water Right Permit Application Custer and Fall River Counties, South Dakota* and the DENR Water Rights Program staff report entitled *Report to the Chief Engineer on Water Permit Application No. 2686-2, Powertech (USA) Inc.* for the Inyan Kara aquifer, which is a technical assessment of Powertech's report.

As discussed in Section 11.0 of this document, the EPA evaluated climate change impacts on the region where the Dewey-Burdock Project Area is located. Chapter 19 of the *Climate Change Impacts in the United States* produced by the U.S Global Change Research Program discusses the impact of climate change in the Great Plains region. According to this report, winter and spring precipitation is projected to increase in the northern states of the Great Plains region, which indicates that the recharge to the Inyan Kara aquifers will not decrease from the recharge values used by the DENR Water Program during evaluation of Powertech's Inyan Kara water rights permit.

The EPA agrees with the DENR Water Program's conclusions that the approval of Powertech's application will not result in average annual withdrawal from the Inyan Kara aquifer to exceed the average annual recharge to the aquifer and the proposed diversions can be developed without unlawful impairment of existing water rights. Therefore, the EPA finds that Powertech's proposed net withdrawal of Inyan Kara groundwater should not affect the availability of groundwater for other Inyan Kara groundwater users.

3.1.2 Madison Aquifer

Powertech proposes to install up to two water supply wells completed in the Madison aquifer, one in the Dewey Area and one in the Burdock Area of the Project Site. The proposed locations for these wells are shown in Figure 2. These wells will supply water to the project site and to residents within the project area once Powertech takes over operation of their private wells. Powertech is requesting from the South Dakota Water Rights Program the appropriation of a maximum rate of 551 gpm (equivalent to 1.228 cfs or 888.8 ac-ft per year) from the Madison aquifer to cover the maximum volume required for the ISR operation.

South Dakota DENR Water Rights Program staff reviewed the available information for the Madison aquifer and concluded that an approval of Powertech's application will not result in average annual withdrawal from the Madison aquifer to exceed the average annual recharge to the aquifer and that there is reasonable probability that Powertech's consumptive use will not adversely impact existing water rights including domestic users.

Powertech determined that the flow within the Madison aquifer is more than three times the amount requested in their Application for a Permit to Appropriate Water from the Madison, and an estimate of the amount of water in storage in the vicinity of the project area will be less than 1 percent of the available water in storage in close proximity to the project area. The EPA agrees with the review and findings of the DENR Water Rights Program staff.

Table 5 summarizes the anticipated groundwater consumption from the Madison Limestone. This includes approximately 12 gpm usage at the Central Processing Plant plus groundwater restoration water. If the Class V deep injection wells are used for the disposal of process waste fluids, the water withdrawn from the wellfields will be treated with reverse osmosis, and resulting permeate will be reinjected along with Madison Limestone water into the wellfields. Based on an estimated permeate recovery rate of 70%, the Madison Limestone requirement will be 65 to 145 gpm at 17% and 1% groundwater restoration bleed, respectively.

Powertech has proposed two options for the disposal of treated ISR waste fluids: deep injection well disposal under an EPA UIC Class V well permit or land application under a DENR Groundwater Discharge Permit (GDP). If land application is used for the disposal of process waste fluids, then the reverse osmosis treatment process cannot be used because it generates a high concentration brine. Under the land application disposal method, all of the water withdrawn during groundwater restoration will be treated and disposed. The water will be replaced with water from the Madison Limestone or another suitable aquifer except for the restoration bleed, which will vary from 1% to 17%. Since the groundwater restoration pumping rate will be up to 500 gpm, between 415 and 495 gpm from the Madison Limestone will be reinjected into wellfields undergoing groundwater restoration.

Table 5. Anticipated Madison Aquifer Water Usage (in gpm) during Concurrent Operation and Restoration (Table 5.6-2: Typical Madison Water Usage from Large Scale Mine Permit Application)

Usage	Amount
Production Only	
CPP usage, gpm	12
Aquifer Restoration Only	
Deep Disposal Well Option	
CPP usage, gpm	12
Madison Usage (1% bleed), gpm	145
Madison Usage (17% bleed), gpm	65
Land Application Option	
CPP usage, gpm	12
Madison Usage (1% bleed), gpm	495
Madison Usage (17% bleed), gpm	415
Concurrent Production and Restoration	
Maximum Anticipated Madison Usage (DDW option), gpm	157
Maximum Anticipated Madison Usage (land application option), gpm	507

Table 6 is Table 2-1 in Powertech's *Report to Accompany Madison Water Right Permit Application* shows a different breakout of the maximum estimated Madison usage as shown in Table 4. The maximum anticipated Madison usage is one gallon per minute more in Table 5 than in Table 4. The proposed appropriation that Powertech is requesting is also shown in both gpm and acre-feet per year.

Table 6. Maximum Estimated Madison Usage (in gpm) and Requested Appropriation Volume (in gpm) (from Table 2-1 in Powertech's *Report to Accompany Madison Water Right Permit Application*)

Usage	Amount
Burdock Area Madison Usage	
Aquifer Restoration, gpm	248
Central Processing Plant, gpm	12
Total Burdock	**260**
Dewey Area Madison Usage	
Aquifer Restoration	248
Total Dewey	**248**
Maximum Anticipated Madison Usage, gpm	**508**
Proposed Appropriation Amount, gpm	**551**
Proposed Appropriation Amount, ac-ft/yr	**888.8**

Powertech is requesting a permit to appropriate up to 888.8 ac-ft of water annually, or 551 gpm, from the Madison aquifer for ISR operations. This is approximately equal to 1.228 cfs. Powertech proposes to construct up to two Madison wells within the project area. Depending on well yield and water demand, one well may be used to provide the necessary Madison water for the entire Dewey-Burdock Project, in which case Powertech would construct a pipeline between the Dewey Satellite Facility and Burdock Central Processing Plant to convey Madison water. Alternately, one well may be constructed at each of the Dewey and Burdock areas. If necessary due to low well yield, Powertech may apply for a modification to the water permit to allow the construction of additional Madison wells. Powertech does not anticipate requesting an increase in the total appropriation amount for the Dewey-Burdock Project, which is approximately 9% higher than the maximum estimated usage. Maximum estimated water usage and the proposed appropriation amounts are shown in Tables 5 and 6.

The EPA reviewed Powertech's report entitled *Dewey-Burdock Project Report to Accompany Madison Water Right Permit Application Custer and Fall River Counties, South Dakota* and the DENR Water Rights Program staff report entitled *Report to the Chief Engineer on Water Permit Application No. 2685-2, Powertech (USA) Inc.* for the Madison aquifer, which is a technical assessment of Powertech's report. The EPA agrees with the DENR Water Program's conclusion that it is probable that Powertech's annual usage of Madison groundwater over the life of the project will not exceed the expected annual recharge of the Madison aquifer and is, therefore, in compliance with South Dakota law.

As mentioned in the previous section, the EPA evaluated climate change impacts on the region where the Dewey-Burdock Project Area is located and found that winter and spring precipitation is projected to increase in the northern states of the Great Plains region. Increase in winter and spring precipitation indicates that the recharge to the Madison aquifer will not decrease from the recharge values used by the DENR Water Program during evaluation of Powertech's Madison water rights permits. The EPA agrees with the DENR Water Program's conclusion that it is probable that Powertech's annual usage of Madison groundwater over the life of the project will not exceed the expected annual recharge of these this aquifers and is, therefore, in compliance with South Dakota law. Therefore, the EPA finds that the impacts from Powertech's proposed net withdrawal of Inyan Kara groundwater will not affect the availability of groundwater for other Madison groundwater users.

3.2 Potential Drawdown of Aquifer Potentiometric Surfaces

When a well is installed in an aquifer, the aquifer potentiometric surface elevation is drawn down as the well is pumped. An aquifer's potentiometric surface is the level to which water in a well will naturally rise (i.e., to an elevation above the top of the aquifer it penetrates). If the well is pumped at a greater rate than the aquifer can provide water, the potentiometric surface may be drawn down below the level of the pump and the well will not provide enough water to the user. The EPA examined the potential drawdown in the potentiometric surfaces for the Inyan Kara and Madison aquifers to evaluate whether resulting drawdown may affect the availability of groundwater in wells completed in each aquifer outside the Project Boundary. Based on EPA's evaluation, although the potentiometric surface of each aquifer will be drawn down during ISR operations, the amount of drawdown will not affect availability of groundwater to well owners outside the Project Boundary.

3.2.1 Inyan Kara Aquifers

The EPA reviewed the information Powertech provided about the potentiometric surface drawdowns of the Inyan Kara Aquifers expected from the maximum gross pumping rate of 8,500 gpm Powertech is requesting from the DENR Water Rights Program. The EPA concludes that Powertech adequately modeled the potentiometric surface drawdown for the Fall River and Chilson aquifers. South Dakota DENR Water Rights Program staff reviewed the available information on the Inyan Kara aquifers and concluded that an approval of Powertech's application will not result in unlawful impairment of existing water rights. The EPA agrees with the DENR's determination. The EPA evaluated Powertech's modeling results showing expected Inyan Kara aquifer potentiometric surface drawdown outside the Dewey-Burdock Project Boundary during ISR activities. Estimated drawdown at the locations of private wells outside Dewey-Burdock Project Boundary shows that groundwater supplies at these wells should not be affected over the life of the project. In addition, the potentiometric surface elevations are expected to recover to within one to two feet at the locations of the pumping well after decommissioning of the project, so there should be no long-term effects of water levels outside the Dewey-Burdock Project Boundary.

3.2.1.1 Impacts to Inyan Kara Aquifers within the Dewey-Burdock Project Boundary

Powertech proposes removing all domestic wells within the Project Boundary from drinking water use and all stock wells within ¼ mile of wellfields to be removed from private use. Depending on the well construction, location and screen depth, Powertech may continue to use the well for monitoring or plug and abandon the well. Powertech will notify the well owner in writing prior to removing any well from private use and work with the well owner to determine whether a replacement well or alternate water supply is needed.

Powertech stated in the Class III Permit Application that replacement wells will be located an appropriate distance from the wellfields and will target an aquifer outside of the aquifer exemption area that provides water in a quantity equal to that of the original well and of a quality which is suitable for the same uses as the original well, subject to the lease agreement and South Dakota water law. The water supply aquifer proposed for this use is the Madison aquifer.

Lease agreements for the entire permit area currently allow Powertech to remove and replace the water supply wells as needed. The following is an excerpt from the lease agreements with each landowner. (Note: all lease agreements formerly held by Denver Uranium have been assigned to Powertech.)

> *DENVER URANIUM shall compensate LESSOR for water wells owned by LESSOR at the execution of this lease, as follows: Any such water which falls within an area to be mined by DENVER URANIUM, shall be removed from LESSOR's use. Prior to removal, DENVER*

URANIUM shall arrange for the drilling of a replacement water well or wells, outside of the mining area, in locations mutually agreed upon between LESSOR and DENVER URANIUM, as may be necessary to provide water in a quantity equal to the original well and of a quality which is suitable for all uses the original water well served at the time such well was removed from LESSOR's use.

An example of a replacement well is provided in Figure 3, which shows use of the project Madison well to supply water by pipeline to local stock tanks.

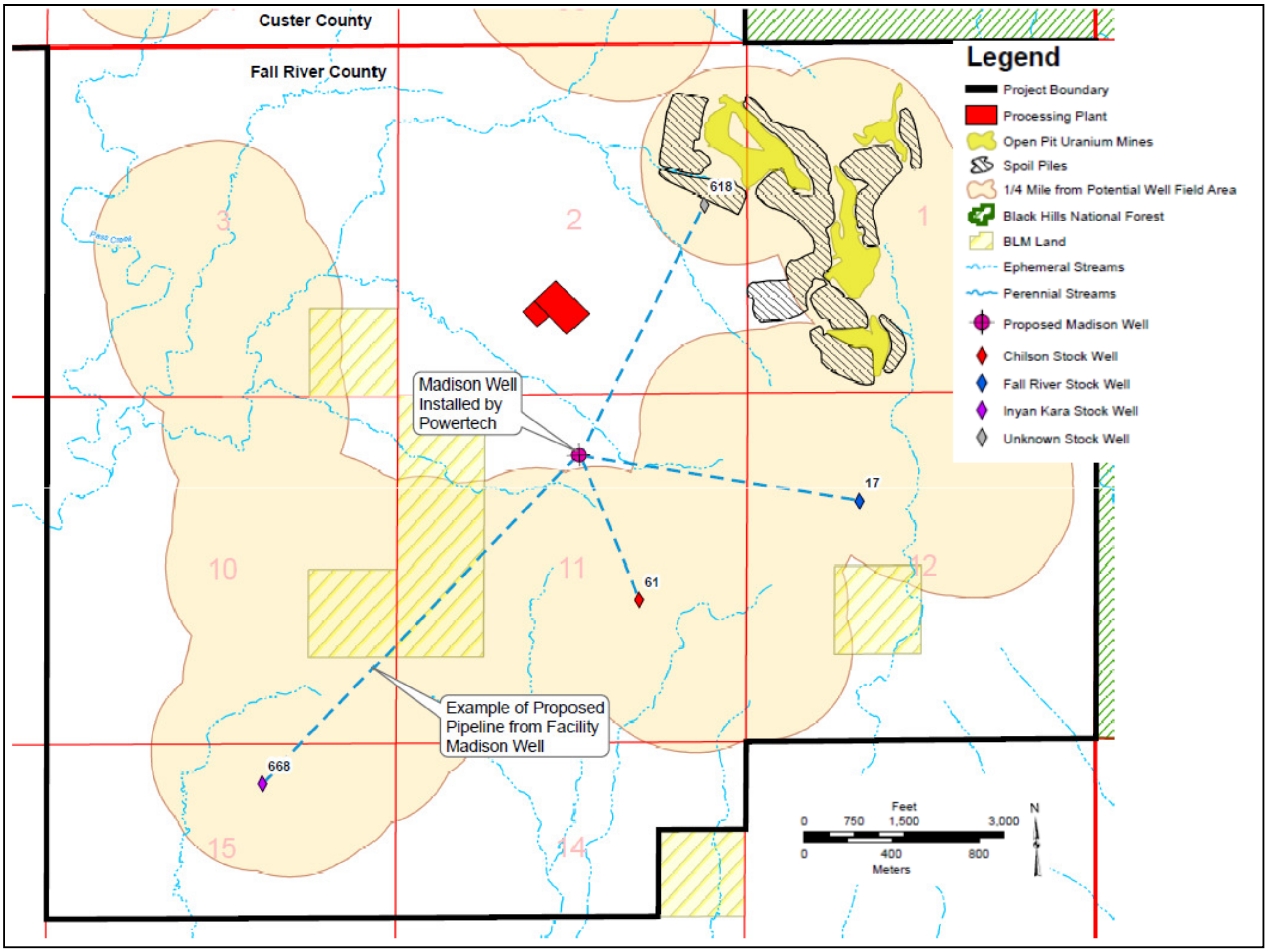

Figure 3. An Example of a Replacement Water Supply Well.

Because Powertech is providing a better quality, alternative water source to well owners located within the Project Boundary before commencement of ISR operations, the EPA concludes that impacts to well owners within the Project Boundary should be minimal.

3.2.1.2 Impacts to Inyan Kara Aquifers outside the Dewey-Burdock Project Boundary

Powertech included as Appendix D to its Inyan Kara aquifer water rights permit application a report prepared by Petrotek Engineering Corporation (Petrotek) in June 2012. The Petrotek report includes a numerical groundwater flow model using site-specific data to predict hydraulic responses of the Fall River and Chilson aquifers to ISR operation and groundwater restoration at the Dewey-Burdock Project. One of the primary model objectives was to predict drawdown of the Inyan Kara aquifer potentiometric surfaces on a local and regional scale resulting from the proposed Inyan Kara aquifer usage discussed in Section 3.1.1.

The numerical groundwater model domain encompasses nearly 360 square miles with north-south and east-west dimensions of 100,000 feet (18.9 miles). The northern and eastern boundaries of the model domain represent the up-dip limits of saturated conditions within the Inyan Kara aquifer system. The southern and western boundaries of the model extend at least 10 miles beyond the permit area. The Dewey Fault forms a no-flow boundary along the northwestern and northern boundaries of the model domain. This assumption is supported by the 1983 TVA[5] report which states "Evaluation of the drawdown responses recorded in test wells and private wells during the aquifer test and review of existing subsurface geologic data indicates that the Dewey fault zone acts as a hydrogeologic barrier to horizontal ground-water movement between the Inyan Kara aquifers located on opposite sides of the fault zone." Four layers were modeled. From shallowest to deepest these include the Graneros Group, Fall River Formation, Fuson Shale, and the Chilson Member of the Lakota Formation.

The model was calibrated to average 2010-2011 water level data by varying recharge to the Fall River and Chilson aquifers. Transient calibrations also were performed by simulating results of the 2008 aquifer tests conducted in support of the NRC license application. The calibrated model was then verified through simulation of aquifer tests conducted in 1982 by TVA.

Operational simulations were performed for gross Inyan Kara ISR operational rates ranging from 4,000 to 8,000 gpm. Restoration was simulated as a 1% bleed for a 500 gpm, gross restoration flow rate (5 gpm net extraction). Additional restoration bleed also was simulated for the groundwater sweep option. The results of the numerical groundwater modeling are presented in Appendix D of the Inyan Kara water rights permit application. Figures 6-38 and 6-39 in Appendix D depict the modeled maximum drawdown for the Fall River and Chilson, respectively, at an 8,000 gpm gross ISR operational rate with a 1% ISR operational bleed and 1% groundwater restoration bleed applied to a 500 gpm gross restoration rate plus groundwater sweep. This represents a maximum net Inyan Kara water usage rate of 147.2 gpm, or an amount approximately equal to the typical net Inyan Kara usage during concurrent ISR operation and restoration of 150 gpm (from totaling the Bleed column) in Table 2 above.

Figure 6-38 in Inyan Kara aquifer water rights permit application Appendix D shows the maximum predicted drawdown in the Fall River Formation, and Figure 6-39 in Appendix D shows the maximum predicted drawdown in the Chilson. Maximum drawdown outside the permit area during the simulation was slightly greater than 12 feet within the Fall River and approximately 10 feet in the Chilson. Figure 4 is Appendix D Figure 6-38 superimposed on Plate 3.1 showing the expected drawdown in the Fall River aquifer and Fall River private domestic drinking water wells outside of the Dewey-Burdock Project Area. The drawdown is expected to be about 7.5 feet at well 18, about 4 feet at well 7 and about three feet at well 8. It is important to keep in mind

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[5] Boggs, J. M., 1983, Hydrogeologic Investigations at Proposed Uranium Mine near Dewey, South Dakota, TVA WR28-2-520-128, p. 21.

that the potentiometric surface of the Fall River in the location of these three wells is above the ground surface. The wells are completed in the Fall River aquifer 200 to 300 feet below the ground surface, so the groundwater supply from these wells will not be affected by the drawdown of the Fall River potentiometric surface. Fall River stock water wells 112 and 631 are located up-gradient from the Project Area. Well 112 is not shown in Figure 3, but is shown in UIC Class III Permit Application Plate 3.1 in the center of the SE ¼ of Section16, T6S, R1E. The South Dakota Water Well Completion Report database shows this well to be located at SWSW Section 15, T6S, R1E. According to the well completion report for this well, the well depth is 140 feet and the static water level is about 90 feet below ground surface. According to the model, the groundwater drawdown level will probably be between 1.5 to 2.5 feet at the location of this well. The Fall River potentiometric surface is not above ground surface in this area, but a drop of 1.5 to 2.5 feet in Fall River potentiometric surface level should not affect the availability of groundwater at well 112. Well 631 is located in the SW corner of Section 23, T6S, R1E. According to the model, the groundwater drawdown level will probably be less than 1 foot at the location of this well, not affecting the availability of the groundwater supply at the location of well 631.The groundwater model report in Appendix D shows that potential drawdown impacts will be short-lived, with recovery to within 1 to 2 feet of pre-ISR levels at the location of the modeled pumping well within one year after the end of ISR operations.

Figure 5 is Inyan Kara aquifer water rights permit application Appendix D Figure 6-39 superimposed on Plate 3.1 showing the expected drawdown in the Chilson aquifer and Chilson private domestic drinking water wells 96 and 2 outside of the Dewey-Burdock Project Area. The drawdown is expected to be about 8.5 feet at domestic well 96 and about four feet at domestic well 2. It is important to keep in mind that the potentiometric surface of the Chilson at the location of these domestic wells is above the ground surface. The wells are completed in the Chilson aquifer at a depth of about 650 feet at well 2 and possibly a depth of about 730 feet at well 96, so the groundwater supply at these wells will not be affected by the estimated drawdown of the Chilson potentiometric surface. The groundwater model report in Appendix D shows that potential drawdown impacts will be short-lived, with recovery to within 1 to 2 feet of pre-ISR levels at the location of the modeled pumping well within one year after the end of ISR operations.

South Dakota Codified Law 46-2A-9 stipulates that a permit to appropriate water cannot be issued if the proposed diversion will result in the unlawful impairment of existing water rights. South Dakota DENR Water Rights Program staff reviewed the available information on the Inyan Kara aquifer and concluded that an approval of Powertech's application will not result in average annual withdrawal from the Inyan Kara aquifer to exceed the average annual recharge to the aquifer available for the proposed use and the proposed diversions can be developed without unlawful impairment of existing water rights. The EPA agrees with the DENR's determination. Based on EPA's evaluation of expected drawdown at existing private wells outside the Dewey-Burdock Project Boundary based on modeling results, it appears that the expected drawdown of the Inyan Kara aquifers during ISR activities will not affect the groundwater supplies at these wells. In addition, the potentiometric surface elevations are expected to recover to within one to two feet at the locations of the pumping well after decommissioning of the project, so there should be no long-term effects of water levels outside the Dewey-Burdock Project Boundary.

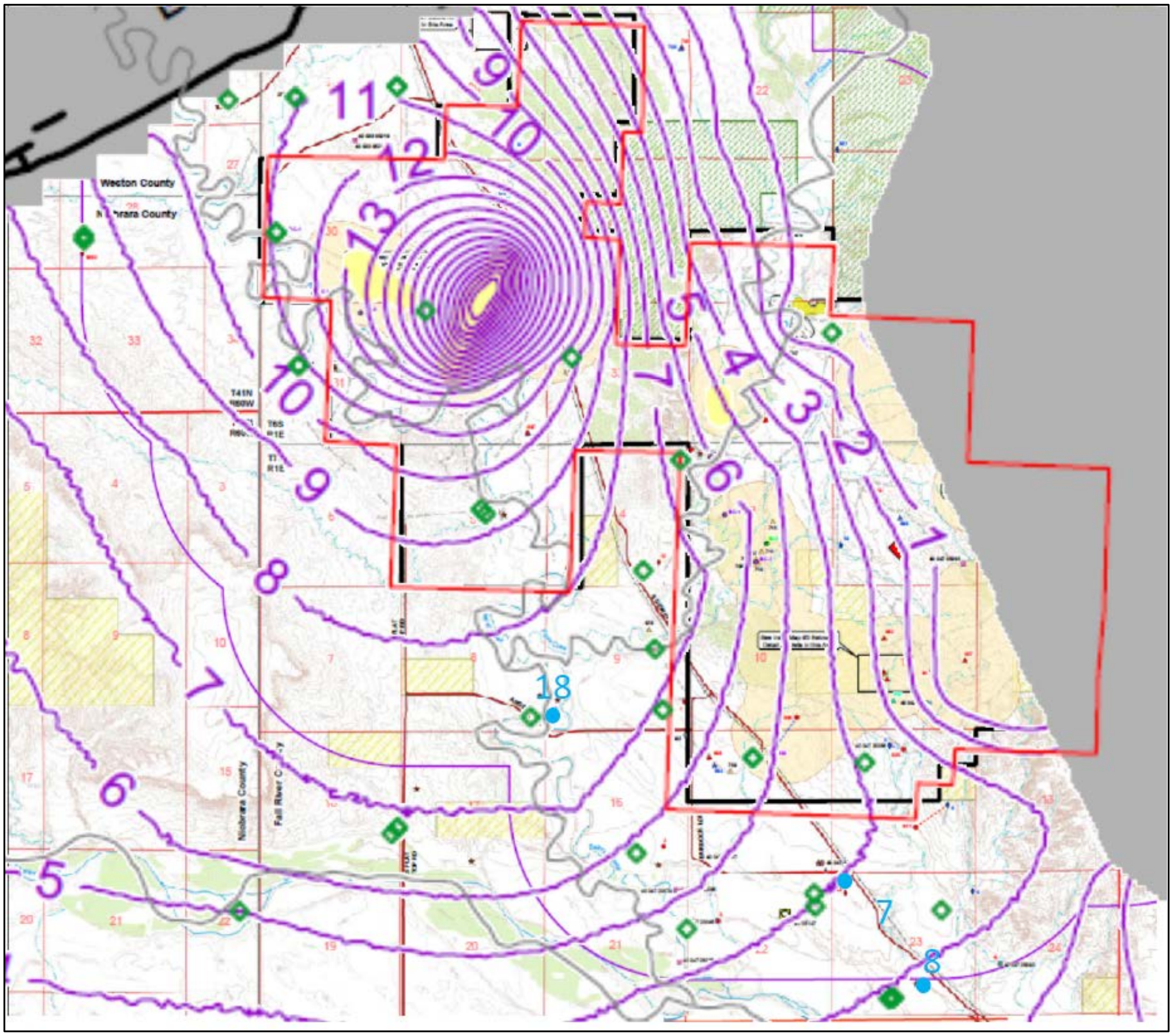

Figure 4. Expected Drawdown of the Fall River Aquifer Potentiometric Surface and Downgradient Fall River Private Drinking Water Wells.

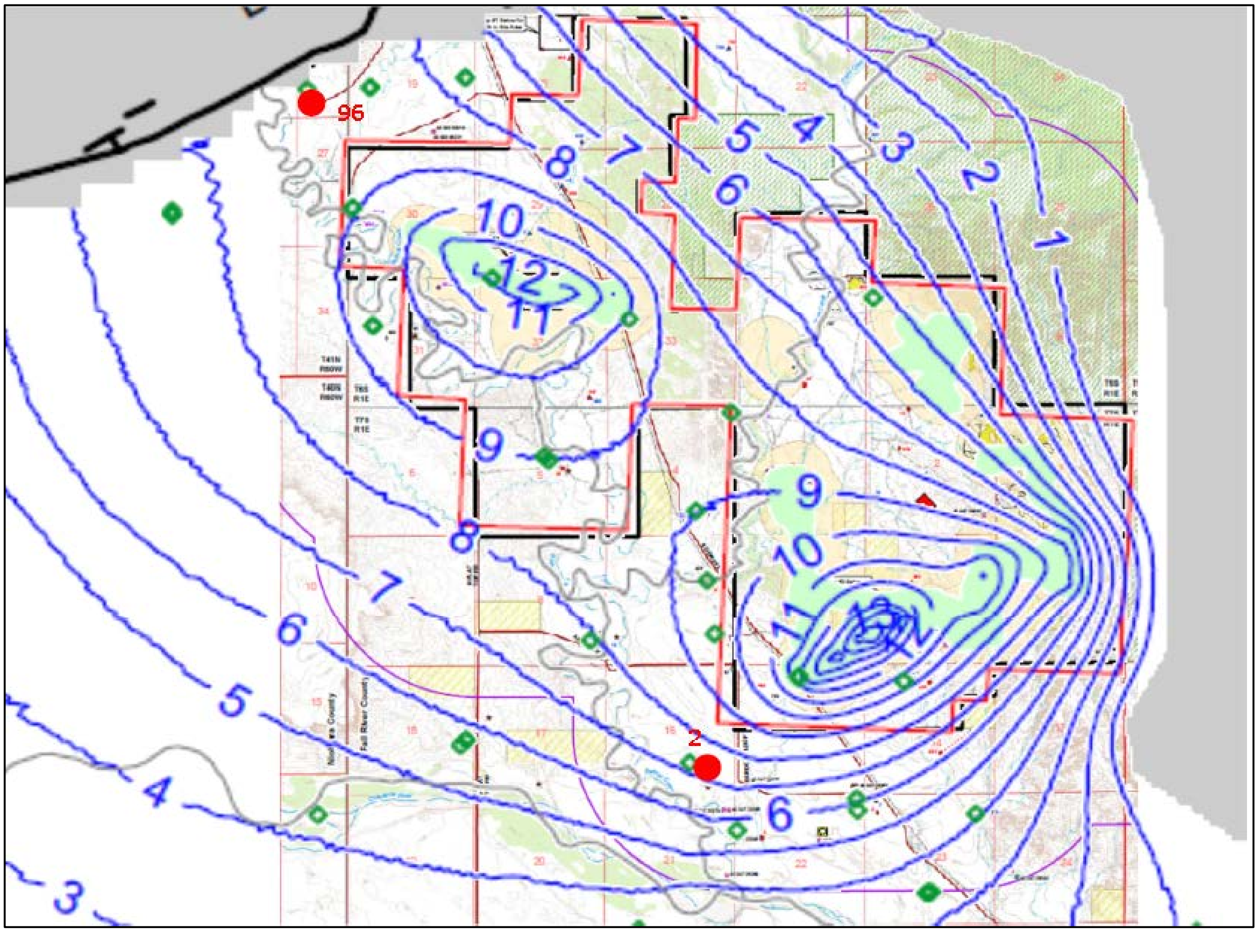

Figure 5. Expected Drawdown of the Chilson Aquifer Potentiometric Surface and Chilson Private Drinking Water Wells.

3.2.2 The Madison Formation

The EPA reviewed the information Powertech provided about the drawdown of the Madison aquifer potentiometric surface expected from the maximum gross pumping rate of the 551 gpm that Powertech is requesting from the DENR Water Rights Program. The EPA reviewed Powertech's estimation of the Madison potentiometric surface drawdown and concludes that Powertech adequately calculated the potentiometric surface drawdown. South Dakota DENR Water Rights Program staff reviewed the available information on the Madison aquifer and concluded that an approval of Powertech's application will not result in unlawful impairment of existing water rights. The EPA agrees with DENR's determination and has concluded that no potentiometric surface impacts are expected at the existing Madison wells outside the project boundary.

South Dakota DENR Water Program staff concluded in the Madison *Report to the Chief Engineer on Water Permit Application No. 2685-2, Powertech (USA) Inc.* [*Report*] that if Powertech's application is approved, the drawdown caused by pumping a well or wells at a rate of 551 gallon per minute is not expected to adversely impact domestic wells or well owners with prior water rights, especially given the fact that the Madison is an artesian aquifer with several hundred feet of pressure head. Figure 5 of the report shows the drawdown predicted by the Theis Equation from a well pumping 551 gpm from the Madison aquifer continuously for one year. The graph shows a drawdown of the aquifer water level of 86.8 feet at the Dewey-Burdock site, 35 feet 1000 feet away and 31 feet 2000 feet away. The *Report* states that because the Madison has higher transmissivity than the value used in the Theis Equation to produce this graph, the actual drawdown will be lower.

The *Report* also states that the springs listed in Table 3 of the report will not be measurably impacted by the volume of use Powertech is requesting. The springs are located 21 to 25 miles away from the Dewey-Burdock Project Site. The water levels in the caves at Wind Cave National Park will not be measurably impacted by this appropriation. The Madison water rights permit that would be issued to Powertech is subject to a term limitation of 20 years. Following a public notice and public hearing, the Water Management Board may cancel the permit or amend it with a new term limitation of twenty years.

As stated in Section 4.4.1 of the Class V Draft Area permit Fact Sheet, the EPA interpolated the depth to the Madison aquifer potentiometric surface to be 15 feet below ground surface elevation in the Burdock Area and right at ground surface elevation in the Dewey Area based on interpretation of Figure D-10 in the UIC Class V Permit Application and Figure 7 in Naus et al., 2001[6]. The Madison Aquifer potentiometric surface will be drawn down by the proposed Madison water supply wells that Powertech plans to install at the Dewey-Burdock Project Site, if the Madison water rights are approved by the South Dakota DENR, Water Rights Program. The South Dakota DENR Water Rights Program *Report* on Water Permit Application No. 2685-2 calculated the drawdown in the Madison aquifer potentiometric surface from the Madison water supply wells to be 86.8 feet at the well locations within the Dewey-Burdock Project Area.

The nearest downgradient user of the Madison aquifer is the City of Edgemont 13 miles to the southeast of the Project Area. Drawdown to the Madison aquifer potentiometric surface at the Project Site will not affect the City of Edgemont public water supply wells 13 miles away.

Based on this analysis, the EPA concludes that the expected drawdown of the Madison aquifer as a result of the Dewey-Burdock Project will not affect any Madison aquifer users. The potentiometric surface of the Madison aquifer will recover after the Project Site is decommissioned. However, if the Madison wells remain in place to continue serving as a drinking water supply replacing the private drinking water wells within the Project Boundary, then there will continue to be a smaller-volume, continuing use of the Madison aquifer that will affect the potentiometric surface in the local area.

3.3 Potential Groundwater Quality Impacts

Potential groundwater quality impacts include potential impacts to the ore zone, potential impacts to aquifers surrounding the ore zone, potential impacts to overlying and underlying aquifers, and potential impacts to the alluvium. Each of these is addressed below. The EPA has included protective permit requirements in the UIC Area Permits to prevent impacts to groundwater quality in USDWs. The Area Permits require characterization of the injection interval confining zones to demonstrate that overlying and underlying aquifer will not be impacted by injection zone fluids migrating across confining zones into aquifers outside of the intended injection zone. Based on these protective permit requirements, the EPA concludes that there will be no groundwater quality impacts from ISR operations to the Inyan Kara aquifers outside the aquifer exemption boundary and there will be no impacts to the Madison aquifer, or any other USDWs, from the authorized deep well injection activities.

[6] Naus et al., 2001. Geochemistry of the Madison and Minnelusa Aquifers in the Black Hills Area, South Dakota.

3.3.1 Potential Impacts to Ore Zone Groundwater Quality

A potential but short-term environmental impact to Inyan Kara groundwater as a result of ISR is the degradation of water quality in the ore zone within the wellfield areas. The interaction of the lixiviant with the mineral and chemical constituents of the aquifer will result in an increase in trace elements and salinity during uranium recovery operations. Powertech has requested an aquifer exemption to allow for the injection of lixiviant through the Class III injection wells into the uranium ore deposits. The EPA is proposing approval of the aquifer exemption for all wellfields except for the area associated with wellfields 6 and 7 in the Burdock Area. The ISR wellfields and the proposed aquifer exemption boundary are shown in Figure 2. The EPA is proposing approval of the aquifer exemption for Burdock wellfields 6 and 7 after well 16, which is a former drinking water well completed in the proposed aquifer exemption area, is plugged and abandoned. For more information about the aquifer exemption, see the document entitled *U.S. EPA Region 8 Underground Injection Control Program Aquifer Exemption Record of Decision*, which is a part of the Administrative Record for these UIC permitting actions. Impacts to the Inyan Kara aquifers are authorized only within approved aquifer exemption areas.

The NRC license requires Powertech to conduct groundwater restoration to the wellfield injection zone to restore the groundwater to pre-ISR conditions. During groundwater restoration, Powertech will restore groundwater quality in the injection zone where uranium recovery occurred consistent with NRC license requirements described in Section 6.1.3.1 of the NRC Safety Evaluation Report and Section 2.1.1.1.4 of the SEIS. The NRC requirements will assure that the post-restoration groundwater concentrations do not pose a hazard to human health and the environment. During groundwater restoration, Powertech will monitor groundwater using standard industry practices to determine the progression and effectiveness of restoration. Therefore, the EPA concludes that impacts to ore zone water quality after completion of groundwater restoration should be minimal.

3.3.2 Potential Impacts to Inyan Kara Groundwater Quality Outside of the Ore Zone

The UIC program is designed to protect USDWs. The Inyan Kara formation outside of the aquifer exemption area shown in Figure 2 is a USDW. Therefore, the UIC Class III Area permit specifies design requirements, pump testing requirements, and operating requirements for each wellfield and its associated monitoring well network to prevent movement of contaminants into the non-exempted areas. The Class III Area Permit requires routine sampling of monitoring wells for changes in water level and concentrations of the highly mobile and conservative excursion parameters (chloride, total alkalinity and specific conductance), which will ensure that any potential excursion is identified early and addressed quickly.

3.3.2.1 Excursion Control

"Excursion" is a term used by the Nuclear Regulatory Commission and is not a term defined under UIC Program regulations. As described by NUREG-1910, Supplement 1 (NRC, 2010), "An excursion is defined as an event where a monitoring well in overlying, underlying, or perimeter well ring detects an increase in specific water quality indicators, usually chloride, specific conductance and total alkalinity, which may signal that fluids are moving out from the wellfield …." The occurrence of an excursion is not a violation of the Class III Area Permit because it does not involve contaminants crossing the aquifer exemption boundary into a USDW. The purpose of excursion monitoring is the early detection of incipient loss of control of injection interval fluids so that control may be regained before any contamination reaches the aquifer exemption boundary.

The Class III Area Permit includes the following protective measures for prevention and early detection potential horizontal or vertical excursions of ISR solutions.
Pre-operational excursion preventative measures will include, but will not be limited to:

1. Proper well construction and mechanical integrity test of each well before use;
2. Design of the monitoring well system based upon delineation drilling to further characterize the ore-bearing zones and to identify the target completion aquifers for all monitoring wells; and
3. Pre-operational pump tests with monitoring systems in place to obtain a detailed understanding of the local hydrogeology and to demonstrate the adequacy of the monitoring system.
4. Verification of hydraulic control and confinement of injection zone fluids.

Operational excursion preventative measures will include but will not be limited to:

1. Regular monitoring of wellfield flow rates and volumes;
2. Regular flow balancing and adjustment of all production and injection flows appropriate for each wellfield pattern;
3. Effective bleed rates for each wellfield to maintain a cone of depression in the injection interval potentiometric surface;
4. Monitoring hydrostatic water levels in perimeter monitoring wells to verify the wellfield cone of depression;
5. Regular sampling and analysis of all monitoring wells to detect the presence of any indicators of ISR contaminant migration horizontally from the wellfield boundary or vertically from the injection interval and
6. Performing mechanical integrity test on all wells prior to use and at least every 5 years thereafter.

The monitoring well detection system described in Section 12.5 of the Class III Area Permit Fact Sheet is a proven method used at historically and currently operated ISR facilities. The monitoring system and operational procedures have proven effective in early detection of potential excursions of ISR solutions for the following reasons:

1. Regular sampling for indicator parameters (such as chloride) that are highly mobile can detect ISR solutions at low levels well before an excursion occurs;
2. Bleed will create a cone of depression that will maintain an inward hydraulic gradient toward the wellfield area;
3. Monitoring hydrostatic water levels in the perimeter monitoring well ring will provide immediate verification of the cone of depression, easily detect a change, and provide the ability for measurement and implementation of corrective response; and
4. The natural groundwater gradient and slow rate of natural groundwater flow is small relative to ISR activities and the induced inward hydraulic gradient caused by the ISR operational and restoration bleed.

An excursion does not become a UIC Permit violation unless it crosses the aquifer exemption boundary into the surrounding USDW. As stated in the NRC *Generic Environmental Impact Statement for In-Situ Leach Uranium Milling Facilities (NUREG-1910)* (GEIS) Supplement 1, the SEIS prepared for the Moore Ranch ISR Project, "the perimeter monitoring wells are located in a buffer region surrounding the wellfield within the exempted portion of the aquifer. These wells are specifically located in this buffer zone to detect and correct an excursion before it reaches a USDW." The EPA's Class III Area Permit requires that the following corrective action plan must be implemented for excursions occurring during ISR operations or groundwater restoration. Corrective actions to halt and retrieve an excursion may include but will not be limited to:

1. Adjusting the flow rates of the production and injection wells to increase the aquifer bleed in the area of the excursion;
2. Terminating injection into the portion of the wellfield affected by the excursion;
3. Installing pumps in injection wells in the portion of the wellfield affected by the excursion to retrieve ISR solutions;
4. Replacing injection or production wells; and
5. Installing new pumping wells adjacent to the well on excursion status to recover ISR solutions.

According to NRC license condition 11.5 pertaining to excursion monitoring, if the concentrations of any two excursion indicator parameters exceed their respective upper control limits or any one excursion indicator parameter exceeds its upper control limit by 20 percent, the excursion criterion is exceeded and a verification sample shall be taken from that well within 48 hours after results of the first analyses are received. If the verification sample confirms that the excursion criterion is exceeded, the well shall be placed on excursion status. If the verification sample does not confirm that the excursion criterion is exceeded, a third sample shall be taken within 48 hours after the results of the verification sample are received. If the third sample shows that the excursion criterion is exceeded, the well shall be placed on excursion status. If the third sample does not show that the excursion criterion is exceeded, the first sample shall be considered an error and routine excursion monitoring will be resumed (the well is not placed on excursion status).

In the event of an excursion as defined by the NRC license, the sampling frequency will be increased to weekly. The Class III Area Permit requires Powertech to notify the EPA within 24 hours by telephone or email and within 5 days in writing from the time an excursion is verified, according to the excursion requirements in condition 11.5 of the NRC license. The NRC license requires that Powertech submit a written report describing the excursion event, corrective actions taken and that corrective action results be submitted to all involved regulatory agencies within 60 days of the excursion confirmation. If wells are still on excursion status when the report is submitted, the report also must contain a schedule for submittal of future reports describing the excursion event, corrective actions taken, and results obtained. If an excursion is not corrected within 60 days of confirmation, Powertech must terminate injection into the affected portion of the wellfield until the excursion is retrieved, or provide an increase to the reclamation financial assurance obligation in an amount that is agreeable to NRC and that would cover the expected full cost of correcting and cleaning up the excursion. The financial assurance increase will remain in force until the excursion is corrected. The written 60-day excursion report will state and justify which course of action will be followed. If wells are still on excursion status at the time the 60-day report is submitted to NRC, and the financial assurance option is chosen, the wellfield restoration financial assurance obligation will be adjusted upward. When the excursion is corrected, the additional financial assurance obligations resulting from the excursion will be removed.

The Class III Area Permit requires Powertech to conduct Post-Restoration Groundwater Monitoring to demonstrate that no constituent will pass the aquifer exemption boundary at a concentration above the baseline water quality limits of the USDW. Because of these Class III Area Permit requirements, the EPA concludes there should be no impacts to Inyan Kara groundwater quality outside of the aquifer exemption area.

3.3.2.2 Post-restoration Monitoring of Wellfields

As described earlier, the NRC license requires Powertech to conduct groundwater restoration to the wellfield injection zone to restore the groundwater to pre-ISR conditions. This process is described in Section 6.1.3.1 of the NRC Safety Evaluation Report and Section 2.1.1.1.4 of the SEIS. The NRC requirements will assure that the post-restoration groundwater concentrations do not pose a hazard to human health and the environment. During groundwater restoration, Powertech will monitor groundwater using standard industry practices to determine the progression and effectiveness of restoration.

3.3.3 Potential Impacts to Overlying or Underlying Aquifers

The Class III Area Permit includes construction and operational requirements designed to prevent vertical migration of ISR contaminants out of the injection interval. The Area Permit also contains extensive monitoring requirements that will detect any impacts to overlying and underlying aquifers, should they occur, and requires remediation of any ISR contaminants that migrate into any aquifers overlying or underlying the injection interval.

During ISR uranium operation, potential impacts to overlying or underlying aquifers could occur from a vertical excursion of ISR solutions into an overlying or underlying aquifer. Vertical excursions can occur through a breach in the confining zones from man-made or naturally occurring structures such as fractures, faults or thin or missing portions of the confining zone. The Class III Area Permit requirements will decrease the potential for vertical excursions to occur and allow for early detection and mitigation if a vertical excursion does occur.

The Class III Area Permit requires wellfield delineation drilling and logging and the wellfield pump tests which will detect breaches in the confining zones. If breaches in confining zones are caused by historic exploration drillholes or improperly completed wells, the Class III Area Permit requires Powertech to identify the location of these structures and perform corrective action. If the breaches in confining zones are caused by naturally occurring structures or the location of the historic exploration drillhole cannot be identified, then operational controls such as balancing injection and production well flow rates will be required to maintain control of injection interval fluids to prevent vertical excursions. The Class III Area Permit requires that the monitoring well network be designed to verify control of injection interval fluids and the absence of vertical excursions.

Another potential source of vertical excursions is potential well integrity failures during ISR operations. Inadequate construction, degradation, or accidental rupture of well casings above or below the uranium-bearing aquifer could allow fluids to travel from the well bore into the surrounding aquifer. Monitoring wells drilled through the injection interval aquifer and confining zones that penetrate aquitards could potentially create pathways for vertical excursions as well. However, mechanical integrity demonstration requirements in the Class III Area Permit are designed to prevent and detect any vertical excursions caused by well integrity failures.

The Class III Area Permit contains requirements designed to prevent vertical migration of ISR contaminants out of the approved injection interval. Controls for preventing migration of ISR solutions to overlying and underlying aquifers consist of:

1. Regular monitoring of water levels and sampling for analysis of excursion indicators;
2. Routine mechanical integrity testing of all injection and production wells on a regular basis (at least every 5 years) to reduce any possibility of casing leakage;

3. Completion of mechanical integrity tests on all wells before putting them into service or after work which involves drilling equipment inside of the casing;
4. Proper plugging and abandonment of all wells which cannot demonstrate mechanical integrity or that become unnecessary for use;
5. Proper plugging and abandonment of exploration holes with potential to impact ISR operations;
6. Sampling monitoring wells located within the overlying and underlying hydrogeologic units on a frequent schedule;
7. Plugging any exploration holes that pose the potential to impact the control and containment of ISR solutions prevents hydraulic communication between the injection interval and overlying and underlying units;
8. The Class III Area Permit requirements for mechanical integrity assure proper well construction, which is the first line of defense for maintaining appropriate pressure without leakage; and
9. Sampling the monitoring wells will enable early detection of any ISR solutions should an excursion occur.

These controls work together to detect and prevent ISR solution migration out of the injection interval and into USDWs.

If a vertical excursion does occur, the corrective actions to halt and retrieve a vertical excursion are the same as those discussed in the previous section. The Class III Area Permit requires remediation of the aquifer into which the excursion occurred. Because of the Class III Area Permit requirements, the EPA concludes that there will be no long term impacts to aquifers overlying and underlying the injection interval.

3.3.4 Effects of Storage Ponds for Treated and Untreated Water on Groundwater Quality

Powertech intends to construct a series of ponds to treat and store the liquid waste fluids generated by ISR operations that will be injected into the Class V deep disposal wells or land applied under a Groundwater Discharge Permit (GDP) issued by the South Dakota DENR Ground Water Quality Program. As discussed in the Pond Design Report included as Appendix 5.3-A of the Large Scale Mine Permit Application, Powertech proposes the construction of the ponds described below:

The land application option includes six categories of ponds:

1. Radium settling ponds to contain bleed and restoration water and used to settle radium out of solution;
2. Outlet ponds to intercept treated water from the radium settling ponds and to store stormwater falling on the radium settling ponds;
3. Storage ponds to store treated water during the non-irrigation season;
4. A central plant pond to contain brine produced at the Burdock Plant site;
5. Spare ponds for emergency containment should the radium settling or central plant ponds fail; and
6. Spare storage ponds for emergency containment should any of the storage ponds fail, or portions of the land application system become temporarily inoperable.

The deep well disposal option includes five categories of ponds:

1. Radium settling ponds to contain bleed water and restoration water and to settle radium out of solution;
2. Outlet ponds to intercept treated water from the radium settling ponds and to store stormwater falling on the radium settling ponds;

3. Surge ponds to contain water that has been treated and which is to be pumped to the disposal wells;
4. Spare ponds for emergency containment should any of the ponds fail; and
5. A central plant pond to contain brine produced at the Burdock Plant site.

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

1. An 80-milli-inch (mil) high density polyethylene (HDPE) primary liner
2. A 60-mil-HDPE secondary liner
3. A 1-ft-thick clay liner below the secondary liner
4. A geonet drainage layer in between the primary and secondary HDPE liners
5. 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 injected into the deep injection wells. The current design plans for these ponds include a single 40-mil-HDPE liner underlain by a 1-ft-thick clay liner.

Figures 6a and b show the locations of the ponds described above for the Dewey Area.

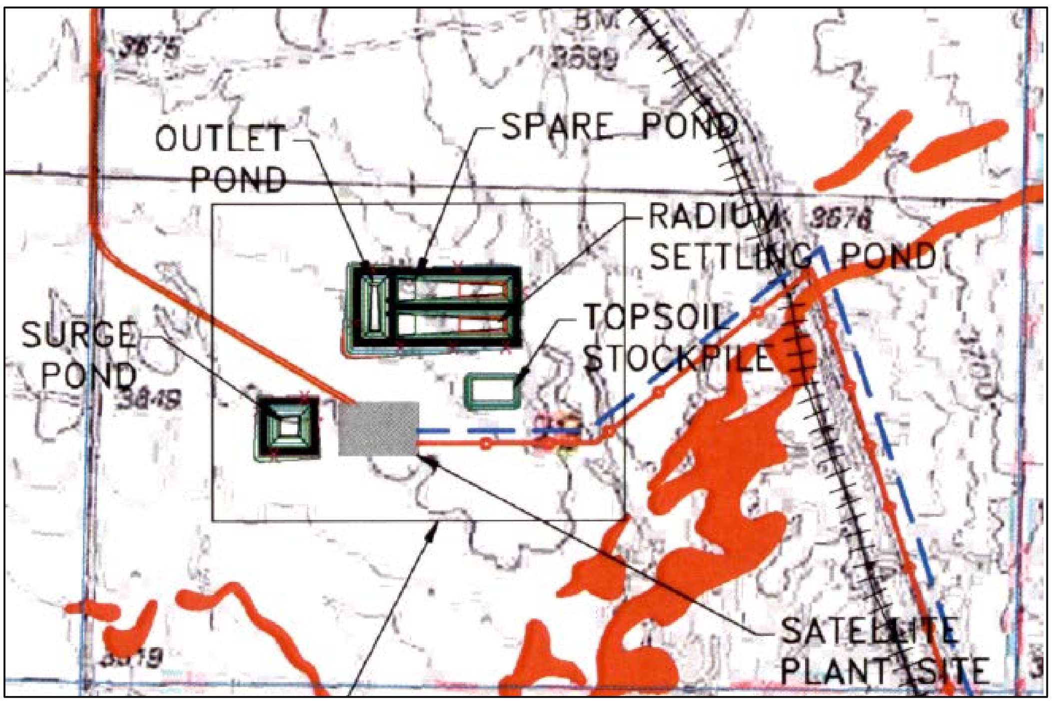

Figure 6a. Location of Dewey Area Ponds for the Deep Injection Well Disposal Method from Large Scale Mine Permit Application Appendix 5.3-A Pond Design Report Figure 4.6-1

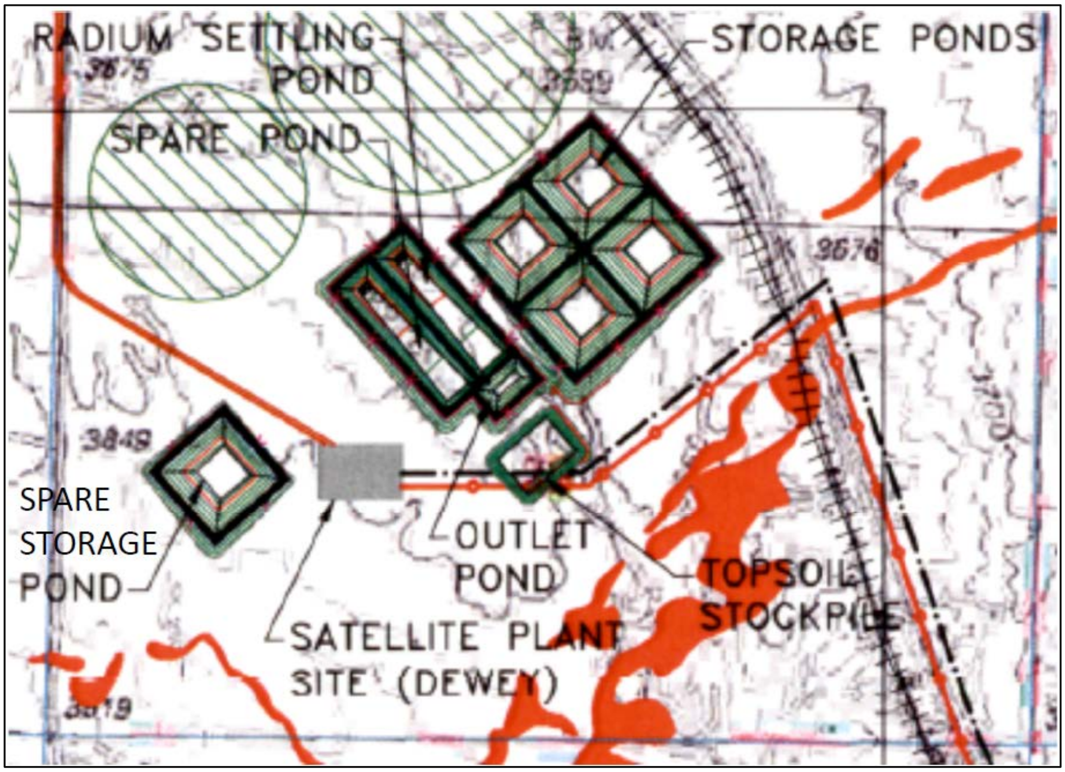

Figure 6b. Location of Dewey Area Ponds for the Land Application Disposal Method From Large Scale Mine Permit Application Appendix 5.3-A Pond Design Report Figure 3.7-1

Figures 7a and b show the locations of the ponds described above for the Burdock Area.

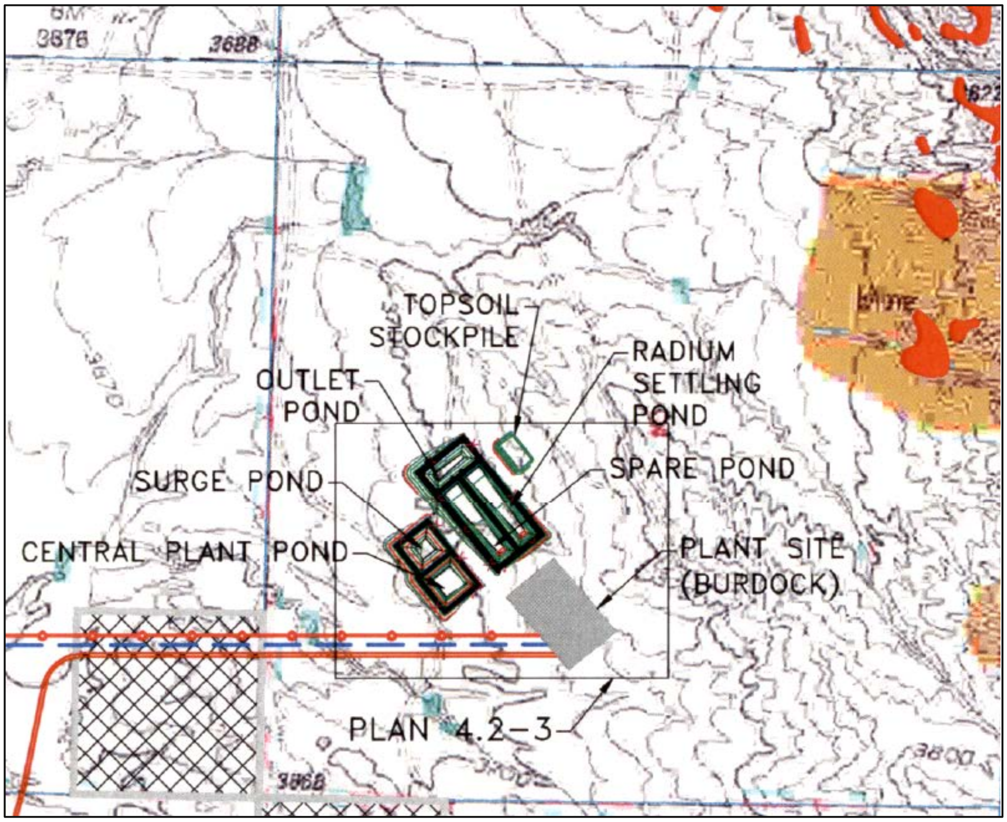

Figure 7a. Location of Burdock Area Ponds for the Deep Injection Well Disposal Method
From Large Scale Mine Permit Application Appendix 5.3-A Pond Design Report Figure 4.6-1

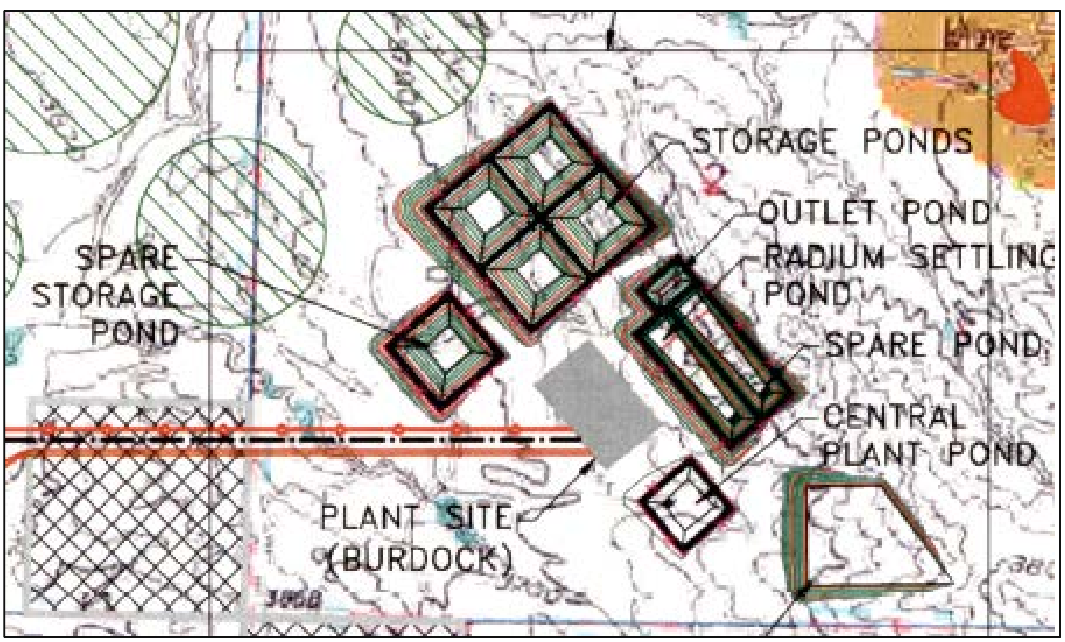

Figure 7b. Location of Burdock Area Ponds for the Land Application Disposal Method
From Large Scale Mine Permit Application Appendix 5.3-A Pond Design Report Figure 3.7-1

The Burdock pond designs are preliminary designs. If the ponds comply with subpart W requirements, the concerns discussed in Section 3.3.4.2 below will be resolved. The EPA has placed a permit condition in each of the UIC area permits that authorization to inject will not be issued until EPA makes an applicability determination under subpart W, and if necessary, Powertech receives the necessary construction approvals.

3.3.4.1 Dewey Area Analysis

The surface geology where the ponds will be located in the Dewey Area consists of the Graneros Group Shales, which includes the Mowry, Skull Creek and Belle Fourche Shales as shown in Figures 8a and b. In addition to the pond liners, the shale provides a protective barrier between the proposed ponds and the first underlying aquifer, which is the Fall River. The drill logs and cross sections provided in the Class III Permit Application show that the Graneros Group Shales are the over 400 feet in the Dewey Area.

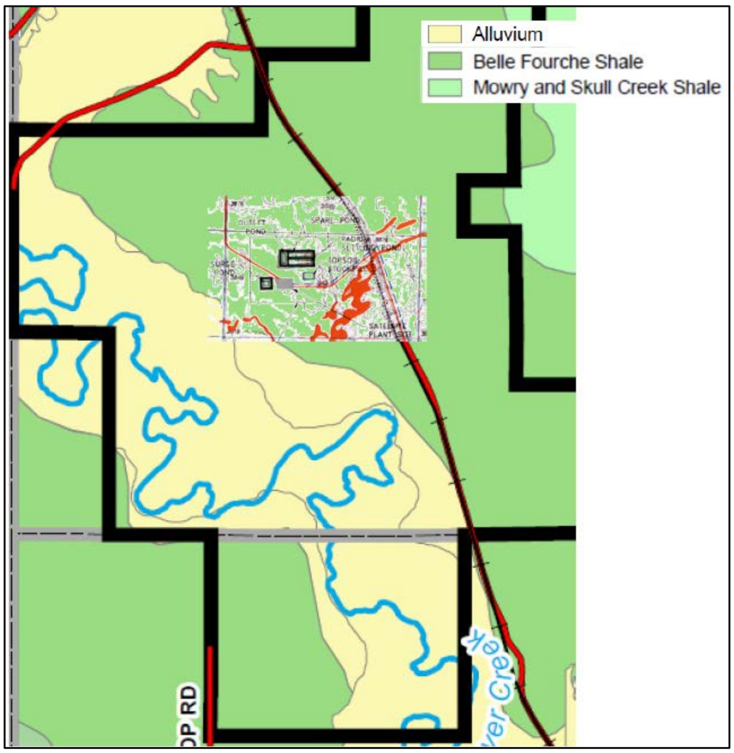

Figure 8a. Dewey Area Pond Locations for the Deep Injection Well Disposal Method and the Surface Geology from Class III Permit Application Figure 6.3

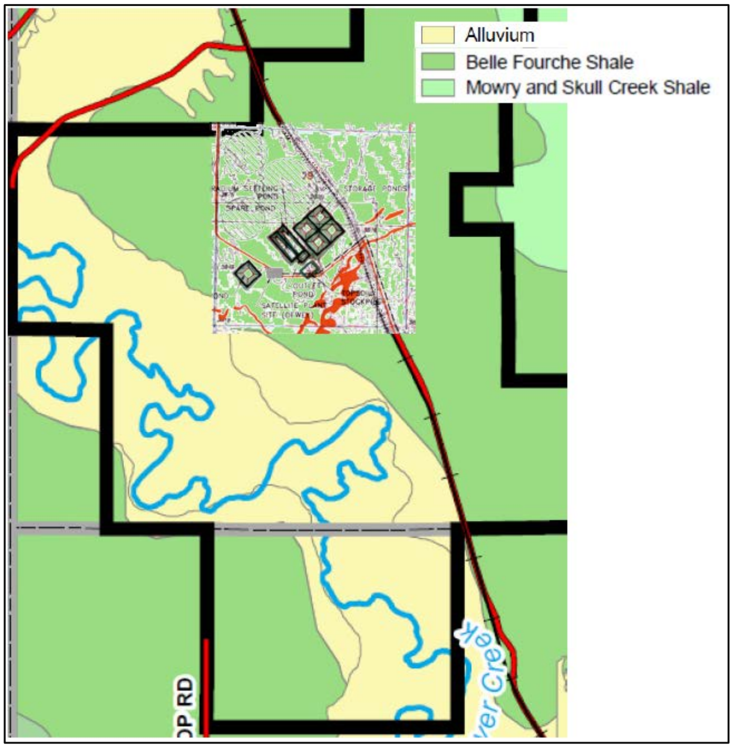

Figure 8b. Dewey Area Pond Locations for the Land Application Disposal Method and the Surface Geology from Class III Permit Application Figure 6.3

Overlaying a map of Section 29, Township 6 South, Range 1 East from the UIC Class III Permit Application Figure 4.2 Dewey-Burdock Drillhole Map on the Dewey pond map shows that the deep well ponds do not appear to be located where any historic boreholes have penetrated the Graneros Shale as shown in Figure 9a.

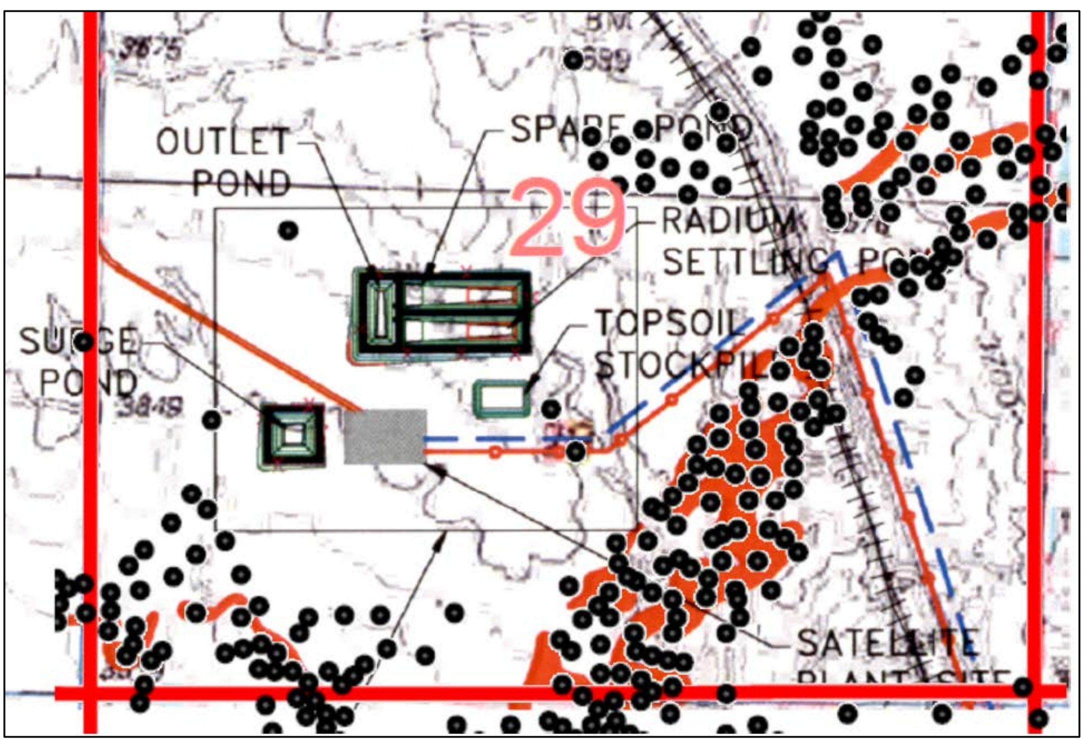

Figure 9a. Dewey Area Pond Locations for the Deep Injection Well Disposal Method and UIC Class III Permit Application Figure 4.2 Dewey-Burdock Drillhole Map

However, Figure 9b shows that there are some drillholes in the proposed location of the storage ponds and one drillhole in the location of the spare storage pond. The co-location of drillholes and the storage ponds and spare storage is a concern, because these ponds, as currently proposed, do not have a secondary HDPE liner over the clay liner, no leak detection systems and the drillholes could be a potential breach in the Graneros confining zone if not plugged in a manner that prevents leaks.

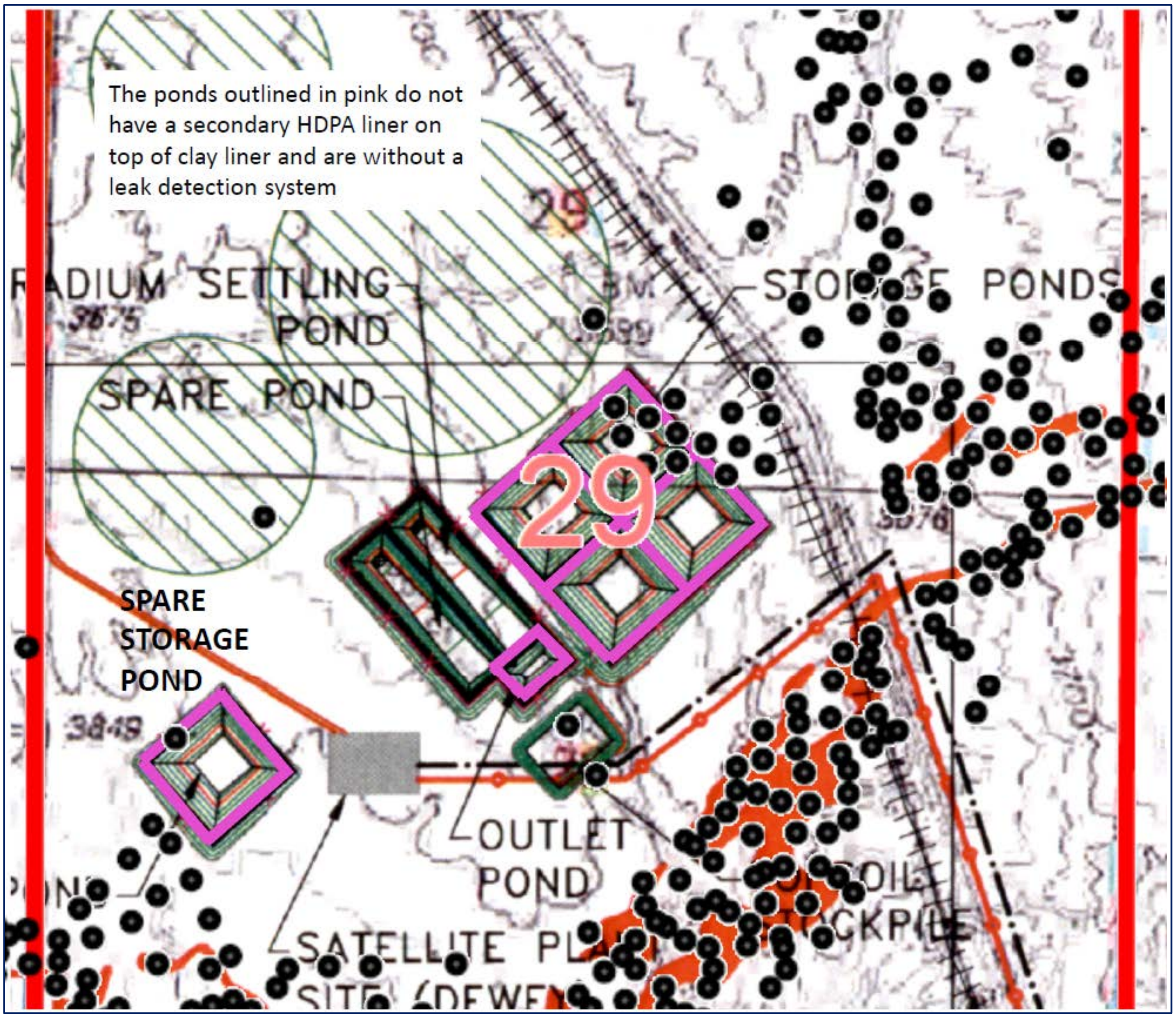

Figure 9b. Dewey Pond Locations for the Land Application Disposal Method and UIC Class III Permit Application Figure 4.2 Dewey-Burdock Drillhole Map

The EPA analyzed this area further taking into account the potentiometric surface elevation of the Fall River aquifer presented in Figure 10. Figure 10 shows Section 29 with the Dewey land application pond locations, drillhole locations and the area where the Fall River aquifer potentiometric surface is above ground surface elevation. Where the Fall River aquifer potentiometric surface is either above the ground surface or very close to the ground surface, leaky drillholes would results in the groundwater surfacing and forming a wet area. The "alkali area" is an example of this situation. The alkali area is a wet area located in the southwestern corner of the Burdock portion of the project area (N1/2 NE1/4 Section 15, T7S, R1E). The location of the alkali area is shown in Figure 11. Powertech has identified this area as possible location where groundwater may be discharging to the surface from the Inyan Kara through an abandoned exploration drillhole. Powertech has not found any other areas like the alkali area within the Project Area. If another area existed, it would have been observed during the detailed surveys performed during the pond design phase.

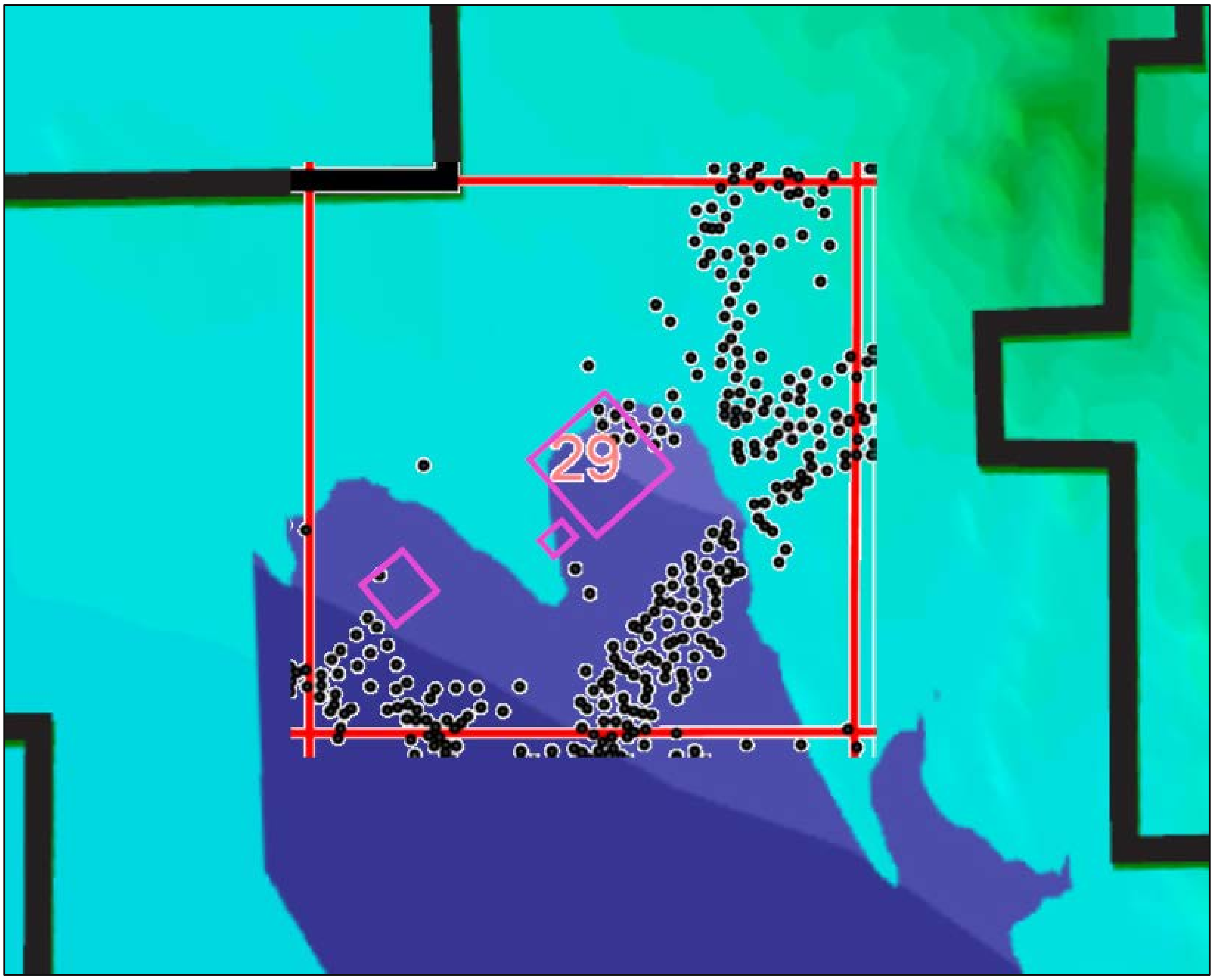

Figure 10. Dewey Pond Locations for the Land Application Disposal Method, the Dewey-Burdock Drillhole Map and Class III Permit Application Figure 4.7 Area where Fall River Potentiometric Surface is above Ground Surface

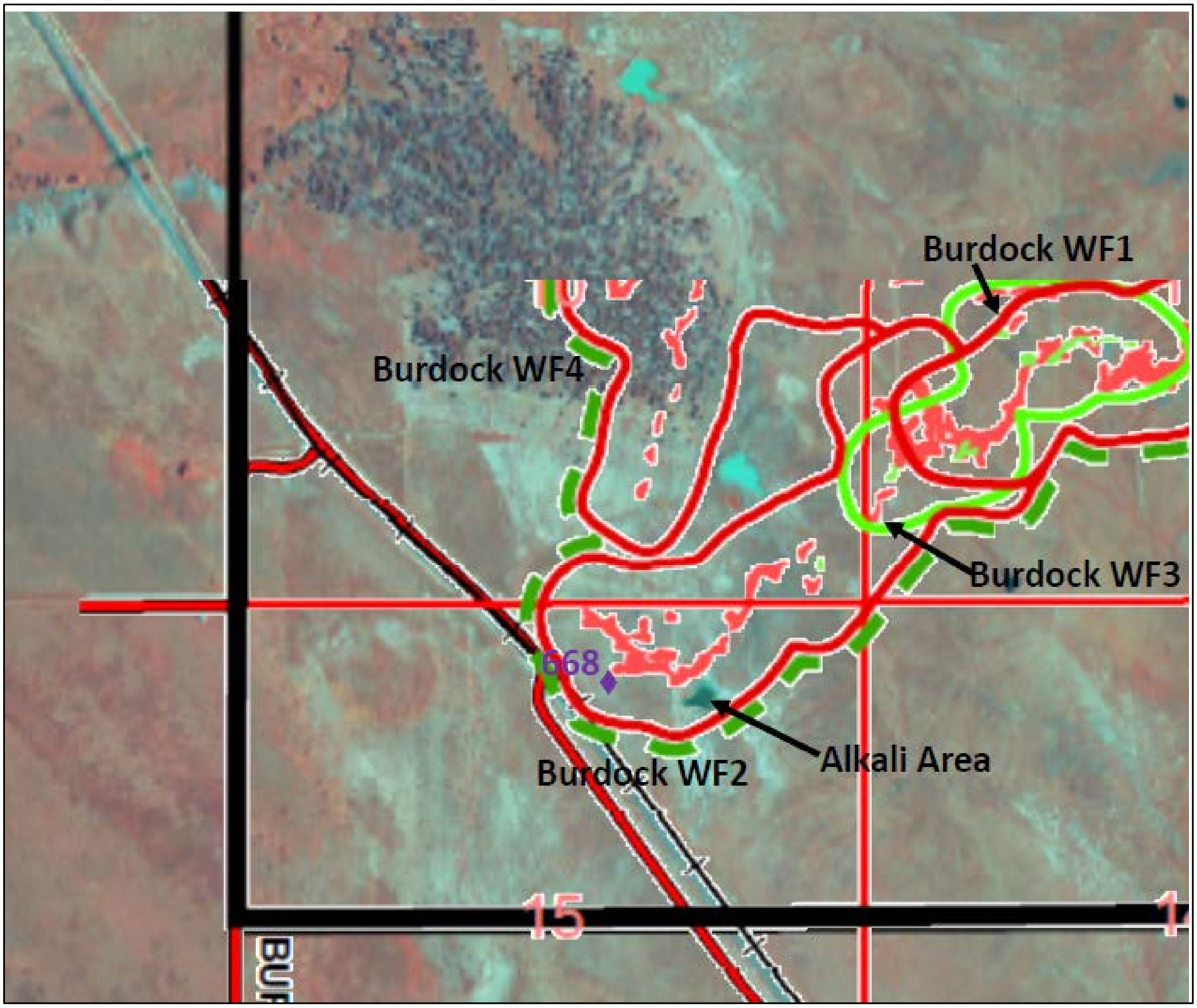

Figure 11. Location of the Alkali Area

3.3.4.2 Burdock Area Analysis

The surface geology where the Burdock Area proposed ponds are located also consists of Graneros Shale. The information available from the two nearest well logs indicates the thickness of the Graneros Shale near the pond locations varies from 75 feet to 120 feet. The proposed Burdock ponds partially lie on the Pass Creek alluvium as shown in Figures 12a and b. The Pass Creek alluvium overlies the Graneros Shales as shown in the stratigraphic column in Figures 12a and b. Figures 13a and b show the pond locations relative to an alluvial isopach map, which shows the thickness of the alluvium. The alluvium is thinning from 10 feet to 0 feet thickness toward the east where the ponds are located.

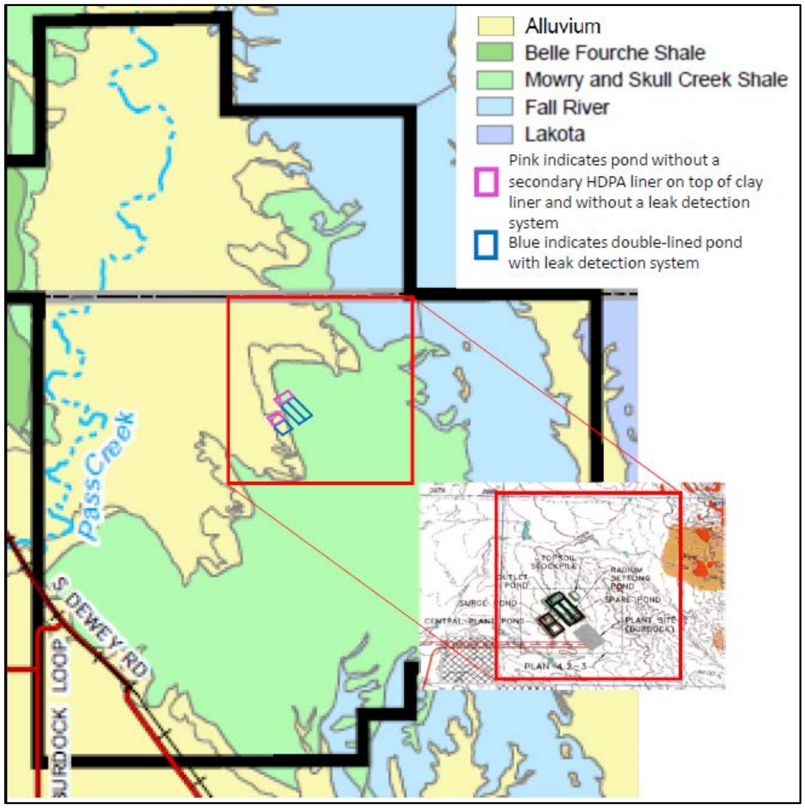

Figure 12a. Burdock Area Pond Locations for the Deep Disposal Well Disposal Method and Surface Geology from Class III Permit Application Figure 6.3

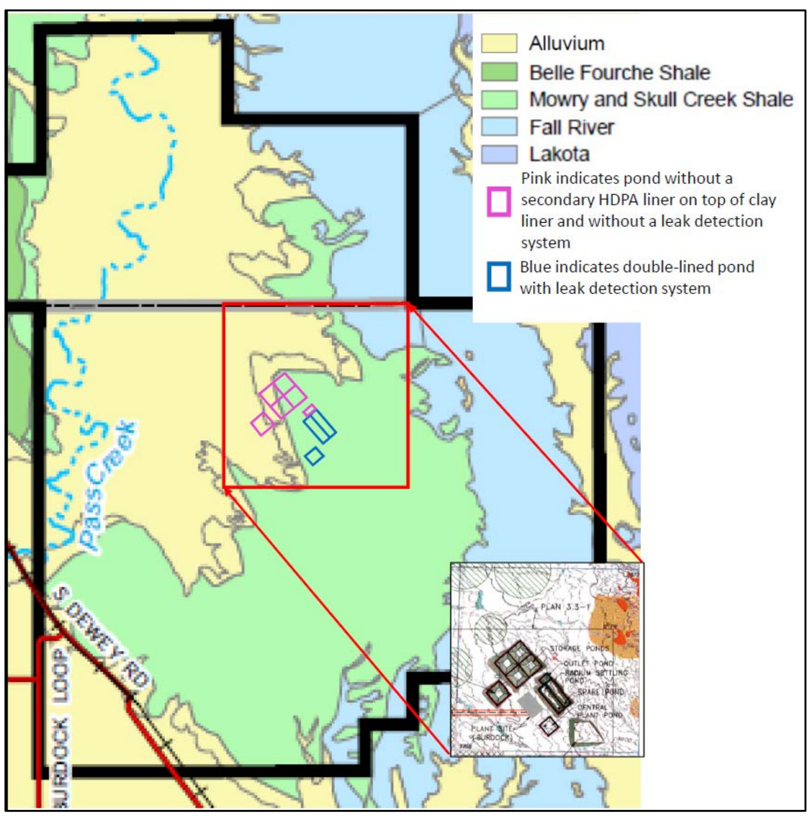

Figure 12b. Burdock Area Pond Locations for the Land Application Disposal Method and Surface Geology from Class III Permit Application Figure 6.3

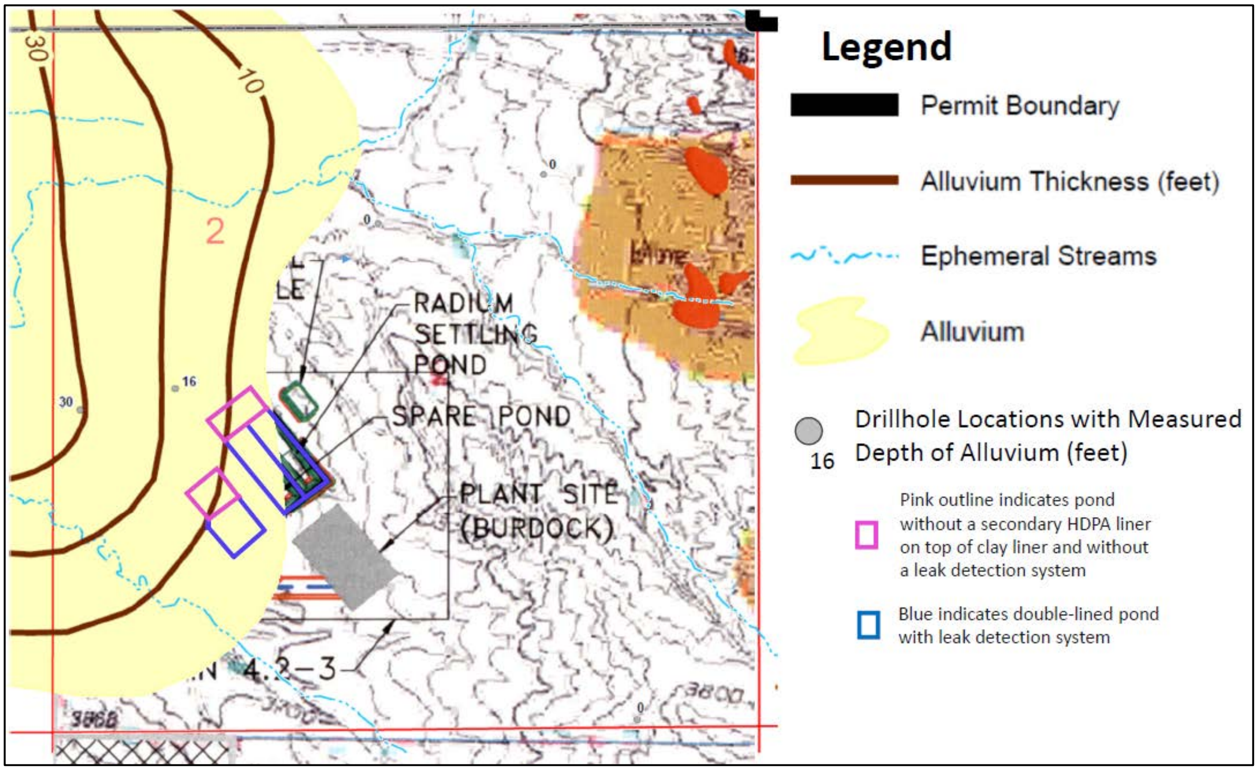

Figure 13a. Burdock Area Pond Locations for the Deep Disposal Well Disposal Method and Alluvium Isopach Map (Plate 3.6-4 from the GDP Application Powertech Submitted to the South Dakota DENR)

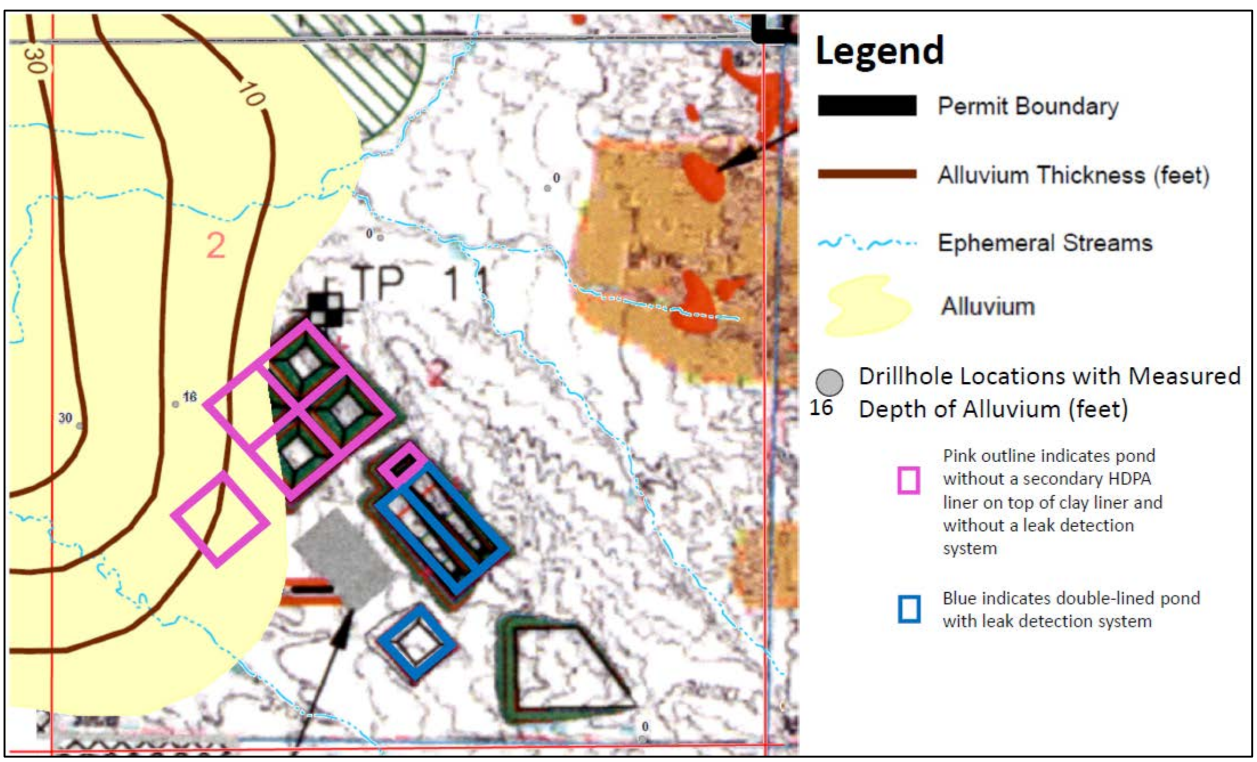

Figure 13b. Burdock Area Pond Locations for the Land Application Disposal Method and Alluvium Isopach Map (Plate 3.6-4 from the GDP Application Powertech Submitted to the South Dakota DENR).

The ponds outlined in pink are the ponds for which there is no secondary liner over the clay liner and no leak detection system. These ponds will contain water treated to below NRC radioactive waste and EPA hazardous waste limits, but will still be high in TDS. The Class V permit application estimates the Class V injectate to be about 15,000 mg/L TDS. The TDS of the Pass Creek alluvium ranges between 3100 and 3900 mg/L. The treated water may also contain metals concentrations above that of the alluvial groundwater.

The NRC Source Material License requires the licensee to submit to the NRC for review and verification, a pond detection monitoring plan that contains the number, locations, and screen depths of groundwater monitoring wells to be installed around the Burdock area and Dewey area ponds. Any leaks from the Burdock Ponds without a leak detection system will flow into the Pass Creek alluvium. The resulting plumes will eventually be detected in the down-gradient monitoring wells as an increase in TDS. However, by the time the plume has reached the monitoring wells, extensive impact will have already occurred which will be difficult and expensive to remediate. The alluvium is not being used for drinking water because of the poor water quality with high sulfate, uranium, gross alpha and, at one well, arsenic above drinking water standards, and iron and manganese above Region 8 health advisory limit.

The Burdock ponds do not appear to be located where any historic boreholes have penetrated the Graneros Shale as shown in Figures 14a and b. Therefore, leakage into deeper aquifers through improperly plugged boreholes is not a concern.

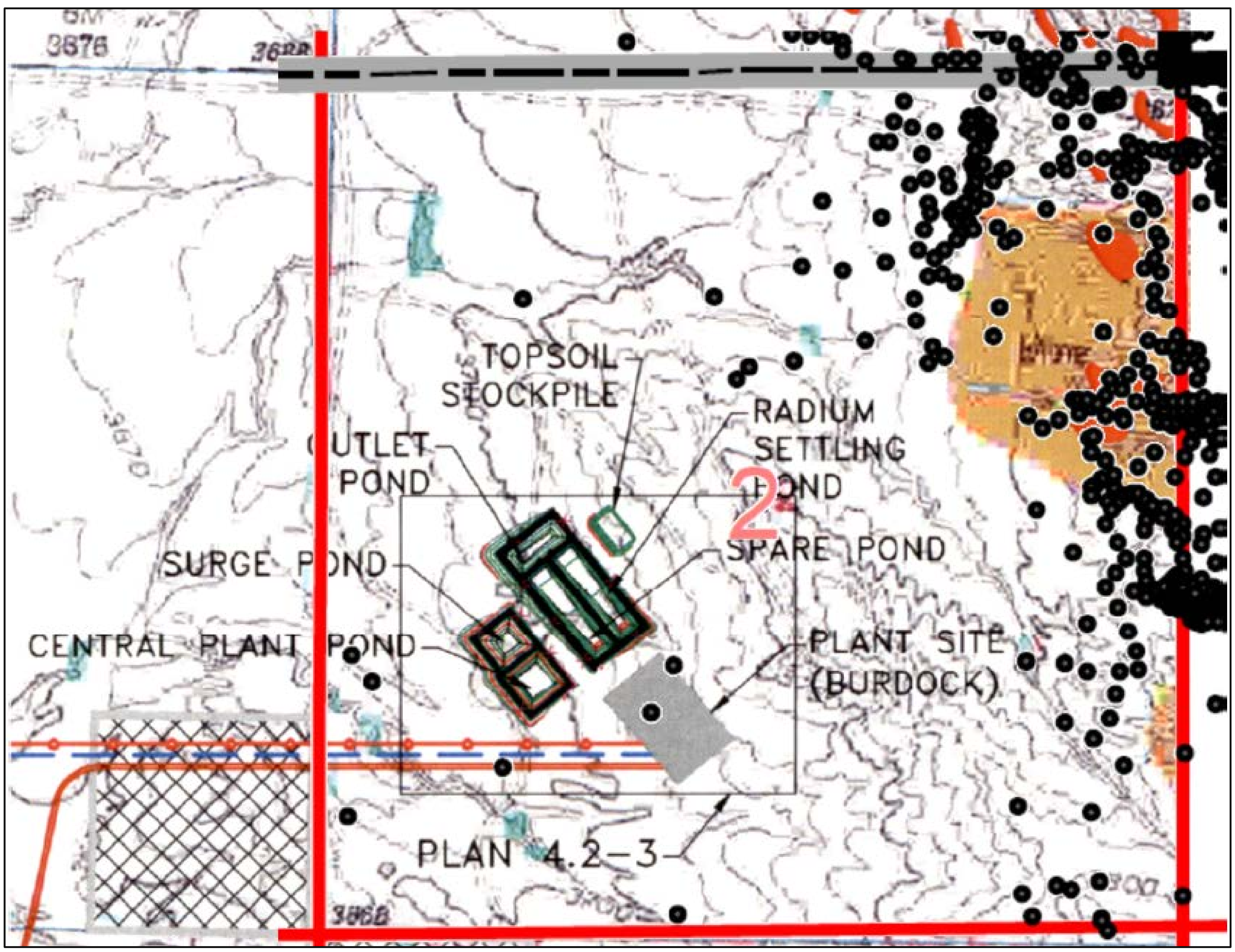

Figure 14a. Burdock Area Pond Locations for the Deep Injection Well Disposal Method and UIC Class III Permit Application Figure 4.2 Dewey-Burdock Drillhole Map

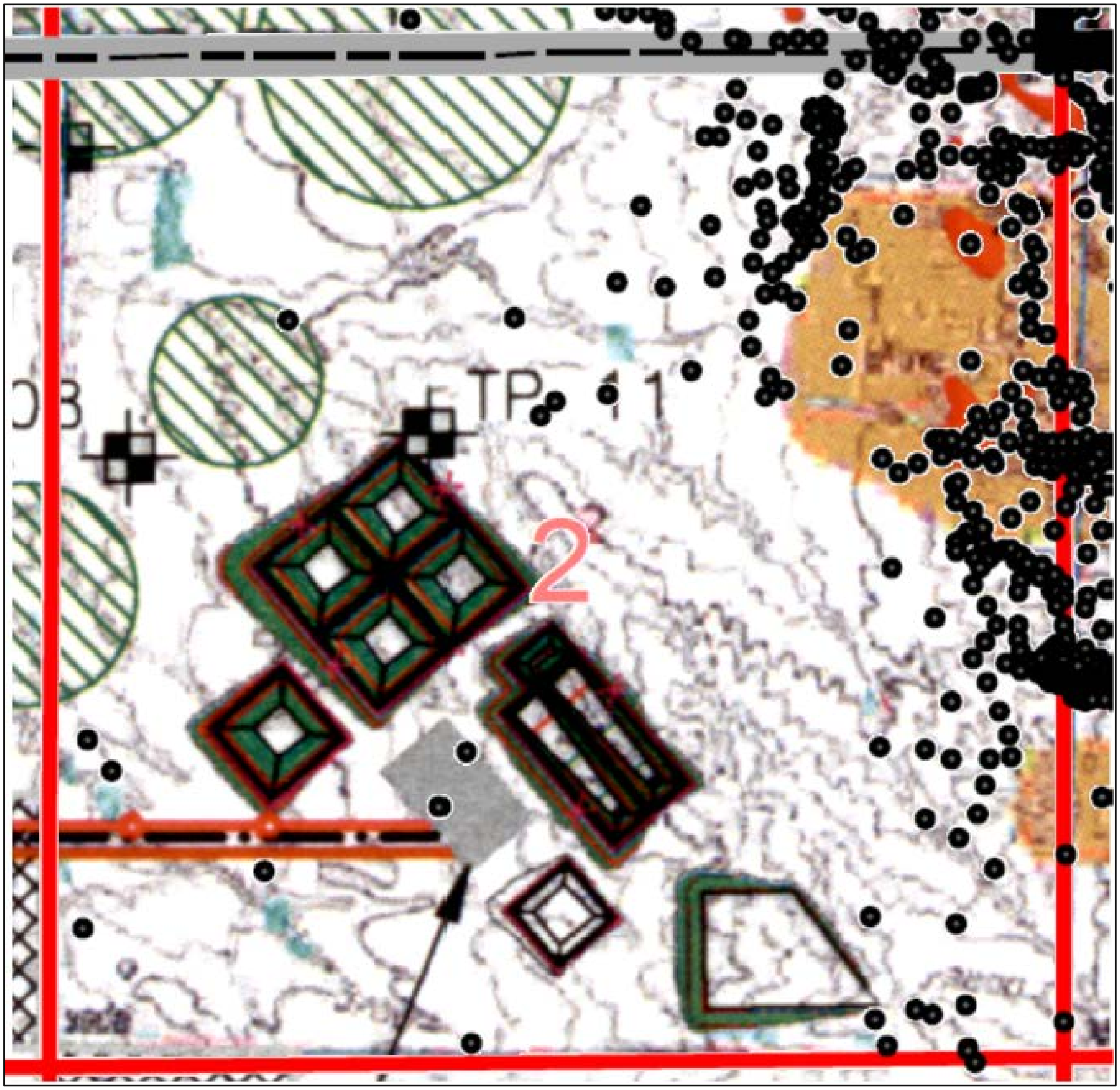

Figure 14b. Burdock Area Pond Locations for the Land Application Method and UIC Class III Permit Application Figure 4.2 Dewey-Burdock Drillhole Map

40 CFR subpart W applies to "owners or operators of facilities licensed to manage uranium byproduct material during and following the process of uranium ores, commonly referred to as uranium mills and their associated tailings" (40 CFR § 61.250). Subpart W defines "uranium byproduct material or tailings" as "the waste produced by the extraction of concentration of uranium from any ore processed primarily for its source material content" (40 CFR § 61.251(g)). Thus, any type of uranium recover facility that is managing uranium byproduct material or tailings is subject to subpart W.

Based on the information contained in the Final SEIS, the EPA has determined that the requirements of subpart W specifically apply to the structures at the proposed Dewey-Burdock uranium recovery facility that are used to contain the uranium by-product material. This includes all impoundments or ponds where uranium byproduct material is stored or treated, included those storing treated uranium byproduct material prior to either land application or deep well injection.

As required by 40 CFR § 61.252(c), these impoundments or ponds must be in compliance with the provision in 40 CFR § 192.32(a). In addition, the requirements in 40 CFR part 61 subpart A apply to subpart W regulated structures. Subpart A requires owners or operators to submit to the EPA an application for approval for either construction or modification of subpart W regulated structures (i.e. all ponds holding uranium byproduct material whether treated or not) before the construction or modification is planned to commence (40 CFR § 61.07).

Subpart W requires ponds to meet the requirements of 40 CFR 192.32(a), which in turn requires the ponds or surface impoundments to be "'designed, constructed and installed in such a manner to conform to the requirements" of 40 CFR 264.221. In general, this means the ponds must have:

1. A composite bottom liner consisting of a least two components;
    a. an upper component or liner that prevents migration of hazardous constituents, and
    b. a secondary liner that will minimize migration should the upper component fail, and
2. A leachate collection and removal system between the two liners.

If constructed and installed under the current design plans, several of the proposed ponds will not be in compliance with these regulations or with 40 CFR Part 61, subpart W, which requires that there be no more than two ponds, each with a surface area of no more than 40 acres that are in operation at any given time. In accordance with the provisions of 40 CFR 61.07, subpart A, the EPA must also approve the design of the ponds prior to construction.

In conclusion, the EPA is concerned about impacts to the alluvial aquifer if there is a leak from a pond not meeting subpart W requirements. To ensure that the ponds meet 40 CFR part 61 subpart W requirements, the EPA has placed a permit condition in each of the UIC area permits that authorization to inject will not be issued until EPA makes an applicability determination under subpart W, and if necessary, Powertech receives the necessary construction approvals.

3.3.5 Potential Groundwater Impacts from Spill and Leaks

Potential impacts to groundwater could occur from spills and leaks at wellfield header houses, pipelines and wellheads, processing facilities, from transportation accidents, or as releases from treatment and storage ponds. Potential impacts to groundwater could also occur from accidental spills or leaks of fuels and lubricants from construction equipment and stormwater runoff from limited impervious areas including buildings, roads, and parking areas that infiltrates and recharges shallow aquifers. Potential groundwater impacts from spills and leaks are addressed in Section 5.0 of this document. Mitigation measures are described in Large Scale Mine Permit Section 5.6.5.2 and in this document in Section 5.4.

3.4 Potential Subsidence in ISR Wellfields

There is no potential for subsidence in the ISR wellfields due to limited drawdown in the ore zone and other aquifers and due to the nature of uranium ISR, which does not affect the structural integrity of the ore-bearing geological units. Refer to Section 5.6.3.1.2 of the Large Scale Mine Permit Application and the Petrotek 2012 report included as Appendix D of Powertech’s Inyan Kara water rights permit application, which describe how potential drawdown in the Inyan Kara aquifer will be limited, and the potentiometric surface elevation is anticipated to recover to pre-ISR levels rapidly after the end of ISR activities.

The following information from Section 4.4.3.2 of the NRC GEIS addresses subsidence potential in ISR wellfields in the Nebraska-South Dakota-Wyoming Uranium Milling Region, which includes the proposed permit area:

> *The removal of uranium mineral coatings on sediment grains in the target sandstones during the uranium mobilization and recovery process will result in a change to the mineralogical composition of uranium-producing formations. However, the uranium mobilization and recovery process in the target sandstones does not result in the removal of rock matrix or structure, and therefore no significant matrix compression or ground subsidence is expected. In addition, the source formations for uranium in the Nebraska-South Dakota-Wyoming Milling Region occur at depths of tens to hundreds of meters [hundreds of feet] … and individual mineralization fronts are typically 0.6 to 7.5 m [2 to 25 ft] thick … At these depths and thicknesses and considering that rock matrix is not removed during the uranium mobilization and recovery process, it is unlikely that collapse in the target sandstones would be translated to the ground surface.*

3.5 Summary of Mitigation Measures to Prevent Groundwater Impacts

Based on the protective UIC permit requirements, the EPA has concluded that there will be no water quality impacts to Inyan Kara USDWs outside of the aquifer exemption area and there will be no impacts to deeper USDWs from the injection activities in the Minnelusa injection zone.

The following is a summary of mitigation measures that will be implemented to prevent impacts to groundwater and monitoring to verify that there are no impacts:

1. The Class III Area Permit requires that Powertech perform mechanical integrity test on all wells prior to use. For injection and production wells, mechanical integrity tests must be repeated every 5 years after the last successful mechanical integrity test;
2. The Class III Area Permit requires continuous monitoring of injection pressure, flow rate and flow volume which will detect leaks in wellfield piping if a sudden change in any of these parameters occurs;
3. The Class III Area Permit requires an extensive monitoring system to detect potential horizontal or vertical excursions of ISR solutions;
4. The Class III Area Permit requires Powertech to plug and abandon or mitigate any of the following should they pose the potential to impact the control and containment of wellfield solutions within the permit area:
    a. Historical wells and exploration holes.
    b. Holes drilled by Powertech for delineation and exploration.
    c. Any well failing a mechanical integrity test that cannot be repaired.
5. The Class III Area Permit requires Powertech to maintain a wellfield pumping rate greater than the injection rates (wellfield balance) to ensure radial hydraulic flow into and through the injection interval;
6. The NRC license requirements include monitoring to detect and define unanticipated surface spills, releases, or similar events that may infiltrate into the groundwater system;
7. The NRC license requires implementation of a spill prevention and cleanup plan to minimize potential impacts to groundwater, including rapid response cleanup and remediation capability, techniques, procedures, and training; and

8. The Class III Area Permit requires operational monitoring of nearby domestic, livestock, irrigation, and designated monitoring wells as during operations.

4.0 IMPACTS TO SURFACE WATER AND WETLANDS

The proposed Dewey-Burdock Project Area lies within the Beaver Creek watershed, which includes Beaver Creek, Pass Creek, and their tributaries. Beaver Creek is a perennial stream, and its tributaries have ephemeral flow depending on the amount of precipitation. Pass Creek and its tributaries are dry for most of the year, except for short periods of high runoff following major storms. Beaver and Pass Creeks are not used for domestic water supply within the proposed project area, but water from Beaver Creek is used for local irrigation. Beaver Creek is a tributary to the Cheyenne River and joins the Cheyenne River approximately 1.4 miles south of the project boundary upstream from Edgemont, South Dakota. The EPA discusses the potential impacts to the Beaver Creek watershed in this section. Wetlands occur in the permit area along Beaver Creek and Pass Creek. Additional potential wetlands are dispersed throughout the Dewey-Burdock Project Area as small depressions and ponds, historical mine pits, and an area around a flowing artesian well.

After reviewing the available information discussed in this section, the EPA finds that if Powertech implements all the mitigating measures described in this section, the potential impacts to surface water and wetlands from the drilling and operation of injection wells at the Dewey-Burdock Project Site should be minimal and contained within the Dewey-Burdock Project Boundary. The EPA evaluated the impacts to surface water documented in the NRC Dewey-Burdock SEIS and the South Dakota DENR Large Scale Mine Permit. This section examines the DENR surface water monitoring requirements and mitigation measures that should prevent or minimize impacts to surface water. The EPA reviewed Powertech's stormwater management and erosion control plan, and evaluated impacts to stream channels, riparian areas and wetlands, and impacts from spills and leaks. This section also compares the effects to surface water from the deep injection well and the land application methods for the disposal of treated ISR waste fluids.

4.1 Surface Water and Stormwater Permitting Requirements

The DENR Water Program requires Powertech to obtain a construction and an industrial stormwater NPDES permits in accordance with regulations in ARSD Chapter 74:52. The NPDES permit requirements for discharges to surface water, as established in ARSD 74:52, will control the amount of pollutants that can enter surface water bodies, such as streams, wetlands, and lakes or ponds. Powertech has not yet submitted any NPDES permit applications to the DENR, but will do so before any construction work is initiated on the site.

The DENR NPDES permit will establish surface water monitoring requirements. Under this permit, Powertech must comply with South Dakota surface water quality standards for surface water sites during and after ISR operations and during decommissioning. As described in SEIS Section 7.2.4, the applicant plans to monitor 24 impoundments and 10 stream sampling sites as part of the operational surface water monitoring program. The 10 operational surface water monitoring stream sampling sites are listed in the Large Scale Mine Permit Table 5.5-3. Four of these sites are on stream segments with designated beneficial uses (Beaver Creek and the Cheyenne River). Large Scale Mine Permit Section 3.5.4.1.1 describes how the sampled segments of Beaver Creek and the Cheyenne River have beneficial uses for warmwater semipermanent fish life propagation and limited-contact recreation. Section 3.5.4.1.1 also describes how baseline samples collected from Beaver Creek met the ARSD 74:51:01:48 criteria for warmwater semipermanent fish life propagation waters except for some measurements of total suspended solids (TSS). Similarly, Cheyenne River baseline samples met the criteria except for some TSS measurements and one dissolved oxygen measurement.

Routine operational monitoring of surface water sites will be used to demonstrate compliance with the antidegradation policy for surface waters in ARSD 74:51:01:34, which requires existing beneficial uses to be maintained and protected. The mitigation measures described in this section will ensure that the Dewey-Burdock Project will not cause significant changes in surface water quality. To verify the effectiveness of mitigation measures, Powertech will analyze surface water samples for the parameter list in Large Scale Mine Permit Table 5.5-4. Surface water monitoring locations are shown in Large Scale Mine Permit Plate 5.5-1.

Powertech must develop a Stormwater Management Plan (SWMP) to control erosion, stormwater runoff, and sedimentation from disturbed areas. The SWMP is required as part of the NPDES permit in accordance with DENR requirements to detain and treat stormwater runoff to ensure that runoff does not contaminate surface waters and wetlands. The SWMP will be very similar to, and complement, the Large Scale Mine Permit Water Management and Erosion Control Plan discussed in Section 4.2 of this document.

SWMP control measures will require Powertech to:

1. Minimize disturbance of surface areas, drainage channels, and vegetation;
2. Employ grading to direct stormwater runoff away from water bodies;
3. Use riprap where roads and stream bed intersect to make bridges and culverts more effective;
4. Stabilize slopes;
5. Avoid unnecessary off-road travel;
6. Provide rapid response cleanup procedures and training for potential spills;
7. Store hazardous materials and chemicals in bermed or curbed areas;
8. Place surface piping outside identified 100-year floodplain levels; and
9. Build curbs around facilities and structures to control process fluid spills.

As part of the SWMP, Powertech must identify and evaluate routes by which spills could cross the project boundary and lay out best management practices (BMPs) as preventative measures to minimize stormwater contamination. The SWMP will require stormwater runoff to be diverted away from the facility, avoiding contact that would allow it to become contaminated, resulting in clean stormwater being directed to areas where it can be absorbed into soils. Powertech must implement the mitigation measures discussed in this section to control erosion and sedimentation, as part of the SWMP.

The DENR NPDES permit will also require that stormwater runoff from the land application irrigation fields does not contaminate surface water bodies and wetlands. Implementation of the required mitigation measures will control erosion, runoff, and sedimentation over the land application areas.

4.2 The Large Scale Mine Permit Water Management and Erosion Control Plan

The Administrative Rule of South Dakota (ARSD) 74:29:02:11 *Effect on hydrologic balance and on surface water and groundwater* requires Powertech to develop a drainage, erosion, and sedimentation control plan. This plan must be implemented during and after ISR operations to reduce soil loss within the permit area. The plan includes the use of ditches, diversions, sediment traps/ponds, culverts, and other BMPs to be used to control surface water flow within the permit boundary. Large Scale Mine Permit Plates 5.3-6 through 5.3-19 show the structures included in the plan for water control and erosion control. Table 7 provides a description of each of these plates.

4.2.1 Erosion Control

Potential environmental impacts to surface waters and wetlands may occur during all ISR facility lifecycle phases: construction, operation, aquifer restoration and decommissioning. Impacts to surface waters and wetlands may result from

1. road construction and crossings;
2. erosion runoff;
3. spills or leaks of fuels, chemicals, and process-related fluids;
4. stormwater discharges; and
5. discharge of wellfield fluids as a result of pipeline or well head leaks.

Potential surface water impacts from the drilling and operation of injection wells include increased sediment load due to sediment migration from surface disturbance, a limited amount of disturbance to stream channels, potential encroachment on wetlands, and potential water quality impacts from spills and leaks. Each of these is described below. Temporary changes to spring and stream flows due to grading and changes in topography and natural drainage patterns are other potential impacts. Powertech plans to minimize erosion of disturbed, reclaimed and native areas through proper land management and farming techniques. Typically, following ground disturbance, areas will be prepared and seeded as soon as possible to reduce the possibility of erosion. Also, erosion control measures will be used to reduce overland flow velocity, reduce runoff volume or trap sediment. Examples include rip-rap, vegetative sediment filters, check dams, mulches, cover crops, and other measures. Large Scale Mine Permit Plates 5.3-6 through 5.3-19 show the water flow and sediment control measures that will be used in the both the Dewey and Burdock Areas under the Land Application and Deep Disposal Well disposal options as discussed in the sediment control plan.

4.2.2 Sediment Control Plan

The greatest potential for erosion and sedimentation will occur during the construction and decommissioning phases of the project. To mitigate soil loss Powertech will minimize the surface disturbance to soil and vegetation by using existing roads where possible, limiting secondary and tertiary road widths, and locating access roads adjacent to utility corridors. Powertech also will limit the sediment mobility by reseeding disturbed areas as soon as possible. Sediment control structures will be most critical while the wellfield is being constructed and immediately after redistributing topsoil.

Large Scale Mine Permit Plates 5.3-6 and 5.3-7 show a large-scale plan of the sediment control measures that will be implemented in the permit area. Plate 5.3-6 Sheet 1 shows the Sediment Control Plan in the Dewey Area under the deep disposal well (DDW) Option; Plate 5.3-6 Sheet 2 shows the Sediment Control Plan in the Burdock Area under the DDW Option. Plate 5.3-7 Sheet 1 shows the Sediment Control Plan in the Dewey Area under the Land Application (LA) Option; Plate 5.3-7 Sheet 2 shows the Sediment Control Plan in the Burdock Area under the LA Option.

Table 7. List and Description of Plates Illustrating the Large Scale Mine Permit Water Management and Erosion Control Plan

Large Scale Mine Permit Plate No.	Date	Description
Plate 5.3-6 Sediment Control Plan - DDW Option, Sheet 1: Dewey Area	27 Sept 2012	Dewey Area Sediment Control Plan showing structures in the pond area and around wellfields in the Dewey Area under the DDW Option
Plate 5.3-6 Sediment Control Plan - DDW Option, Sheet 2: Burdock Area	27 Sept 2012	Burdock Area Sediment Control Plan showing structures in pond area and around wellfields in the Burdock Area under the DDW Option
Plate 5.3-7 Sediment Control Plan - LA Option, Sheet 1: Dewey Area	27 Sept 2012	Dewey Area Sediment Control Plan showing structures in the pond area and around wellfields in the Dewey Area under the LA Option
Plate 5.3-7 Sediment Control Plan - LA Option, Sheet 2: Burdock Area	27 Sept 2012	Burdock Area Sediment Control Plan showing structures in pond area and around wellfields in the Burdock Area under the LA Option
Plate 5.3-8 Alternative Sediment Control Measures	26 Sept 2012	Shows design features of the alternative sediment and water control structures
Plate 5.3-9 Diversion No. 1 LA Option	27 Sept 2012	Blocking dike and diversion located in Section 3 to divert drainage out of land application drainage areas in Sec 2 & 3 T7N R1E & Sec 34 & 35 T6N R1E in Burdock Area
Plate 5.3-10a Diversion No. 2, DDW Option	27 Sept 2012	Dewey Area Section 29 Diversion and blocking dike redirecting drainage from ephemeral channels to a channel to the east around Dewey wellfield 1
Plate 5.3-10b Diversion No. 2, LA Option	27 Sept 2012	Dewey Area Section 29 blocking dike and diversion to redirect downhill runoff around north end of Dewey Wellfield 1
Plate 5.3-11 Diversion No. 3 LA Option	27 Sept 2012	Dewey Area blocking dike and diversion redirecting drainage coming under railroad northeast end of Dewey wellfield 1, SE Sec 29
Plate 5.3-12 Sediment Pond No. 1 DDW Option	28 Sept 2012	Sediment pond located in Dewey Area in NW Section 32 T6S R1E
Plate 5.3-13 CPP Facility Diversion, DDW Option	3 Dec 2012	Burdock area diversion redirecting downhill drainage around Burdock ponds Sec 2
Plate 5.3-14 Satellite Facility Diversions, DDW Option	3 Dec 2012	Dewey Satellite Facility Pond Diversions directing drainage through ditches along roads
Plate 5.3-15 Facility Cross Sections, DDW Option	3 Dec 2012	Shows Dewey & Burdock Ponds and cross sections
Plate 5.3-16 Facility Cross Sections, LA Option	3 Dec 2012	Shows Dewey & Burdock Ponds and cross sections, drainage ditches and diversions
Plate 5.3-17a - Diversion 4 DDW Option	29 Mar 2013	Dewey Area diversion around surge pond Sec 29 Diversion No. 4
Plate 5.3-17b - Diversion 4 LA Option	29 Mar 2013	Dewey Area Diversion No. 4 around spare storage pond Sec 29
Plate 5.3-18 - Diversion 5 LA Option	29 Mar 2013	Dewey Area Diversion on NE side of the 4 storage pond unit Sec 29
Plate 5.3-19 - CPP Facility Diversion 4 LA Option	29 Mar 2013	Burdock Area diversion around Central Processing Plant Pond Sec 2

Sediment control structures include sediment ponds, traps, and other Alternative Sediment Control Measures (ASCMs). Because there will be so many silt fences installed during construction, not all of them have been included on the Plates. Silt fences typically will be used at the toes of disturbed slopes to trap sediment caused by sheet flow. ASCMs will be used in drainages below projected disturbance to capture sediment. Several sediment control ponds also are planned to service larger drainage areas. The sediment pond location for the Dewey Area is shown on Plate 5.3-12. Sediment pond locations for the Burdock Area are shown on Plate 5.3-6 Sheet 2 and Plate 5.3-13 For the Dewey Area, the sediment pond will be constructed by Powertech for use under the DDW disposal option only; for the Burdock Area existing impoundments, Sub 30, 32, 33 and 34 will be used and monitored. Other sediment pond designs will be completed following delineation of future wellfields and will be provided to DENR for review and verification prior to construction.

Table 8 lists the types of sediment control structures Powertech will use and the corresponding drainage basin size criteria Powertech will consider in selecting the sediment control structures.

Table 8. Sediment Structures Planned for Use at the Dewey-Burdock Project Site and Corresponding Drainage Basin Acreage.

Sediment Control Structure	Drainage basin acreage
Silt fence	sheet flow[7]
Straw bale check dam	0 to 5 acres
Reinforced silt fence	5 to 10 acres
Incised sediment trap	10 to 20 acres
Sediment fence check dam	20 to 30 acres
Single fence rock check dam	30 to 40 acres
Loose rock check dam	40 to 50 acres
Wire-bound rock check dam	50 to 60 acres
Sediment pond	60 acres and greater

The design criteria for sediment ponds and ASCM structures will vary depending upon the length of time that the structure will be required. The proposed design event for sediment control structures associated with wellfield construction is the 5-year, 24-hour precipitation event. This is justified on the basis that typical wellfield construction is anticipated to be approximately 2 years per wellfield, during which time topsoil will be redistributed and revegetated as portions of the wellfield are completed. The runoff volume for the precipitation event will be calculated using the Natural Resources Conservation Service triangular hydrograph method. Powertech may use computerized models to conduct the hydrologic analysis. Ponds also will be sized to contain 2 years of sediment accumulation. Sediment volumes will be calculated using the revised soil loss equation (Renard et al., 1997). For structures in areas that will be disturbed for more than 5 years, the design criteria will be the capacity for the runoff from a 10-year, 24-hour precipitation event and 3 years of sediment accumulation.

[7] Any stormwater surface runoff that occurs in the form of overland flow on the land surface without concentrating in clearly defined channels.

Throughout the life of the project, Powertech will continue to identify potential sources of pollution and determine BMPs to be used, including erosion and sediment controls (e.g., silt fence, straw bale check dams, etc.) and operational controls (e.g., housekeeping, signage, etc.).

Powertech will conduct quarterly inspections of sediment ponds using trained personnel who are knowledgeable of pond construction and safety features. Powertech will develop a detailed checklist that will be used to document the pond structural and erosional condition. The inspector will document findings in reports that will be retained on site for reference and inspection by regulatory agencies.

4.2.3 Diversion Channels

Powertech plans to construct a number of diversion channels within the permit area to divert stormwater flow in ephemeral stream channels around the processing facilities, ponds and wellfields. Table 8 provides the list of Large Scale Mine Permit plates showing the designs of the different diversion structures. In accordance with ARSD 74:29:07:09(6), the diversions around the Central Processing Plant, Satellite Facility and associated radium settling ponds and central plant pond have been designed for the 6-hour Probable Maximum Precipitation event. Diversions were not designed for the Probable Maximum Precipitation event around the storage ponds or spare storage ponds, for the following reasons:

1. These ponds will store only treated water *en route* to the land application that will not contain radionuclides in excess of allowable discharge limits;
2. The treated water storage ponds are not associated with uranium processing or wastewater treatment; and
3. NRC guidance in Regulatory Guide 3.11 indicates that diversion designs for isolated areas where pond failure would neither jeopardize human life nor create damage to property or the environment beyond Powertech's financial assurance capabilities do not need to use extremely conservative flood design criteria.

Powertech cannot change the use of the treated water storage ponds or spare storage ponds without obtaining DENR authorization through a technical revision or permit amendment, the application for which would include diversion designs for the 6-hour Probable Maximum Precipitation event. In the land application option, no diversions will be required around the processing facilities, radium settling ponds or central plant pond due to the small drainage area above these facilities.

With the exception of Beaver Creek, all stream channels within the permit area are ephemeral. Pass Creek is considered to be an ephemeral stream within the permit area. There is no groundwater inflow into Pass Creek, therefore, it contains flowing water only during precipitation or snowmelt events. No diversions are planned on Beaver Creek or Pass Creek, and no diversions are planned on perennial or intermittent streams. Plates 5.3-6 and 5.3-7 provide the locations of planned ephemeral stream channels within the permit area. Some of the structures have been updated since Plates 5.3-6 and 5.3-7 were released. The designs for the diversions associated with the initial wellfields and land application areas are listed in Table 7. Diversion designs for future wellfields, if needed, will be provided to DENR for review and verification prior to construction.

Diversions of ephemeral channels will be designed to maintain channel velocities equal to or less than 5 feet per second for the discharge from a 2-year, 6-hour precipitation event and have the ability to contain the discharge from a 100-year, 24-hour precipitation event.

Powertech intends to perform Interim revegetation on the bottoms and side slopes of all diversions to reduce erosion. In instances where the diversion channel velocity during the design storm exceeds 5 feet per second, other erosion control measures will be implemented such as geosynthetic liners, geosynthetic filter media, or riprap. Diversions will be constructed with 3:1 or shallower side slopes to reduce the risk of slope failure, promote interim revegetation, and allow safe passage for humans, wildlife and livestock. Diversion bottom elevations will tie to undisturbed upstream and downstream channel elevations to eliminate increased erosion potential. Diversions will not discharge onto topsoil or spoil stockpiles or other unconsolidated material such as newly reclaimed areas. Culvert or bridge crossings over the diversions are not planned. If it becomes necessary to cross a diversion in the future, Powertech will submit design drawings to DENR for review and approval prior to construction.

4.3 Potential Impacts from Floods at the Dewey-Burdock Project

The EPA reviewed the extensive flood analysis that Powertech conducted which takes into account 100-year precipitation events and the topography of the area surrounding the Dewey-Burdock Project Area.

4.3.1 Powertech's Flood Analysis

Powertech's flood analysis includes estimates of peak flood discharges and water levels produced by floods on Pass Creek, Beaver Creek and local small drainages that could potentially impact the Dewey-Burdock Project Area. This information is available for review in the Large Scale Mine Permit Section 3.5.2.3 and APPENDIX 3.5-A, *Dewey-Burdock Project Flood Analysis*. Large Scale Mine Permit Plate 3.5-1 depicts the modeled flood inundation areas for all surface water features during the 100-year, 24-hour storm event in relation to proposed facilities and infrastructure.

Powertech developed a floodplain map that shows the maximum area inundated by the design flood, as well as detailed information on the depth and velocity of flood water at points of interest in the study area. The 100-year event was used for the design flood, along with a much less likely flood referred to as an upper-bound flow or an extreme flow. The 100-year event represents an appropriate level of risk for the evaluation of flood potential near the permit area facilities. The extreme flow event was used to demonstrate the additional extent of land that would be inundated between the 100-year event and floods that have an extremely low probability of occurring.

The final model results for the spatial representation of the extreme condition floodplains for Beaver Creek and Pass Creek within the permit area are shown in Large Scale Mine Permit Figures 3.5-10 and 3.5-11, respectively. The figures indicate the relationship of the maximum extent of the extreme condition floodplain to the locations of the primary facility zones and the known ore bodies. The sole purpose of including the extreme condition flood in the analysis for flood and erosion potential is to illustrate that there is very little additional land area inundated by the extreme condition floods compared to the 100-year floods. The risk of flood or erosion damage to the permit area facilities from Beaver and Pass Creeks is extremely low.

The inundation maps of Pass Creek indicate that one known ore body, Burdock wellfield 10 in Section 34, T6S, R1E, would become inundated during a 100-year or extreme flood event. It is estimated that the water depth would be 15 feet for the 100-year flood and approximately 25 feet for the extreme condition flood.

As a result of these analyses Powertech defined the 100-year flood inundation boundaries and potential flood water elevation levels for the Project Area. Except for an occasional unavoidable situation, Powertech plans to construct facilities outside of these boundaries to avoid potential impacts to facilities from flooding and potential impacts to Beaver Creek and Pass Creek in the event of any potential spills or leaks. Pipelines will be buried below the frost line and will be isolated from impacts of surface flooding. Pipeline valve stations will be located outside of the 100-year flood inundation boundaries.

The Burdock central plant and Dewey Satellite Facility and supporting buildings will be constructed outside the 100-year floodplain of Pass and Beaver Creeks and away from other small ephemeral drainages (see the NRC SEIS Section 3.5.1). These buildings will be located on relatively flat terrain, which will require minimum soil movement to create level pads for the Burdock central plant area (see Large Scale Mine Permit Plate 5.3-6 Sheet 2) and the Dewey Satellite Facility area to natural drainages (see Large Scale Mine Permit Plate 5.3-6 Sheet 1). Facility buildings will be located away from these intermittent drainage channels and outside of floodplains so facilities will not flood.

As discussed in NRC SEIS Section 3.5.1, some wellfields and storage ponds located in Sections 29 and 32, T6S, R1E in the Dewey area will be located within the 100-year floodplain boundary of an ephemeral drainage to Beaver Creek. In addition, some wellfields, the main access road, and the plant-to-plant pipeline in the Burdock area are located within the 100-year floodplain boundary of ephemeral drainages to Pass Creek. These locations are shown on Large Scale Mine Permit Plate 3.5-1. To protect facilities and infrastructure from flood damage and avoid discharges from storage ponds that are located within the 100-year inundation boundary, Powertech will implement the Water Management and Erosion Control Plan described in Section 4.2 of this document.

Facilities which cannot be located outside the flood inundation boundaries will be protected from flood damage by the use of straw bales, collector ditches, and/or berms. If it is necessary to place a well head within a flood inundation boundary, for example in Burdock wellfield 10, diversions or erosion control structures will be constructed to divert flow and protect the well head. In addition, Powertech plans to seal each well head to withstand brief periods of submergence. Figures 5 and 6 of the Class III Area Permit show that all ISR wells and monitoring wells will be sealed to prevent inflow of water from surface precipitation. The debris sweeping through flooded areas would pose the largest threat for structural damage. Wellfields will be enclosed in fences, which will block debris being swept along by floodwaters from contacting well heads and header houses.

4.3.2 Historic Flood Events in Western South Dakota

The EPA is aware of the flood that occurred northwest of the unincorporated community of Dewey in July 2013. The *Edgemont Herald-Tribune* reported that a wall of water hit a train traveling near mile marker 496 just north of Dewey. The flood resulted from heavy rains within the Beaver Creek drainage basin to the east. The flood waters washed across the railroad tracks with enough speed to remove the railroad bed ballast under about 5 miles of track, derailing 37 empty coal cars, 13 of which were overturned.

The National Weather Service provides a *Summary of Historic Floods and Flash Floods* for western South Dakota through 2013 (https://www.weather.gov/unr/summary-of-historic-floods-and-flash-floods). This flood northwest of Dewey was not included in the list, but 19 other entries of flood occurrence are listed between May and October 2013. Table 9 lists the number of flood reports on the National Weather Service website from 2006 through 2013. Although the numbers may not represent all of the floods that occurred, a trend of increasing number of flooding incidents in western South Dakota is evident.

FEMA report FEMA-4186-DR, *South Dakota – Severe Storms, Tornadoes, and Flooding* was declared July 28, 2014 assessing the cost of damages resulting from severe storms, tornadoes, and flooding in Butte, Clay, Corson, Dewey, Hanson, Jerauld, Lincoln, Minnehaha, Perkins, Turner, Union, and Ziebach Counties and the Standing Rock Sioux Tribe.

Table 9. Number of Flood Reports on the National Weather Service Website for Western South Dakota from 1996 through 2013.

Year	Number of Floods Reported
1996	2
1997	3
1998	3
1999	3
2000	0
2001	5
2002	4
2003	4
2004	5
2005	7
2006	0
2007	9
2008	19
2009	11
2010	7
2011	17
2012	2
2013	19

Of all the flood events listed on National Weather Service the web page, only one flood appears to have occurred near the Dewey-Burdock Project Site: "June 14, 2009 (Southern Custer County) Runoff from heavy rain washed out Dewey Road between Red Canyon Creek and Pleasant Valley Creek." However, based on the locations of the Dewey Road, Pleasant Valley Creek and Red Canyon Creek, this location description does not appear to be accurate. A report of regional flooding that included Custer and Fall River Counties on May 24, 2010 states that Pennington, Meade, Custer, and Fall River Counties experienced "a strong upper level wave combined with ample moisture to produce strong thunderstorms along the eastern and southern slopes of the Black Hills. Strong thunderstorms moved over the same areas for about three hours. Torrential rain of two to four inches fell in a brief period of time. This heavy rain caused flooding from Piedmont, SD southward to the Nebraska border."

The apparent trend of increase number and severity of flooding events in western South Dakota emphasizes the importance of Powertech's plans for adequate planning and protection of the ponds and other structures that could impact surface water and wetlands in the Dewey-Burdock Project Area. The South Dakota DENR reviewed the protective measures in the Water Management and Erosion Control Plan Powertech submitted as part of the Large Scale Mine Permit application and discussed in Section 4.2 of this document.

The EPA compared the topography of the Project Site and surrounding areas with the topography of the area northwest of Dewey where the July 2013 flood occurred. The area northwest of Dewey, where the July 2013 flood occurred is a narrow valley with a broad, high topographic feature located to the east of the valley. The flood water source area is the broad, high topographic feature with a maximum elevation of 4949 ft. above mean sea level at Twin Buttes. Precipitation falling on this broad, high feature was directed into the narrow valley through tributaries to Beaver Creek that traveled through incised stream channels which did not provide very much area to dissipate the flood water volume and velocity before reaching the railroad. In contrast, the Dewey Area wellfields located in Sections 29, 30, 31, 32 and 33 of T6S, R1E are located in a broader valley. There is a high topographic feature located to the east located in Sections 21 and 29 of T6S, R1E with maximum elevation of 4004 feet above mean sea level. This feature is of a smaller surface area than the high topographic area further north. Stormwater drainage from this high topographic feature does not run through narrow, incised channels, but is more dispersed. The Dewey Area ponds and wellfields lie in a wide open valley that will allow stormwater flowing from the topographic high area to the east to spread out, dissipating flood water flow speed and water depth. The intermittent tributary flowing into Section 29 will be blocked by diversions and ditches to flow around the Dewey Area ponds and wellfields as discussed in Section 4.2.3 of this document.

4.4 Potential Impacts to Stream Channels and Riparian Areas

As discussed in Section 4.3 of this document, Powertech has performed a Surface Water Hydrologic Analysis which include evaluation of the 100 year flood inundation boundaries. For the most part, Powertech plans to construct facilities outside of these boundaries to avoid potential impacts to facilities from flooding and potential impacts to the stream channels. Any facilities located within stream channels, such as pipeline corridors and access roads will cross the stream channels perpendicular to the flow direction to minimize disturbance. Primary and secondary access road stream channel crossings will include culverts to direct water flow under the road.

Ephemeral stream channels also will be disturbed temporarily at the upstream and downstream ends of the diversion channels described in Section 4.2.3 of this document, which describes the erosion protection measures that will be used for diversion channels.

Facilities potentially constructed in the cottonwood gallery riparian zone along Pass Creek include a limited number of access roads, pipelines and utility corridors. Following is a discussion of potential impacts associated with these facilities.

To a limited extent, access roads will be constructed within the cottonwood gallery riparian zone. Most of these roads will be light-use roads (tertiary access roads), which are described in Large Scale Mine Permit Section 5.3.8 as essentially non-constructed, two-track trails. To the extent possible, existing two-track roads will be used. The route for any new light-use roads that will be required within the cottonwood gallery riparian zone will be selected to minimize impacts to the riparian zone and to minimize erosion.

One secondary access road is planned through the cottonwood gallery riparian zone. This road is depicted on Large Scale Mine Permit Plate 5.3-5 (Sheet 2) in the NWNW Section 3, T7S, R1E. It is an existing road near a dwelling that crosses Pass Creek and the riparian zone using a well-established route. Since the proposed secondary access road will be an upgrade to an existing road, potential impacts to Pass Creek will be minimized. Powertech intends to continue to use the existing low-water crossing and not install a bridge or culvert at this location. Sediment control measures described Section 4.2.2 of this document will be used for any disturbance areas that could contribute sediment to Pass Creek.

If a pipeline is constructed between the Central Processing Plant and the Satellite Facility, it will cross the riparian zone near the existing low-water crossing. In addition, a utility corridor consisting of an overhead power line and buried pipeline is planned across the Pass Creek riparian zone in the SESW Section 34, T6S, R1E (refer to Large Scale Mine Permit Plate 5.3-1, Sheet 2). The pipeline and utility routes through the riparian zone will be selected to minimize potential impacts. The Pass Creek pipeline crossings will be trenched or bored. Mitigation measures to minimize impacts will include use of sediment control measures, avoiding construction during early spring while runoff from snowmelt is occurring, and complying with applicable USACE permitting requirements.

Disturbance to the cottonwood gallery riparian zone will be relatively small due to the limited number of utility crossings and use of existing roads. Special care will be taken in this area to control sediment. During construction, silt fences, straw beds, and other sediment control measures will be used to minimize any potential water quality impacts.

4.5 Potential Impacts to Wetlands

The majority of the potential wetlands in the permit area occur along Beaver Creek and Pass Creek. Potential wellfield areas all occur away from Beaver Creek and Pass Creek, and potential wetlands along Beaver Creek and Pass Creek will not be impacted by construction activities. The remaining potential wetlands are dispersed throughout the permit area as small depressions and ponds, historical mine pits, and an area around a flowing artesian well. The wetlands within the historical mine pits are not planned to be disturbed.

The USACE identified 20 wetlands within the proposed project area (see SEIS Section 3.5.2), of which only four were considered jurisdictional[8]: Beaver Creek, Pass Creek, and an ephemeral tributary to each. The jurisdictional ephemeral tributary to Beaver Creek has wetlands present near its confluence with Beaver Creek located in Section 32, Township 6 South, Range 1 East as shown in NRC SEIS Figure 4.5-1 and Figure 15a of this document. The drainage area for this tributary includes surface facilities, infrastructure, and wellfields constructed in the Dewey area. The jurisdictional ephemeral tributary to Pass Creek has wetlands present near its confluence with Pass Creek located in Section 3, Township 7 South, Range 1 East as shown in NRC SEIS Figure 4.5-1 and Figure 15b of this document. The drainage area for this tributary includes surface facilities, infrastructure, and proposed wellfields in the Burdock area.

Powertech will use a phased approach to wellfield development beginning with wellfield 1 in the Dewey and Burdock Areas. The Burdock B-WF1 wellfield and Dewey D-WF1 wellfield will be constructed during the initial construction phase of the project. Wellfield B-WF1 will be situated at least 3,300 ft. from Pass Creek and the ephemeral tributary to Pass Creek identified as a jurisdictional wetland. Wellfield D-WF1 is located at least 330 ft. north of Beaver Creek and 1,000 ft. northwest of the ephemeral tributary to Beaver Creek, which is a

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[8] For information about wetland definition and jurisdictional determination, please see https://www.epa.gov/cwa-404/section-404-clean-water-act-how-wetlands-are-defined-and-identified.

jurisdictional wetland. However, wellfield D-WF1 crosses over ephemeral tributaries upstream of the tributary to Beaver Creek identified as a jurisdictional wetland. Figures 15a and 15b are taken from NRC SEIS Figure 4.5-1 and show the locations of the jurisdictional wetlands in the Dewey and Burdock Areas respectively.

Additional wellfields will be built and developed in phases as operations in preceding wellfields become uneconomical. Figure 15a shows that Dewey wellfield D-WF2 and a portion of Dewey wellfield D-WF4 are located 330 ft. north of the ephemeral tributary to Beaver Creek identified as a jurisdictional wetland. However, like wellfield D-WF1, wellfields D-WF2 and D-WF4 cross over ephemeral tributaries upstream of thetributary to Beaver Creek identified as a jurisdictional wetland. Figure 15b shows that Burdock wellfields B-WF9 and B-WF10 cross nearby ephemeral tributaries upstream of Pass Creek. In addition, Figure 15b shows that the ephemeral tributary to Pass Creek identified as a jurisdictional wetland bisects wellfield B-WF5.

USACE permits under Section 404 of the Clean Water Act are required for placing fill material, excavating, or using earthmoving equipment to clear land in wetlands. The presence of wellfields within jurisdictional wetlands and crossing tributaries upstream of jurisdictional wetlands may require Powertech to obtain USACE permits before construction activities (e.g., drilling wells, laying pipeline, and constructing access roads). In addition, Powertech's plant-to-plant pipeline crosses Pass Creek between wellfields B-WF9 and B-WF10 in the Burdock construction.

The USACE permitting process ensures that proper filling and dredging techniques are used and proper mitigation measures are defined and implemented to ensure protection of wetland habitat and water quality in affected jurisdictional wetlands. Powertech will be required to seek authorization from USACE and comply with Section 404 permitting requirements before conducting work in jurisdictional wetlands identified in the project area.

Construction, operation or reclamation activities that will cause disturbance or impacts to jurisdictional wetlands will be performed in accordance with appropriate Nationwide Permits issued by the USACE, if applicable. These may include Nationwide Permit (NWP) 44 non-coal mining activities, which requires Pre-construction Notification (PCN) for all activities, NWP 12 utility line activities, which requires PCN for an area where a Section 10 permit is required, discharges that result in the loss of >0.1 acre, and NWP 14 linear transportation projects, which requires a PCN for 0.5 acre in non-tidal waters. NWP 44 has an acreage limit of 0.5 acre for Waters of the U.S. NWP 12 and 14 also have 0.5-acre disturbance limits. Impacts to Other Waters of the U.S. are not considered under the acreage limit. Large Scale Mine Permit Appendix 3.8-B contains the USACE jurisdictional determination for the permit area. At this time, Powertech has not applied for a Section 404 permit. Therefore, USACE has not conducted additional Section 404 permitting activities at the proposed project site, such as determining specific acreages of jurisdictional wetlands that could be impacted or identifying mitigation measures to be implemented to minimize wetland impacts.

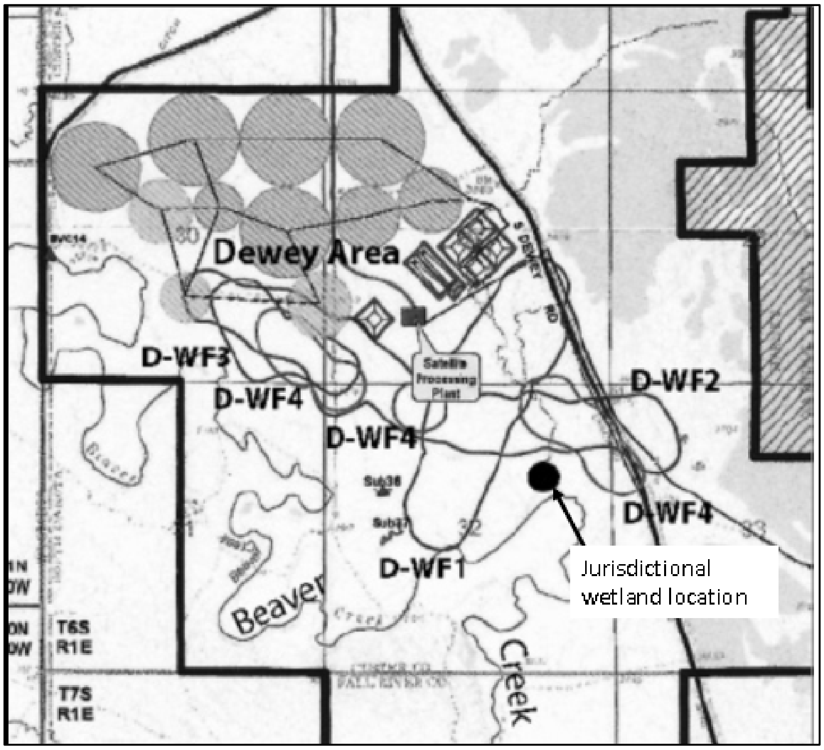

Figure 15a. Location of Jurisdictional Wetland in the Dewey Area (from NRC SEIS Figure 4.5-1)

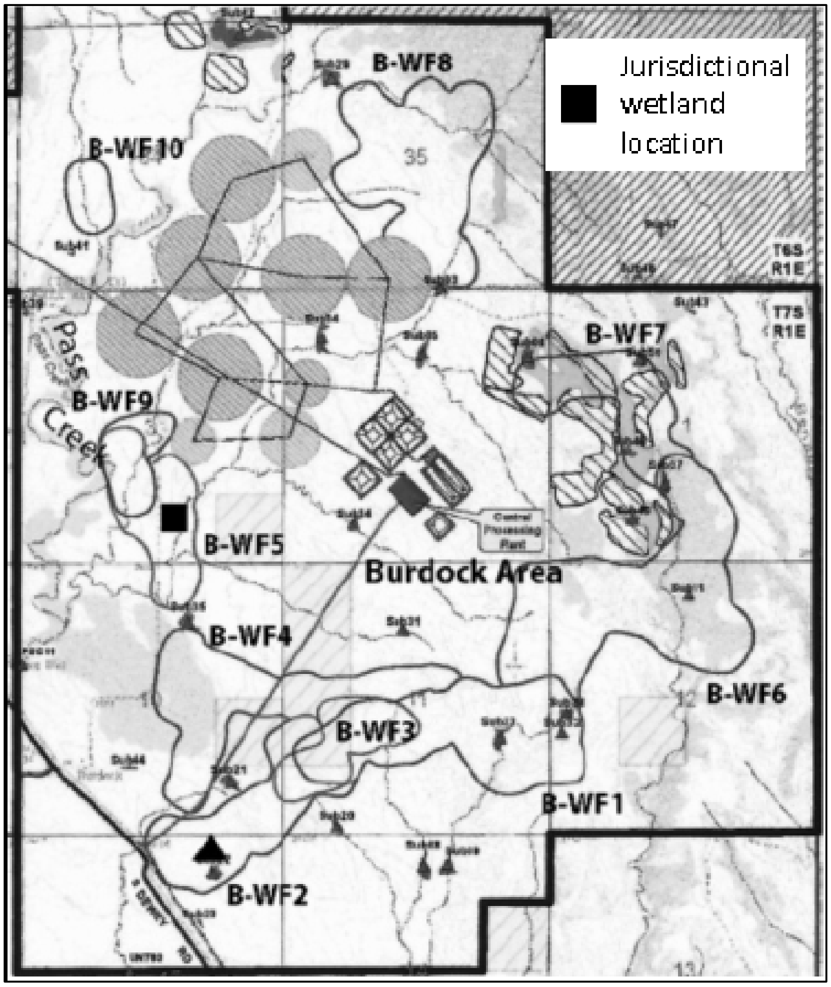

Figure 15b. Location of Jurisdictional Wetland in the Burdock Area (from NRC SEIS Figure 4.5-1)

4.6 Potential Surface Water Quality Impacts from Spills and Leaks

Potential impacts to surface waters and wetlands could occur from spills and leaks at wellfield header houses, pipelines and wellheads, processing facilities, from transportation accidents, or as releases from treatment and storage ponds. Potential impacts to surface water could also occur from accidental spills or leaks of fuels and lubricants from construction equipment. Potential surface water quality impacts from spills and leaks are addressed in Section 5.0 of this document. Mitigation measures are described in Large Scale Mine Permit Section 5.6.5.2 and in this document in Section 5.4.

4.7 Impacts from Deep Injection Well and Land Application Disposal Options for Treated ISR Waste Fluids

Powertech has proposed two options for the disposal of treated ISR waste fluids: deep injection well disposal under an EPA UIC Class V well permit or land application under a DENR GDP. Powertech's preferred option is to dispose of all ISR waste fluids into deep injection wells after the fluids have been treated to hazardous waste and radioactive waste standards. However, if the deep injection wells are not able to be used or if the wells do not have the capacity to dispose of the total volumes of ISR waste fluids generated at the site, then Powertech will implement the land application disposal option under the proposed DENR GDP. For a discussion of the land application disposal methods refer to the proposed South Dakota DENR Groundwater Discharge Permit found at https://denr.sd.gov/des/gw/Powertech/Powertech_GW_Discharge_Permit.aspx.

4.7.1 Impacts from the Deep Disposal Well Option

Powertech's preferred option for disposal of treated ISR waste fluids is the deep disposal well option. As proposed in the Class V permit application, the deep injection wells will be located near the Satellite Facility in the Dewey area and near the Central Processing Plant in the Burdock area. The Land Application method of treated ISR waste fluid disposal will be used only if the Class V Area Permit cannot be issued or if the deep disposal wells cannot accommodate the volume of treated ISR waste fluids produced by the Dewey-Burdock ISR Project.

Surface disturbance and associated impacts to surface waters and wetlands from the drilling and operation of the deep disposal wells is discussed in NRC SEIS Section 4.5.1.1.1.1. The deep well liquid waste disposal option is estimated to disturb about 243 acres of land or 2.3 percent of the permit area. This area includes land disturbance from construction of facilities, pipelines, initial wellfields, radium settling and holding ponds, the deep injection wells, and access roads. There will be impacts to the ground surface during the drilling and construction of the deep injection wells, but this area will be reclaimed once well construction is complete. During operation of the deep injection wells, there is a chance of leaks in the pipelines between the ponds holding the treated injectate and the injection well head. The deep injection wells will be operating during the periods of wellfield operation and aquifer restoration. During decommissioning, there will be a limited amount of ground surface disturbance while the well is being plugged and abandoned. This disturbed area will be restored.

There should be no impacts to surface water and wetlands from disposal into the deep injection wells. In the Dewey-Burdock area, there is no evidence of any hydraulic connection between surface waters and proposed aquifers for the Class V injection well disposal option. The UIC deep well area permit contains protective measures to ensure that injection zone fluids will be vertically confined and injection will not in the migration of injection zone fluids to the surface at the Dewey Fault or at the location of plugged and abandoned oil and gas test wells located within the Dewey-Burdock Project Area. The nearest springs to the deep Class V wells injecting into the Minnelusa Formation are Hot Brook Spring and the Evans Plunge Spring in Hot Springs and Cascade Springs and Cool Spring located approximately 9 miles south of Hot Springs. These springs are located more than 20 miles away from the Dewey-Burdock Project Site. The springs near Hot Springs are fed by groundwater flowing from the Madison aquifer. The potentiometric surface of the Minnelusa aquifer near Hot Springs is not high enough to reach the ground surface. Cascade Springs has a small component of Minnelusa groundwater flowing to the surface in addition to the larger volume of Madison groundwater. The prevailing direction of groundwater flow at the Dewey-Burdock Project Site follows the dip of the geologic units, which is towards the southwest. However, a map of regional flow for upper Paleozoic aquifers (see Class V Permit Application Figure D-6) shows that at some distance south of the Dewey-Burdock Project Area, groundwater flow turns toward the northeast. At some point in the very distant future (on the scale of 10,000 years), injectate from the Dewey-Burdock Class V injection wells could conceivably arrive at Cascade Springs. At that point in time, the injectate from the Class V injection wells will be indistinguishable from the mixture of predominantly Madison groundwater with a small component of Minnelusa groundwater flowing to the surface as Cascade Springs. Therefore, the EPA does not expect there to be any impact to surface waters and wetlands from injection into the Minnelusa aquifer.

4.7.2 Impacts from the Land Application Option

For the land application option, a total of 1,398 acres of land or 13.2 percent of the proposed permit area will be disturbed by activities associated with construction of facilities including buildings, pipelines, wellfields, storage ponds, irrigation areas, and access roads. This area of land disturbance is larger than for the deep injection well disposal option, which is approximately 243 acres, due to the addition of 1,052 acres of land irrigation areas and the need for 136 acres of increased pond capacity for storage during non-irrigation periods. Table 10 is Table 4.2-1 from the NRC SEIS and shows the breakdown of land disturbance for the deep injection well and land application disposal options.

Table 10. Breakdown of Land Disturbance for the Deep Injection Well and Land Application Disposal Options at the Proposed Dewey-Burdock ISR Project Site (from the NRC SEIS Table 4.2-1)

Facilities/Infrastructure	Surface Disturbance
Disposal Via Class V Injection Wells	
Site Buildings	9.7 ha [24 ac]
Trunkline Installation	10.1 ha [25 ac]
Access Roads	8.5 ha [21 ac]
Wellfields	56.7 ha [140 ac]
Impoundments (ponds)	13.4 ha [33 ac]
Total	98.3 ha [243 ac]
Disposal Via Land Application	
Site Buildings	9.7 ha [24 ac]
Trunkline Installation	10.1 ha [25 ac]
Access Roads	8.5 ha [21 ac]
Wellfields	56.7 ha [140 ac]
Impoundments (ponds)	55.0 ha [136 ac]
Irrigation Areas	425.7 ha [1,052 ac]
Total	565.7 ha [1,398 ac]
Source: Powertech (2010a)	

Irrigation areas and the additional pond area are situated on flat topography along Pass Creek and its tributaries in the Burdock area (see Large Scale Mine Permit Plate 5.3-7 Sheet 2) and along Beaver Creek and its tributaries in the northwest part of the Dewey area (see Large Scale Mine Permit Plate 5.3-7 Sheet 1). Powertech will apply treated liquid effluent to native vegetation or to existing soil after it has been prepared to grow crops such as alfalfa or salt-tolerant wheatgrass. Significant earthmoving activities will not be conducted to prepare irrigation areas. Runoff from precipitation events or snowmelt on land application areas will be conveyed to catchment areas downgradient of land application areas and allowed to evaporate or infiltrate. The soil horizon found throughout most of the project area is clayey, which will minimize infiltration and enhance evaporation.

Implementation of mitigation measures associated with the SWMP, discussed in Section 4.1 of this document, will control erosion, stormwater runoff, and sedimentation from disturbed areas, as part of the NPDES permit from DENR. As discussed in Section 4.1, the NPDES permit requirements for discharges to surface water will ensure that surface runoff, if any, will not contaminate surface water and wetlands. Additionally, Powertech is required to implement an emergency spill response plan to address cleanup of accidental spills and leaks. Powertech must also seek authorization from USACE and comply with Section 404 permitting requirements before conducting work in jurisdictional wetlands identified in the project area. The USACE permit ensures that proper filling and dredging techniques are used and proper mitigation measures are defined and implemented and to protect wetland habitat and water quality in affected jurisdictional wetlands.

Because irrigation fields are located on relatively flat topography (See Large Scale Mine Permit Plate 5.3-7), runoff of treated liquid wastes applied to land irrigation areas is not expected. Additionally, the DENR GDP will require land application activities to be conducted so that no ponding and no runoff of effluent (i.e., wastewater solutions) occur. The proposed land application areas are located outside the 100-year flood inundation boundaries of Beaver Creek and Pass Creek. Potential runoff produced by snowmelt or precipitation in land application areas will be diverted to adjacent catchment areas and allowed to evaporate or infiltrate. Powertech intends to grow crops on irrigation fields, which may require adjustments in water application rates to optimize both evaporation and crop production during the irrigation season.

The DENR NPDES permit requirements will require that surface runoff at the ISR facilities and irrigation fields from rain events do not contaminate surface water bodies and wetlands. Implementation of mitigation measures will control erosion, runoff, and sedimentation over the land application areas. In addition, Powertech is required to implement an emergency spill response plan to address cleanup of accidental spills and leaks.

The NRC License requires that radioactive constituents in liquid effluents applied to land application areas are within allowable release limits. Powertech is required to treat liquid wastes applied to land application areas so they meet NRC release limit criteria for radiological contaminants, as referenced in 10 CFR Part 20, Appendix B, Table 2, Column 2. The DENR Groundwater Discharge Permit also regulates land application of treated wastewater which requires Powertech to comply with applicable state discharge requirements for land application of treated wastewater. Additionally, the DENR Groundwater Discharge Permit will require land application activities to be conducted so that no ponding and no runoff of effluent (i.e., wastewater solutions) occur. Therefore, the NRC staff conclude that treated liquid wastes applied to land application areas will contain contaminant levels below NRC and DENR requirements.

4.8 Summary of Mitigation Measures to Prevent or Minimize Potential Impacts to Surface Water and Wetlands

This section summarizes the mitigation measures that Powertech will be required to implement at the Dewey-Burdock Project Site to prevent or minimize impacts to surface water and wetlands from uranium-ISR-related processes.

The DENR NPDES permit will require Powertech to prepare and implement a SWMP that is consistent with state and federal standards for construction and operation activities. The SWMP will require mitigation measures to help prevent impacts to surface water. The NPDES permit will also require monitoring to detect any potential impacts to surface water and wetlands. Powertech will be required to design and implement an emergency response plan to identify and clean up accidental spills and leaks. Powertech must comply with EPA and NRC regulations concerning the construction of settling and holding ponds including the use of liners, underdrains, and leak detection systems. Powertech must obtain and comply with USACE Section 404 permitting requirements for wetlands.

The following summary of procedures are proposed in the DENR Large Scale Mine Permit to prevent or minimize the potential impacts to surface waters and wetlands:

1. Minimize disturbance of surface areas and vegetation which, in turn, will minimize erosion and runoff rates;
2. Minimize physical changes to drainage channels unless changes are made to upgrade drainage;

3. Use erosion and runoff control features such as proper placement of pipe, grading to direct runoff away from water bodies, and use of riprap (broken rock and/or concrete) at these intersections to make bridges or culverts more effective, if necessary;
4. Use sediment trapping devices such as hay or straw bales, fabric fences, and devices to control water flow and discharges to trap sediments moved by runoff;
5. Maintain natural contours as much as possible, stabilizing slopes and avoiding unnecessary off-road travel with vehicles; maintaining natural contours as much as possible, stabilizing slopes and avoiding unnecessary off-road travel with vehicles;
6. The land application of treated wastewater will occur at agronomic rates to avoid irrigation runoff into surface water; catchment areas also will prevent land application water from entering surface water;
7. Facilities will be constructed outside of flood inundation areas to the extent practicable; and
8. BMPs will be utilized during ISR operations.

Based on review of protective requirements and mitigation measures in the permits Powertech will be required to obtain before initiation of any construction activities and the protective measures required by the NRC license and the Large Scale Mine Permit, the EPA finds that if Powertech implements all the mitigating measures described in this section, the potential impacts to surface water and wetlands from the drilling and operation of injection wells at the Dewey-Burdock Project Site should be minimal and contained within the Dewey-Burdock Project Boundary.

5.0 IMPACTS FROM SPILLS AND LEAKS

The EPA reviewed the potential impacts from spills and leaks and the prevention measures and cleanup plans that Powertech must develop and implement as required by the NRC license and the proposed DENR Large Scale Mine Permit. Spills or leaks could potentially occur at pipelines, wellfields, processing facilities, deep well pump houses, from transportation accidents, or as releases from treatment and storage ponds. Each of these potential release points is described below.

The occurrence of spills and leaks would result in short term impacts to soil and groundwater. To mitigate impacts from spills and leaks and to prevent long term impacts, the DENR NPDES permit will require Powertech to develop an Emergency Preparedness Program under the project Environmental Management Plan. In addition, the NRC license requires Powertech to implement an NRC-approved radiation protection program to protect occupational workers and ensure that radiological doses are as low as reasonably achievable (ALARA). The radiation protection program must include commitments to implement management controls, engineering controls, radiation safety training, radon monitoring and sampling, and audit programs. The NRC license requires any radiological impacts to be fully mitigated before the site is decommissioned.

The EPA concluded that these requirements, which include prevention measures, monitoring and mitigation measures for early detection and intervention, and cleanup of spills and leaks, adequately address the short and long term impacts from spills and leaks that could potentially occur related to drilling and operation of injection wells authorized under the UIC area permits. After consideration of these prevention measures and mitigation measures, the EPA concludes that impacts from potential spill and leaks will be short-term and should not result in exposure to the public above health-based standards. Cleanup requirements will help ensure that there will be no long-term impacts from the scenarios for spills and leaks discussed in this section.

5.1 Pipelines

SEIS Section 2.1.1.1.2.3.6 describes the pipelines that Powertech proposes for construction at the Dewey-Burdock Project Site, which include a network of process pipelines typically installed at ISR sites connecting:

1. the central uranium processing facility or the satellite facility and the header houses for transferring lixiviant to the wellfields;
2. the header houses, injection and production wells for injecting and recovering lixiviant; and
3. the central plant and wastewater disposal facilities (e.g., deep injection wells or land application areas).

The piping and metering system for production and injection solutions at the proposed Dewey-Burdock ISR Project will require buried trunk lines to connect the Dewey satellite facility and its related operating wellfield areas and the Burdock central processing plant and its related wellfields to the metering and flow distribution headers inside the header houses. Piping will also be installed to transport liquid waste streams from the Burdock central processing plant and Dewey satellite facility to their respective wastewater disposal facilities (i.e., deep injection wells and/or land application areas).

Powertech proposes the installation up to eight underground pipelines between the Burdock central processing plant and the Dewey satellite facility to transport various fluids used during ISR operations. The plant-to-plant pipelines will transport fluids including but not limited to

1. barren and pregnant lixiviant,
2. restoration water,
3. reverse osmosis reject brines,
4. wastewater from well drilling and maintenance operations, and
5. supply water from the Madison Formation or other aquifers.

Powertech proposes using corrosion-resistant, high density polyethylene (HDPE) pipe with heat-welded joints to connect the wells, header houses, and processing facilities. The HDPE pipine that Powertech plans to use will be designed to withstand operating pressures of 150 to 300 pounds per square inch (psi). Powertech expects actual operating pressures to be less than 100 psi. Powertech proses to pressure-test the pipelines for leaks and document pressure-test results. Powertech will bury the piping approximately 5 feet below ground surface to prevent freezing. The only exposed pipes at the proposed project site will be at the central plant, satellite facility, wellheads, and wellfield header houses. Powertech intends to install pressure and flow sensors on the main trunk lines that connect the CPP and satellite facility to the wellfields for leak detection.

5.2 Header Houses and Wellheads

Wellfield structures where leaks and spill could result in a release of ISR solutions include pipelines, header houses and wellheads. A spill or leak in these areas could potentially impacts soils, surface water and groundwater.

5.2.1 Header Houses

At the header house, the piping will be connected to manifolds equipped with control valves, flow meters, check valves, pressure sensors, oxygen and carbon dioxide feed systems (injection only), and programmable logic controllers. Sensors will measure and record pipeline pressures to monitor for potential spills and leaks resulting from failure of fittings and valves. As a wellfield expands, Powertech will construct additional header houses connected via buried header piping. Powertech proposes using header piping designed to accommodate injection and production flow rates of 2,000 gpm and operating pressures of 150 to 300 psi.

5.2.2 Wellheads

Production and injection wells will be connected by pipelines to header house buildings. Typically, one header house will service up to 20 production wells and 80 injection wells. Piping between the wells and header house will consist of high density polyethylene (HDPE) pipe with heat-welded joints, buried at least 5 feet below grade to prevent freezing. The piping at the header house will consist of flow lines directing lixiviant to the injection wells and flow lines directing uranium-bearing lixiviant from the production wells. The NRC license contains requirements for the construction and inspection of these surface features. Each flow line will be connected to manifolds in the header houses, which will be connected to the individual injection and production wells. The NRC license, the EPA UIC Class III Area Permit and the proposed DENR Large Scale Mine Permit contain construction requirements specifying that the injection and production flow lines will be equipped with control valves to control flow to and from wells, flow meters to track flow volume, check valves to prevent reverse flow, pressure sensors to measure injection pressure and pressure from the production wells, pressure switches that will automatically shut off flow before the injection pressure reaches the maximum allowable injection pressure determined according to the EPA Class III Area Permit. Oxygen and carbon dioxide feed systems will be connected to the injection well flow lines and manifolds to add these constituents to the barren lixiviant flowing from the processing plants. The details of the header house manifolds are shown on Class III Permit Application Plate 10.2.

5.2.3 Wellfield Leak Monitoring and Detection

The NRC license requires Powertech to conduct regular inspections and monitoring of wellfields pipelines and other structure to minimize the potential for spills and leaks through early detection. The EPA Class III Area Permit requires Powertech to install automated control and data recording systems at the Dewey satellite facility and the Burdock central processing plant, which will provide centralized monitoring and control of the process variables including the flows and pressures of production and injection streams. The header house components will be connected to programmable logic controllers that send data to the control systems. The systems will include alarms and automatic shutoffs to detect and control a potential release or spill. Powertech will install pressure and flow sensors on the main trunklines that connect the Burdock Central Processing Plant and the Dewey Satellite Facility to the well fields for the purpose of leak detection. In addition, the flow rate of each production and injection well will be measured automatically. Measurements will be collected and transmitted to both the Central Processing Plant and Satellite Facility control systems. Should pressures or flows fluctuate outside of normal operating ranges, alarms will provide immediate warning to operators which will result in a timely operator response and appropriate corrective action.

Small leaks at pipe joints and fittings in the header houses or at wellheads may also occur occasionally. Figure 16 shows an injection wellhead design diagram; figure 17 shows a production wellhead design diagram. These leaks may drip process solutions onto the underlying soil until they are identified and repaired. The NRC Safety Evaluation Report (SER) Section 3.1 discusses the Powertech's proposed wellfield inspection program, and SER Section 3.1.4 presents a license condition requiring documentation of these inspections. The NRC states that small leaks rarely result in contamination of the underlying soil; however, as required by the NRC license, Powertech must survey affected soil for contamination, and, if contamination is detected, the soil will be appropriately removed. Furthermore, in Section 5.7.1.3 of the Technical Report prepared for the NRC license application, Powertech states that it will develop a response plan for wellfield spills that will include procedures for notification, spill containment and recovery, post spill sampling and cleanup, and reporting.

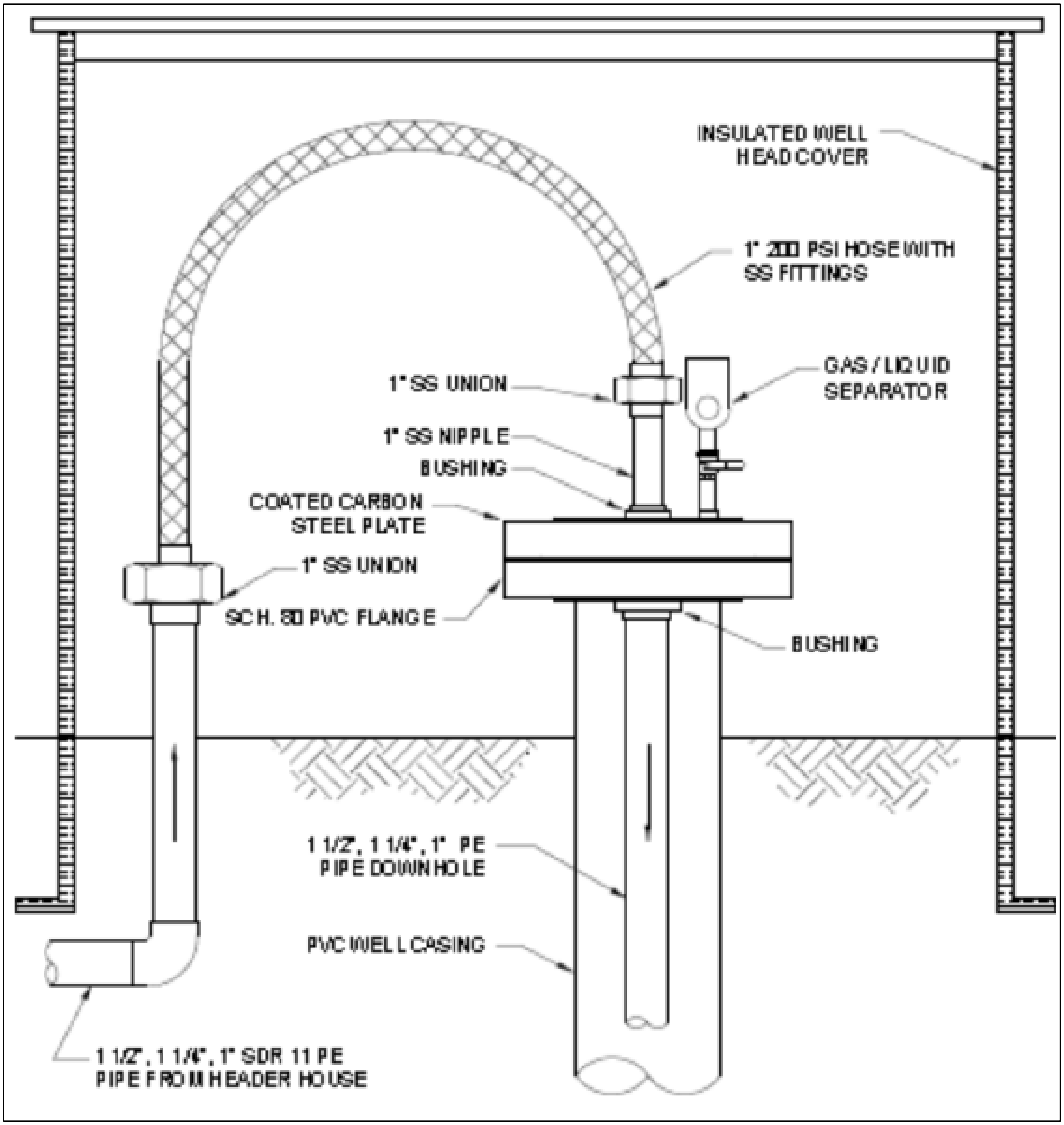

Figure 16. Injection wellhead design diagram.

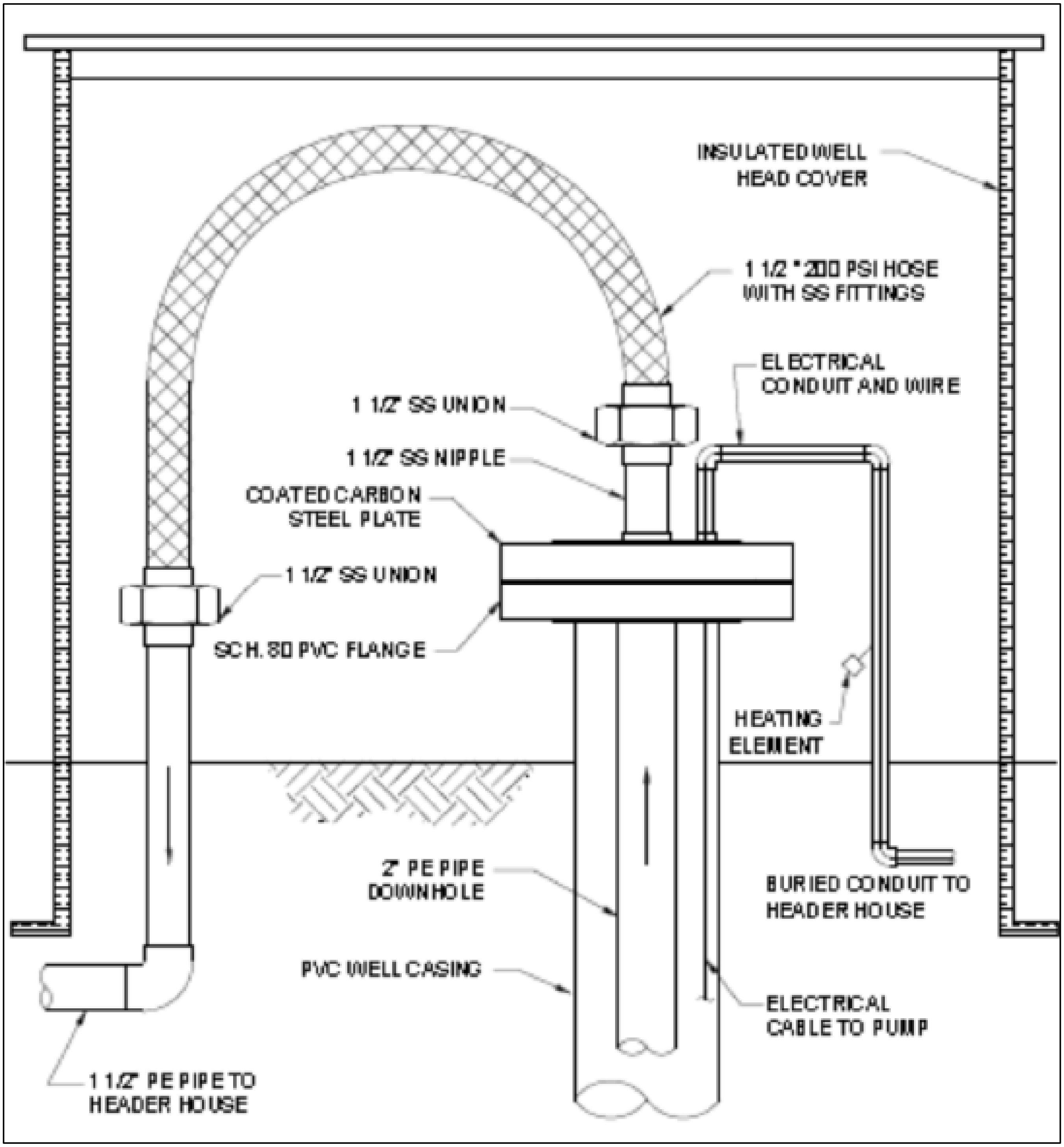

Figure 17. Production wellhead design diagram.

5.2.4 Control of Wellfield Spills and Leaks

Both external and internal shutdown controls will be installed at each header house to provide for operator safety and spill control. The external and internal shutdown controls are designed for automatic and remote shutdown of each header house. In the event of a header house shutdown, an alarm will occur and the flows of all injection and production wells in that header house will be automatically stopped. A control valve that will close when de-energized will be used on the injection header, which will stop the flow to all injection wells.

Each header house also will include a sump equipped with a water level sensor so that if a leak occurs, and the water level approaches a preset level, the sensor will cause an automatic shutdown of the header house.

The EPA Class III Area Permit directs Powertech to determine the maximum injection pressure for each header house. The designated maximum pressure will be posted near the injection trunk line gauge used to monitor injection pressure. The EPA Class III Area Permit requires the maximum injection pressure to be calculated as the lowest value of the following:

1. The lowest value of maximum allowable wellhead pressure for all injection wells connected to the header house based on fracture pressure calculations required in Part II, Section J of the EPA Class III Draft Area Permit and discussed in Section 5.9 of the EPA Class III Draft Area Permit Fact Sheet;
2. The manufacturer-specified maximum operating pressure for the well casing; and
3. The manufacturer-specified maximum operating pressure of the injection piping and fittings.

Powertech plans to pressure test all pipelines for leaks during construction to ensure that the piping system does not leak before ISR operation commences. Automated instrumentation and control system will monitor pressure and flow and immediately detect anomalous pressure and flow conditions to minimize any leaks that form. Powertech must implement a spill response and cleanup program in accordance with NRC license requirements and DENR permit conditions that will ensure that any leaks that occur in the wellfield areas are cleaned up. Powertech's spill contingency plan is included in APPENDIX 5.6-C of the Large Scale Mine Permit which describes the measure for spill prevention, containment, response, cleanup, recordkeeping, and reporting procedures for the Dewey-Burdock Project.

5.3 Central Processing Plant and Satellite Facility

The Central Processing Plant will serve as the hub for production operations at the project; therefore, the Central Processing Plant will likely have the greatest potential for spills or accidents potentially resulting in the release of pollutants. Potential releases also could occur from the Satellite Facility. The Central Processing Plant contains three fluid-handling circuits: ion exchange, elution, and precipitation and drying. Potential releases could result from a tank or process vessel failure, pipe rupture, or transportation incident. Powertech will construct the Central Processing Plant and Satellite Facility on concrete slabs surrounded by protective berms or curbs to contain and control accidental spills.

Failure of a process vessel, tank, or pipeline within the Central Processing Plant or Satellite Facility will be contained within the building via concrete containment curbs and directed into a sump (equipped with a fluid level alarm) that will transport the solution the appropriate tank or disposal system. The concrete containment curb for the Central Processing Plant has been designed to contain the entire contents of the two largest liquid-containing vessels (yellowcake thickeners) in the extremely unlikely event that both vessels should fail simultaneously and spill their entire contents. The sumps will provide additional temporary containment capacity such that the total containment capacity of curbs and sumps will be greater than 200% of the largest liquid-containing tank or vessel in the Central Processing Plant. The Satellite Facility similarly will have a curb and sump system that together will provide approximately 350% of the volume of the largest liquid-containing vessel or tank (utility water tank).

The design of the Central Processing Plant and Satellite Facility will be such that any spill will be contained within the respective building, regardless of sump pump operation. In the event of a total electrical failure, such that no pumps would be operational, a spill due to a vessel failure would be contained within the building in which the vessel failure occurred. Chemical storage areas adjacent to the Central Processing Plant will be provided with secondary containment as discussed in Large Scale Mine Permit Section 5.3.1.2 and the NRC Safety Evaluation Report Section 3.2.3.2.

5.4 Deep Well Pump and Wellhead Houses

Powetech intends to construct the deep well pump and wellhead houses such that fluid leaks will be contained within the buildings or in a bermed containment area surrounding the buildings until the released fluids can be managed as appropriate. Part III, Section H.1.g of the UIC Class V Area Permit requires Powertech to install an automated control system on the Class V deep disposal wells and Part V, Section G requires continuous monitoring to alert the operator if certain operating conditions are encountered. For example, a high injection pressure switch (set below the permit limit) and a low annulus differential pressure switch (set above the permit limit) will shut off injection pump power and alert the operator so that the well can be fully isolated and secured in a timely manner. The alarm will sound in the central control room of the Burdock Central Processing Plant and/or the Dewey Satellite Facility. In the event that any of the license or UIC permit condition related set points are exceeded, injection operations will cease immediately until the problem is identified and corrected. An operator will manually restart the system only when operating parameter compliance is verified. Lines leading to the deep well will be instrumented for leak detection and automatic deactivation. Sections 6.5 and 8.1.5 of the UIC Class V Area Permit Fact Sheet discuss these permit requirements.

5.5 Transportation Accidents

An accident involving transportation vehicles within or to and from the permit area could potentially release pollutants to the environment. Transportation vehicles will include, but are not limited to: vehicles delivering bulk chemical products, transport of uranium-loaded resin from the Satellite Facility or another satellite facility to the Central Processing Plant, transport of solid 11e.(2) byproduct material (as defined under the Atomic Energy Act) from the project site to an approved disposal site, or transport of dried yellowcake product from the Central Processing Plant to a licensed uranium conversion facility. The nearest license uranium conversion facility is the Honeywell International Inc. facility located in Metropolis, Illinois. Chemicals and products delivered to or transported from the Dewey-Burdock Project Area must be transported in accordance with all applicable federal and state regulations.

As part of Powertech's Environmental Management Program, emergency response procedures will be developed and implemented as required under the DENR NPDES permit to ensure a rapid response to any transportation incidents. In addition, Powertech is required under the NRC license to implement an NRC-approved radiation protection program to protect occupational workers and ensure that radiological doses are ALARA. The applicant's radiation protection program includes commitments for implementing management controls, engineering controls, radiation safety training, radon monitoring and sampling, and audit programs. As a result, all personnel will be appropriately trained in emergency response procedures to facilitate proper response from Powertech employees in transportation incidents. A specialized, appropriately licensed transportation company will transport the yellowcake to a licensed uranium conversion facility. Powertech will develop an Emergency Preparedness Program that will be implemented should a transportation accident occur. As part of the Emergency Preparedness Program, Powertech will have administrative controls in place such as standard operating procedures for spill response and cleanup, programs for radiation and occupational monitoring, and training for workers in radiological health and emergency response.

Potential impacts from transportation accidents would differ according to material type, quantity and concentration involved. Transportation risks for yellowcake shipments, uranium-loaded resin shipments, process chemicals/fuel, and 11e.(2) byproduct material are described in the NRC license application. These are briefly summarized below.

5.5.1 Yellowcake Shipments

A specialized, appropriately licensed transportation company will transport the yellowcake to a conversion facility. The NRC license and the proposed DENR Large Scale Mine Permit require Powertech to develop an Emergency Preparedness Program, as part of the Environmental Management Plan, which will be implemented should a transportation accident occur. The primary potential impact associated with an accident involving the spill of yellowcake would be potential impacts to soil in the immediate spill area. The potential impacts will be minimized by implementing the Emergency Preparedness Program and excavating and removing or remediating in place affected soils.

5.5.2 Ion-Exchange Resin

The Burdock central processing plant will house the resin stripping equipment, but the Dewey satellite plant will not. Consequently, Powertech plan to transport uranium-loaded resin in tank trucks from the Satellite Plant to the Central Processing Plant ion-exchange system for processing. A transportation accident involving uranium-loaded resin would have a lower risk than the relatively low risk from an accident involving yellowcake due to the much lower concentration of uranium in the resin and the chemical bond between the uranium and ion-exchange resin. The primary potential impact associated with an accident involving the spill of resin would be impacts to soil in the immediate spill area. The potential environmental impacts from an accident involving the shipment of ion-exchange resin would impact primarily the top soil in the area contaminated by the spill and the subsequent modification to the vegetation structure and the salvage of the top soil. This scenario would only take place if tanker trucks ruptured. Because the uranium is chemically bonded to the resin and the resin is wet, air dispersion is unlikely. Such spills are easily remediated by standard excavation and removal. Although the resin is wet, it is not wet enough for fluid flow to penetrate an aquifer and impact groundwater.

5.5.3 Process Chemicals and Fuel

Powertech anticipates that a number of chemicals and fuel deliveries to the Dewey-Burdock Project Site will occur each week. Process chemicals delivered to the Project Site will include carbon dioxide, oxygen, salt, soda ash, barium chloride, hydrogen peroxide, sulfuric acid, hydrochloric acid, and caustic soda. All applicable U.S. Department of Transportation (USDOT) hazardous materials shipping regulations and requirements must be followed during shipment of process chemicals and fuel to minimize the potential for transportation accidents. Under the proposed DENR Large Scale Mine Permit, Powertech will also be required develop standard operating procedures for unloading process chemicals and fuel within the Project Area to minimize the potential for spills.

5.5.4 11e.(2) Byproduct Material

Byproduct material is defined under Section 11e.(2) of the Atomic Energy Act. NRC regulations include wastes produced by the extraction or concentration of uranium under the definition of 11e.(2) byproduct material. Powertech must transport all solid 11e.(2) byproduct material generated in the Project Area to an appropriately licensed disposal facility. Most of the solid 11e.(2) byproduct material shipping will occur during site reclamation and decommissioning. The potential risk of a transportation accident is low, since solid 11e.(2) byproduct material is generally less radioactive than yellowcake and most of the waste will be in a solid form that is easy to contain. All applicable USDOT regulations and requirements must be followed during shipment to minimize the potential for a spill resulting from a transportation accident. The primary potential impact associated with an accident involving the spill of solid 11e.(2) byproduct material would be potential impacts to soil in the immediate spill area. The potential impacts will be minimized by excavating and removing or remediating in place affected soils.

5.6 Treatment and Storage Ponds

Powertech plans to construct ponds in both the Dewey and Burdock Areas to treat the ISR waste fluids to meet the injectate permit limits included in Part V, Section D.2.a, Table 16 of the UIC Class V Area Permit and to store the treated injectate until it is disposed of in the Class V injections wells. These ponds are another potential source for spills and leaks. However, the ponds are required by regulation to have liners and leak detection systems. The NRC license requires Powertech to conduct and document weekly leak inspections, including visual inspections of the pond embankments, fences, liners, and measurement of freeboard. If any evidence of leakage is found, the NRC license requires corrective action including:

1. Sampling the leaked fluid
2. Notifying the NRC within 48 hours
3. Lowering pond level and investigating liners for leakage
4. Repairing the leak and reintroducing water (daily monitoring for leakage is required during refilling)
5. Submitting a written report to the NRC within 30 days

Powertech will design all ponds with the capacity to store the amount of water discharged to them while maintaining 3 feet of freeboard (i.e., distance from the water level to the top of the embankment). Powertech plans to include control structures, such as collector ditches and berms, will be used to prevent surface runoff for events up to and including a 100-year, 24-hour rainfall event from entering the ponds.

Powertech pond inspection program must be in accordance with Regulatory Guide 3.11 such that Inspections include:

1. daily inspections of the liner, liner slopes, and other earthwork features;
2. daily inspections of pond freeboard;
3. monthly inspections of leak detection systems or daily checks for water accumulation in leak detection systems; and
4. quarterly inspections of embankment settlement and slope stability.

If inspections reveal damage or defects that could result in leakage, this information must be reported to the NRC within 24 hours, and Powertech must implement appropriate repairs. Powertech must sample water found in the standpipes of the leak detection system immediately for chloride and conductivity to determine whether the water in the detection system is from the pond. If analysis confirms a leak, Powertech must collect a second sample for analysis within 24 hours. If the second analysis confirms a leak, the pond will be taken out of service and the leak reported to the NRC within 24 hours. SDDENR must be also notified within 24 hours of any pond leakage or releases, in accordance with ARSD 74:34:01:04. Powertech must take any leaking pond out of service by transferring its contents to a spare pond until the leak is repaired.

5.7 Potential Impacts from Spills and Leaks

A leak from a pipeline carrying barren lixiviant from a process plant to the wellfield would result in the release of a fluid similar to Inyan Kara groundwater, but with a higher chloride concentration. A leak from a pipeline carrying uranium-bearing lixiviant would result in the release of a fluid bearing radiological materials. The NRC license requires that wellfield personnel be trained in emergency procedures for responding to wellfield spills containing radiological materials in case a spill of lixiviant were to occur. Leaks from treatment and storage ponds may consist of high TDS fluids generated by the RO treatment process.

Figure 18 shows the outcrop of the Fall River Formation in the eastern portion of the Burdock Area, which is a recharge zone for the Fall River aquifer. As shown in Figure 18, Burdock wellfields 6, 7 and 8 are located over the Fall River Formation outcrop area. If a spill or leak were to occur in the Fall River outcrop area, the Fall River aquifer groundwater could be impacted. The NRC license, the EPA Class III Area Permit and the proposed DENR Large Scale Mine Permit all require monitoring wells to be completed in the Fall River aquifer as part of wellfield construction plan for each of the wellfields targeting uranium deposits in the Chilson Sandstone aquifer. If a surface spill or leak were to impact Fall River groundwater, the contamination would be detected in the Fall River aquifer monitoring wells. Groundwater remediation would be required for groundwater impacts from surface spills and leaks under the NRC license and the proposed DENR Large Scale Mine Permit. The EPA Class III Area Permit requires groundwater remediation for groundwater contamination resulting from migration of injection zone fluids out of the authorized injection zone.

It should be noted that the Fall River aquifer does not contain any groundwater over most of the outcrop area. Class III Permit Application Cross Sections B-B’ and E-E’ both show Fall River aquifer potentiometric surface to be below the level of the Fuson Shale in the area of Burdock wellfield 6 as shown in Figure 19, which shows a portion of Cross Section B-B’. Class III Permit Application Cross Section F-F’ shows that the Fall River aquifer potentiometric surface is above the level of the Fuson Shale, but the aquifer is not fully saturated as shown in Figure 20, which shows a portion of Cross Section F-F’ in the Fall River outcrop area. The Fall River also contains uranium ore deposits in this area, as indicated by the presence of the open pit and underground mines. Water quality would not be very good in this area of the Fall River aquifer, since oxidized water is infiltrating into the surface outcrop where the uranium ore deposits are located. As shown in Figure 21, which is Section 2, T7S, R1E from Class III Permit Application Plate 3.1, wells 14, 698 and 638 are completed in the Fall River Formation. Well 638 is located in the Fall River outcrop and aquifer recharge area. Wells 698 and 14 are located down gradient of the Fall River outcrop and recharge area. Class III Permit Application Appendix N contains groundwater quality information only for well 698, where the Fall River groundwater exceed MCLs for uranium, gross alpha and Radium 226. If there is a surface spill or leak in the Fall River outcrop area, the groundwater, if present, must be remediated to original water quality concentrations.

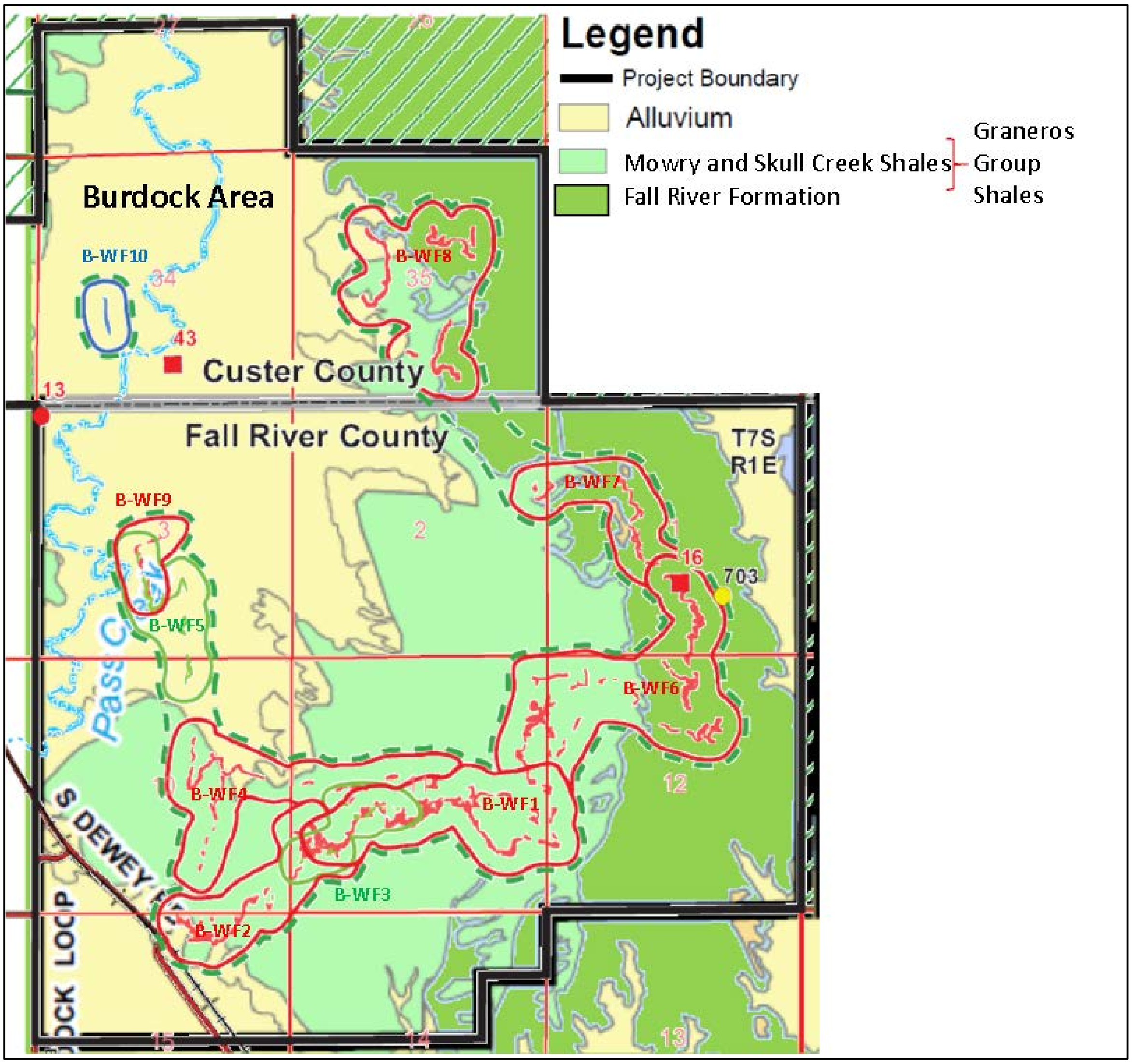

Figure 18. Map Showing Surface Geologic in the Burdock Area.

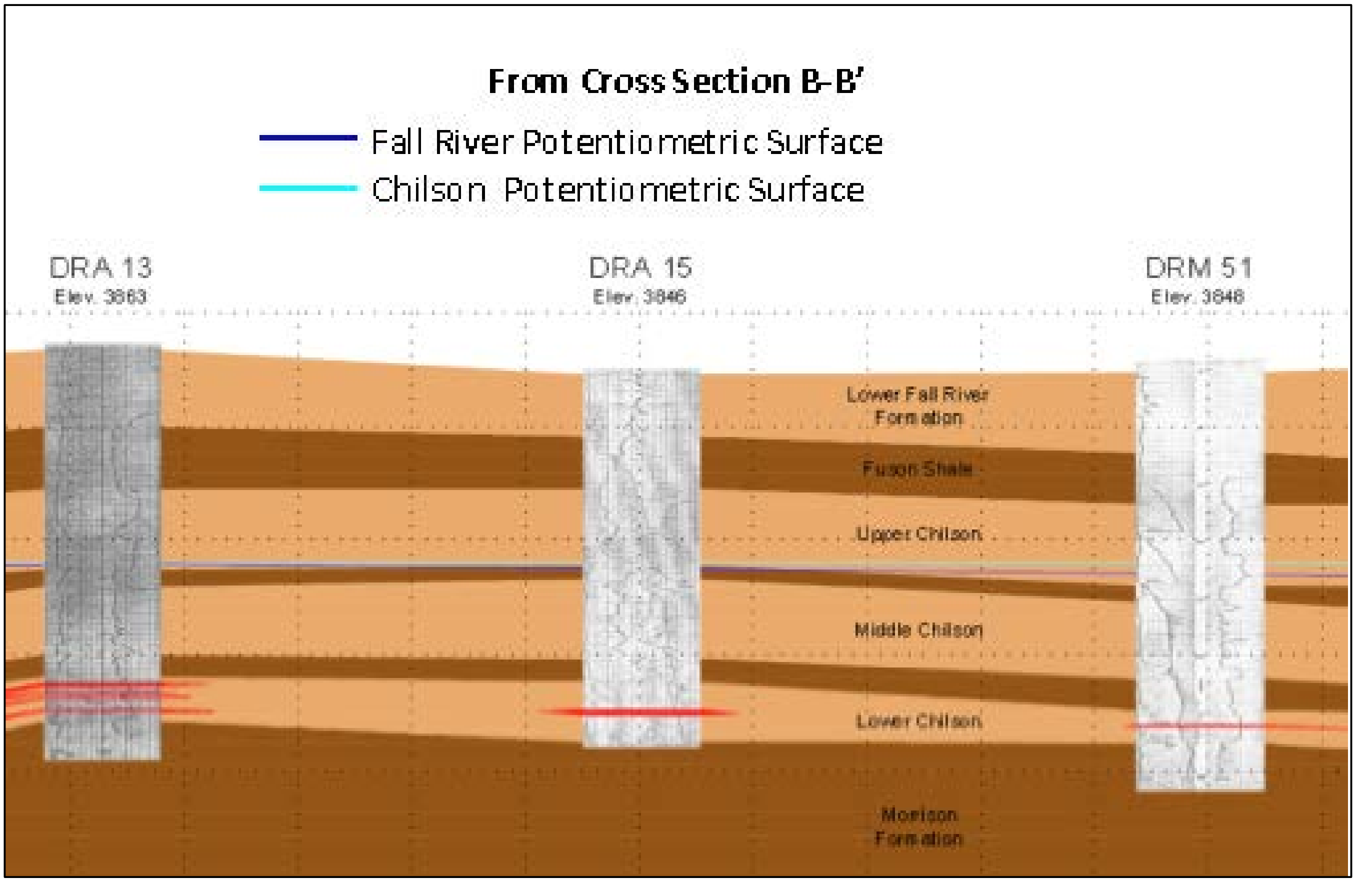

Figure 19. A Portion of Class III Permit Application Cross Section B-B' in Burdock Wellfield 6 at the Fall River Outcrop Area.

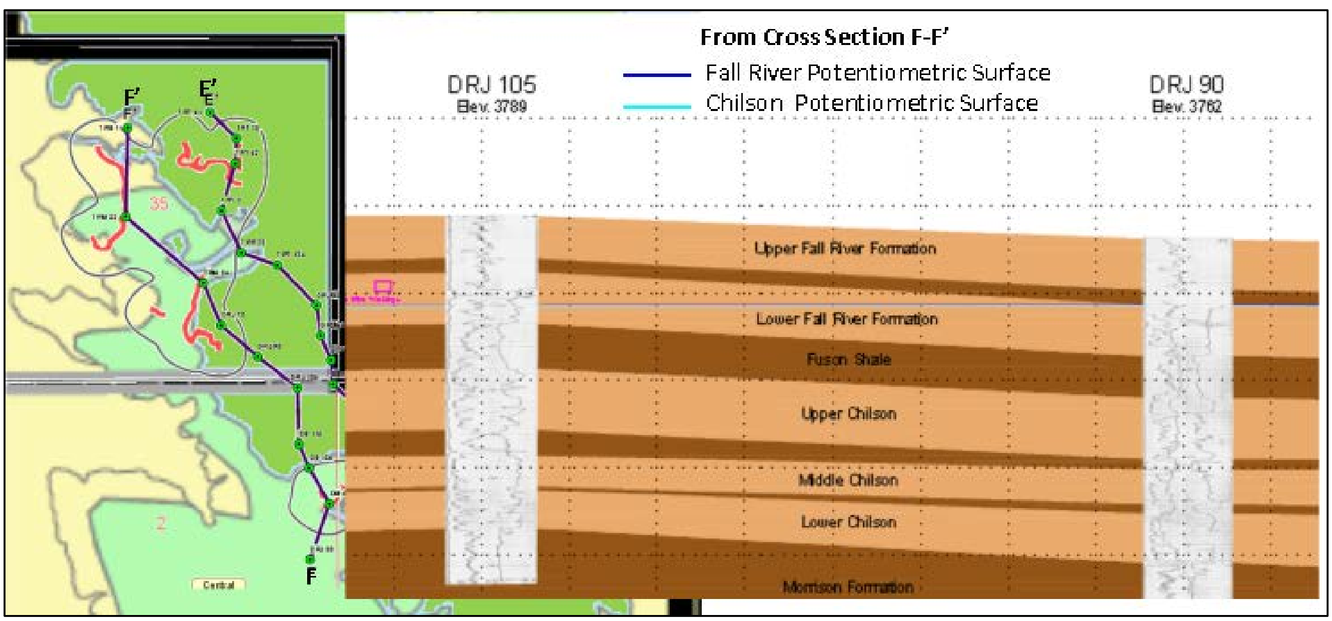

Figure 20. A Portion of Class III Permit Application Cross Section F-F' between Burdock Wellfields 7 and 8 at the Fall River Outcrop Area.

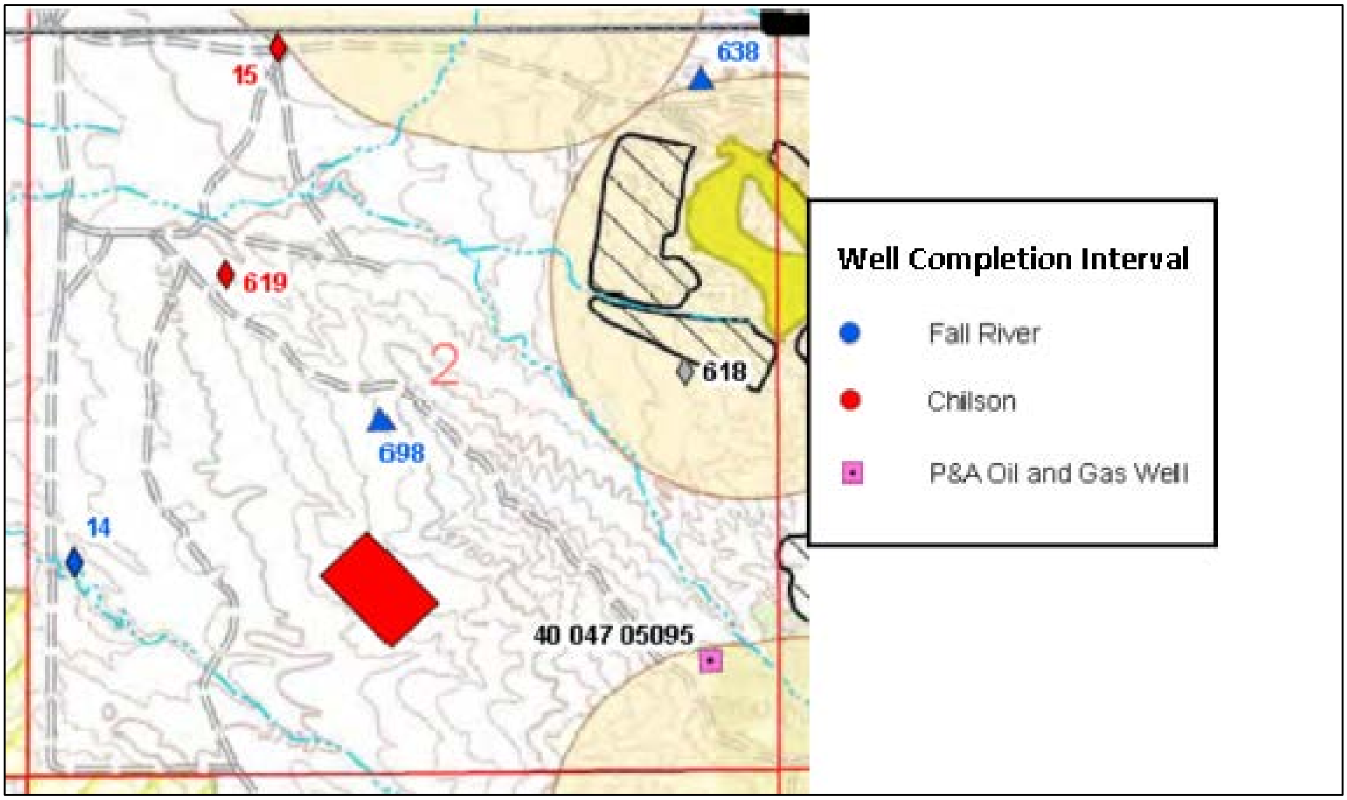

Figure 21. Locations Wells Completed in the Fall River Aquifer in Section 2, T7S, R1E.

5.8 Summary of Prevention and Mitigation of Potential Impacts from Spills and Leaks

Based on the information provided in this section, the EPA has concluded that there will be no long term impacts as a result of spills and leaks because of the prevention and mitigation measures summarized below. If a leak does occur in a pipeline transporting lixiviant, the automated monitoring system will detect the pressure drop before a large impact occurs. The Emergency Preparedness Program that will be established as part of the Environmental Management Plan under the DENR NPDES permit, will be implemented for cleanup should a transportation accident occur. Powertech must also develop and implement a spill response and cleanup program in accordance with NRC license requirements and the proposed DENR Large Scale Mine Permit conditions. Powertech's spill response plan will require cleanup of any spills or leaks that occur.

Based on this discussion of the mitigation measures required under the NRC license, the proposed DENR Large Scale Mine Permit and the EPA Class III Area Permit, the EPA has concluded the effects from potential spills and leaks that may occur related to the drilling and operation of the injection wells proposed under the UIC area permits will not result in any long term effects. The mitigation measures that will be implemented to prevent impacts to groundwater and monitoring to verify that there are no impacts include:

1. Conduct routine MIT of all injection, production and monitor wells.
2. Perform leak testing on all pipelines and aboveground piping systems.
3. Equip wellfield header houses with wet alarms for early detection of leaks.
4. Bury wellfield pipelines for freeze protection and protection from vehicles.
5. Implement engineering and administrative controls at the Central Processing Plant to prevent both surface and subsurface releases to the environment, and to mitigate the effects should an accident occur.
6. Train employees in the handling, storage, distribution, and use of hazardous materials.

7. Provide rapid response cleanup and remediation capability, techniques, procedures, and training for potential spills.
8. Develop written spill reporting procedures, including the procedures to report potential spills of reagents, fuel and other chemicals to the State of South Dakota and the personnel responsible for reporting spills.
9. Design and construct ponds with lining and leak detection systems appropriate to the pond use.
10. Perform routine inspection of pond leak detection systems to rapidly detect a potential leak from the primary liner.
11. Implement standard operating procedures to take a pond out of use in the event of a leak and transfer its contents to another pond with the same lining system.
12. Conduct fueling operations and storage of hazardous materials and chemicals in bermed/curbed areas and in a manner that minimizes potential impacts to surface water.
13. Curb relevant facilities and structures at the Central Processing Plant and Satellite Facility to minimize or eliminate escape of process fluids during spills.
14. Perform all shipments of yellowcake, uranium-loaded resin, process chemicals/fuel, and 11e.(2) byproduct material in accordance with USDOT regulations.
15. Promptly excavate and remove or remediate in place soils from any spill areas to avoid potential impacts to surface or groundwater.

6.0 IMPACTS TO LAND USE

The proposed Dewey-Burdock ISR Project Site encompasses 10,580 acres. Approximately 97.5% of surface rights in the proposed project are held by private landowners with the U.S. Bureau of Land Management (BLM) holding the remaining 2.5%. The primary land uses within the permit area and the surrounding area are rangeland used for cattle grazing and agricultural cropland. Land disturbance will occur in conjunction with construction, operations, aquifer restoration and decommissioning activities, the four lifecycle phases of the ISR operation. Figure 22 shows the area within the Dewey-Burdock Project Area where potential land disturbance is expected. Figure 22 is Figure 1.0 in Appendix A of the NRC Programmatic Agreement (NRC document accession number ML14066A350). The light purple areas include 243 acres containing the plant facilities, wellfields, ponds, roads, and pipelines surrounded by a 2.394 acres buffer zone around the perimeter of the area where disturbance is expected. The dark purple areas include the additional 1,250 acres that will be impacted if treated waste fluids are disposed of by land application. The total impacted area, including all treated waste disposal options and buffer zones, is 2,637 acres. The portions of the land shown in Figure 22 will be temporarily converted from current use to uses such as ISR wellfields, ponds, processing facilities and other associated infrastructure. However, after decommissioning of the project site, Powertech must reclaim these areas in order to release the land for unrestricted use. Because the project site will be reclaimed and released for unrestricted use, the EPA finds there should be no long term impact to land use.

The area of land use impact will be smaller if Powertech is able to dispose of ISR waste fluids using only the deep injection wells. A breakdown of estimated land disturbance for the facilities and infrastructure associated with the deep injection well disposal option is shown in Table 11, which is Table 4.2-1 in the NRC SEIS. For the deep well disposal option, a total of 243 acres of land or 2.3% of the proposed permit area will be potentially disturbed by activities associated with construction of site buildings, pipelines, wellfields, ponds, and access roads. The total amount of BLM-managed land expected to be disturbed during construction activities is 11.63 acres. Land disturbance on BLM-managed land includes an access road, overhead power lines, wellfields, and underground pipelines.

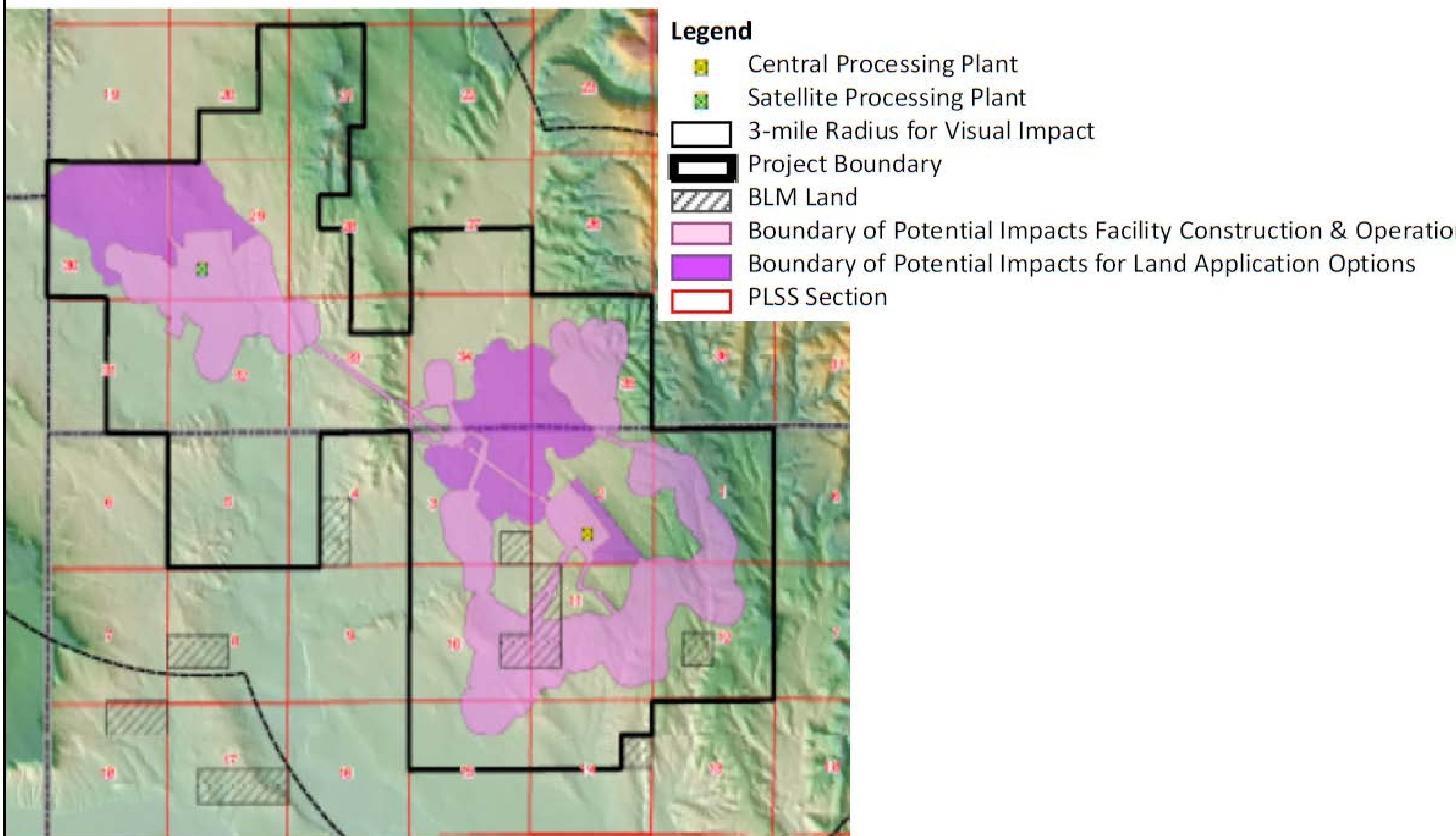

Figure 22. The Area of Expected Land Disturbance within the Dewey-Burdock Project Area

Table 11. Breakdown of Land Disturbance for the Class V Injection Well and Land Application Disposal Options at the Proposed Dewey-Burdock In-Situ Recovery Project (Table 4.2-1 in NRC's SEIS)

Facilities/Infrastructure	Surface Disturbance
Disposal Via Class V Injection Wells	
Site Buildings	9.7 ha [24 ac]
Trunkline Installation	10.1 ha [25 ac]
Access Roads	8.5 ha [21 ac]
Wellfields	56.7 ha [140 ac]
Impoundments (ponds)	13.4 ha [33 ac]
Total	98.3 ha [243 ac]
Disposal Via Land Application	
Site Buildings	9.7 ha [24 ac]
Trunkline Installation	10.1 ha [25 ac]
Access Roads	8.5 ha [21 ac]
Wellfields	56.7 ha [140 ac]
Impoundments (ponds)	55.0 ha [136 ac]
Irrigation Areas	425.7 ha [1,052 ac]
Total	565.7 ha [1,398 ac]
Source: Powertech (2010a)	

If the EPA does not issue the final deep injection wells permit or the deep injection wells are not able to dispose of the full volume of ISR waste fluids, then Powertech plans to use the GDP proposed by the South Dakota DENR for land application of treated waste fluids. This disposal option results in land use impacts to the additional acreage shown in Table 7 required for additional ponds and the irrigation or land application areas.

The NRC SEIS states that construction phase activities will have the largest direct impact on land use. Construction activities include drilling, trenching, excavating, grading, and surface facility construction. Powertech anticipates that the initial construction of processing facilities, infrastructure (e.g., pipelines, access roads, power lines, and storage ponds), and the two initial wellfields is expected to be completed within two years. Powertech will develop the wellfields in a progressive manner, beginning with Dewey and Burdock wellfields #1. The land disturbance associated with drilling, trenching for pipeline installation, and facility construction will be limited and temporary. Powertech must begin the revegetation process within each wellfield immediately after wellfield wells and pipeline are completed. The construction of access roads will be minimized to the extent possible by using and upgrading existing roads.

During the operation phase, the portion of the land indicated in Figure 22 will be restricted in use as rangeland and cropland during ISR operations. The wellfield areas, facility areas, and land application areas will be fenced in to prevent access. Powertech plans to minimize the acreage fenced around the wellfields by enclosing only the injection and production wells. Powertech does not plan to fence around the perimeter monitor wells. Powertech intends to locate the deep injection wellheads and pumping equipment inside locked buildings to restrict access.

The land use impacts of the aquifer restoration phase will be similar to that of the operation phase.
Land disturbance during the decommissioning phase will temporarily increase land disturbance while Powertech conducts activities such as dismantling buildings and other infrastructure and excavating any contaminated soils. The wellfield areas will be disturbed again to plug and abandon the wells and excavate the wellfield pipeline.

In the Large Scale Mine Permit application submitted to the DENR, Powertech committed to implementing the following procedures to minimize the potential impacts to land use:

1. Disturbance will be limited to only what is necessary for operations; Powertech plans to use existing access roads as much as possible and co-locate utility corridors along roadways.
2. Powertech will restrict normal vehicular traffic to designated roads and keep required traffic in other areas of the wellfields to a minimum.
3. Powertech will handle and protect disturbed topsoil in compliance with the propose DENR Large Scale Mine Permit requirements as discussed in the next section.
4. Powertech's preferred method of ISR waste fluid management is disposal into the deep injection wells to the extent practicable for disposal of liquid wastes to mitigate potential land use impacts from land application systems.
5. Powertech will conduct ISR reclamation in phases to minimize potential land use environmental impacts. Sequential wellfield development will minimize land area impacted at any one time.
6. The storage and treatment ponds will be reclaimed and re-vegetated and the land released for post-mining uses.
    a. After groundwater restoration is completed, each wellfield and associated pipelines and facilities will be decommissioned. This includes plugging and abandoning all wells in accordance with DENR and EPA permit requirements. As areas are restored, they will be backfilled, contoured, and smoothed to blend with the natural terrain in accordance with the surface reclamation plan in the Large Scale Mine Permit.
    b. All processing facilities will be decontaminated and removed unless they are to be used for other future activities as agreed in writing by the surface owner.
7. Prior to completion of reclamation, Powertech will contact landowners and give them the option to retain the roads for their private use or have the roads reclaimed. If the roads are deemed beneficial to others (i.e., hunters, ranchers and residents) and the landowner agrees, the roads will not be reclaimed.

The temporary change in land used described in this section is expected to last until Powertech reclaims these areas and releases the land for unrestricted use. The exclusion of grazing from wellfield and facility areas over the course of the project is expected to have minimal impact on local livestock production. Following reclamation, as required by the proposed DENR Large Scale Mine permit and the decommissioning requirements under the NRC license, the site should be successfully reclaimed to its pre-ISR land use. Therefore, the EPA has concluded that there should be there should be no long term impact to land use.

7.0 IMPACTS TO SOILS

The EPA has reviewed the potential impacts to soils and mitigation measures that Powertech will implement at the Dewey-Burdock Project Site proposed under Section 5.6.2 of the Large Scale Mine Permit and discussed in Section 4.4 of the NRC SEIS. If Powertech implements these requirements and mitigation measures, the site should be successfully reclaimed to its pre-ISR use. Therefore, the EPA has concluded that there should be there should be no long term impact to soils.

The impacts to soil will depend on the type of soil present at the site. Characterization of soil types is important for protection of the soil during storage and surface reclamation. The two main drainage basins in the permit area, Beaver Creek and Pass Creek, have different soil types. The soil mapping unit descriptions may be reviewed in Section 3.3 of the Large Scale Mine Permit Application. The Beaver Creek basin soils are composed of Haverson loam, with 0-2% slopes throughout the drainage. The Pass Creek basin soils are composed of Barnum silt loam in the south half of the drainage and Barnum-Winetti complex, with 0-6% slopes. The historical mine pits also were classified as Barnum silt loam and Barnum-Winetti complex. Severity of potential impacts to soil is dependent upon local topography, soil characteristics, type of disturbance, duration of disturbance and quantity of acres disturbed.

Over the life of the ISR project, potential soil impacts to disturbed areas include:

1. Compaction
2. Loss of productivity
3. Loss of soil
4. Increased salinity
5. Soil contamination

These impacts could potentially occur from:

1. Clearing vegetation
2. Soil compaction
3. Ground excavation
4. Ground leveling
5. Redistribution of soil
6. Stockpiling of soil
7. Spills and leaks

7.1 Impacts to Soils during Construction Activities

The greatest impacts to soils will occur during the construction phase mainly from earthmoving activities during construction of ISR surface facilities, access roads, wellfields, and pipelines. Earthmoving activities will be limited to the areas shown in Figure 22. Earthmoving activities affecting soils include ground clearing, topsoil removal, and preparation of land surfaces before construction of facility structures. Such structures include the processing plant, satellite facilities, header houses, access roads, drilling sites, land application areas, and associated structures. Excavating and backfilling trenches for pipelines and cables will also impact soils. Disturbance of soils will be temporary and, as required under the proposed DENR Large Scale Mine Permit, Powertech will mitigate impacts to soils using accepted BMPs for soil handling.

Construction activities will increase the potential for wind and water erosion from the removal of vegetation and the physical disturbance from vehicle and heavy equipment activities. The Large Scale Mine Permit Water Management and Erosion Control Plan, discussed in Section 4.2 of this document, will either prevent or substantially reduce erosion.

Based on the soil mapping unit descriptions, the hazard for wind and water erosion within the project area varies from negligible to severe. The potential for wind and water erosion is mainly a factor of surface characteristics of the soil, including texture and organic matter content. Given the very fine and clayey texture of the surface horizons throughout the majority of the permit area, the soils are more susceptible to erosion from water than wind.

The topsoil in the areas of the Burdock Central Processing Plant and the Dewey Satellite Facility and wellfield header houses will be removed before construction begins. As stated in the Large Scale Mine Permit application submitted to the DENR, Powertech has committed to removing topsoil prior to constructing access roads and will adhere to road construction practices stipulated by landowners. Over the life of the project, Powertech estimates that the area of topsoil to be stripped and removed will include up to 243 acres for the Class V deep well injection option and up to 433 acres for the land application disposal option. The land application option involves a total of 1,398 acres, however, the topsoil will not be stripped away from center pivot irrigation areas.

As described in the NRC SEIS Section 2.1.1.1.2, topsoil will be removed from building sites, storage areas, and access roads and stored in designated topsoil stockpiles, in accordance with DENR requirements. Powertech will mitigate soil potentially resulting from stormwater runoff and wind erosion by using the following soil-handling BMPs:

1. Locating topsoil stockpiles away from drainage channels or other locations that will lead to loss of material,
2. Constructing berms around the base of the stockpiles, and
3. Seeding the stockpiles with an approved seed mix to minimize sediment runoff and wind erosion.

As stated in the Large Scale Mine Permit application submitted to the DENR, Powertech will implement additional mitigation measures to limit potential soil erosion impacts during construction at the proposed Dewey-Burdock site.
These measures include:

1. Reestablishing temporary and permanent native vegetation immediately after wellfield construction has been completed;
2. Decreasing stormwater runoff from disturbed areas by using structures to temporarily divert and/or dissipate surface stormwater runoff;
3. Retaining sediment within disturbed areas by using silt fencing, retention ponds, and hay bales;
4. Implementing drainage designs to minimize potential erosion and/or providing riprap or other soil stabilization controls; and
5. Constructing stream crossings at right angles with adequate embankment and culvert installations to minimize erosion.

Construction and operation activities have the potential to compact soils. Soils most sensitive to compaction, clay loams, are not present within the permit area; however, due to the use of heavy machinery and high-volume heavy-vehicle traffic within certain area, some soils have the potential for compaction. Compaction of the soil can lead to decreased infiltration, thereby increasing stormwater runoff. To mitigate the effects of compaction at the proposed site, as stated in the Large Scale Mine Permit application submitted to the DENR, Powertech proposes to disc and reseed any compacted soils immediately after construction activities are completed.

During the construction phase at the proposed Dewey-Burdock site, activities such as pipeline trench construction, well construction, exploration drilling, and delineation drilling will also impact soils. Powertech estimates that approximately 642 to 646 wells (including delineation, monitor, production, injection, and deep disposal wells) will be drilled for the development of the initial wellfields in the Burdock and Dewey areas.

As discussed in SEIS Section 2.1.1.1.2.3.5, well drilling activities will include the construction of temporary unlined mud pits. During excavation of mud pits, topsoil will be separated from the subsoil and placed at a separate location. The subsoil will then be removed and placed next to the mud pit. Once use of the mud pit is complete (usually within 30 days of initial excavation), Powertech will redeposit the subsoil in the mud pit followed by topsoil replacement. Powertech will follow a similar approach for pipeline ditch construction.

The same procedure used in mud pit excavation during well construction will be used to preserve topsoil; topsoil is stored separately from subsoil and replaced on the subsoil after the pipeline ditch is backfilled. Trenches containing pipelines are typically backfilled with native soil and graded to surrounding ground topography.

If the EPA does not issue final deep well permit, or the permitted deep wells are not able to dispose of the volume of ISR waste fluids generated at the site, Powertech will dispose of liquid waste generated at the proposed Dewey-Burdock ISR Project by land application (see SEIS Section 2.1.1.1.2.4.2). If land application is used to dispose treated wastewater, there could be potential impacts to the soil from the buildup of salts, changes in sodium adsorption ratio (SAR), buildup of radionuclides, buildup of metals and metalloids, and decrease in soil fertility. Mitigation of each of these potential impacts is described in the DENR Groundwater Discharge Permit.

7.2 Impacts to Soils during ISR Operations

The amount of soil disturbance during the operations phase of the proposed project will be less than that for the construction phase. As discussed in Section 5.0 of this document, potential soil impacts during ISR operations can result from leaks from pipeline used to transfer barren and uranium-bearing lixiviant to and from the processing facility. Impacts to soils from spills during operations could range in severity of impact, depending on the volume of soil affected by the spill. The immediate response requirement to report spills at ISR facilities, the mandated spill recovery actions, and the required routine monitoring programs will mitigate the potential impact from spills.

As required under the NRC license and the proposed DENR Large Scale Mine Permit, in the case of spills from pipeline leaks and ruptures, Powertech must initiate immediate spill responses. Powertech will develop and implement onsite standard operation procedures that are part of the Emergency Preparedness Program required under the project Environmental Management Plan that will be required under the DENR NPDES permit, as discussed in Section 5.0 of this document. In addition, Powertech is required to implement an NRC-approved radiation protection program to protect occupational workers and ensure that radiological doses are ALARA. The applicant’s radiation protection program includes commitments for implementing management controls, engineering controls, radiation safety training, radon monitoring and sampling, and audit programs.

Additionally, failure of liners or embankment systems for the treatment and holding ponds may negatively impact soils. Powertech is required to construct and monitor treatment and holding pond liners and embankments in accordance 40 CFR subpart W, after obtaining approval of construction design plans from the EPA. 40 CFR subpart W requires the design of treatment and holding ponds at the Dewey-Burdock ISR Project includes a leak detection system. Detection of a pond leak will initiate measures to take the pond out of use, transfer its contents to another pond, investigate the cause, and repair the condition causing the leak.

The land application of treated ISR waste fluids may result in the buildup of certain constituents in the land-applied water. The DENR Groundwater Discharge Permit for land application requires Powertech to conduct regular soil monitoring. The requirements under the Groundwater Discharge Permit will mitigate impacts to soils from the land application of treated ISR waste fluids.

The NRC license and the DENR Large Scale Mine Permit require systems and procedures to be in place to monitor and clean up soil contamination resulting from pipeline and wellfield spills, pond leaks, and vehicle accidents during the operations phase. Powertech must collect samples and monitor soils for yellowcake and ion-exchange resin contamination along transportation routes and in wellfield areas where spills and leaks are possible. If soil is contaminated by a pipeline spill, pond leak, or vehicle accident, Powertech must remove the contaminated soil and dispose of it at a licensed disposal facility. Soil decontamination requirements are found under Section 6.4.3 of the proposed Large Scale Mine Permit. After decontamination is complete, Powertech will be required by regulation to conduct radiation surveys to confirm that soils have been cleaned to the NRC standards for unrestricted use in 10 CFR part 20.

7.3 Operations Impacts Resulting from the Land Application Disposal Method for Treated ISR Waste Fluids

If land application is used to dispose of process-related liquid wastes, soils may be adversely impacted. The salinity of the treated wastewater could increase the salinity of soils (soil salinization), which will make the soil less permeable. In addition, land application of liquid wastes could cause radiological and/or other constituents (e.g., selenium and other metals) to accumulate in the soils and vegetation. The NRC license requires Powertech to monitor and control irrigation areas. Powertech must collect and monitor soils and sediments for potential contamination in areas used for land application. Powertech's land application monitoring program is described in SEIS Section 7.5. In addition, Powertech must ensure that radioactive constituents in liquid effluents applied to land application areas are within allowable release limits. The NRC license and the proposed DENR Groundwater Discharge Permit require Powertech to treat liquid wastes applied to land application areas so they meet NRC release limit criteria for radionuclides, as referenced in 10 CFR Part 20, Appendix B. The NRC license also requires that Powertech conduct pre-operational and operational sampling of land application areas and the surrounding environment and report operational results to NRC semi-annually so NRC staff can evaluate existing conditions and trends. In accordance with the proposed DENR Groundwater Discharge Permit, Powertech's proposed land application operations will have to meet applicable state standards for the protection of the environment including groundwater, soils, vegetation, biota, and wildlife. Both NRC and the DENR have authority to require corrective actions or issue enforcement actions if standards or permit conditions are violated after operations begin. Because the monitoring and associated regulatory oversight by both NRC and DENR would be conducted for the duration of the proposed project, these activities would help to limit potential short-term and long-term impacts to soils. Finally, as described in SEIS Section 2.1.1.1.5, eventual decommissioning and reclamation activities after operations cease will further mitigate potential impacts to soils and restore vegetation prior to release of the site for other uses.

7.4 Aquifer Restoration Phase Impacts

The impacts on soils from spills during the aquifer restoration phase will be similar to that during the operations phase. The water quality of the groundwater extracted from a wellfield will improve during the aquifer restoration process. The requirements for immediate spill response at ISR facilities, for spill-recovery actions, and for routine monitoring programs will mitigate impacts from spill during the aquifer restoration phase.

7.4.1 Aquifer Restoration Phase Impacts from the Deep Injection Well Disposal Method

For the deep injection well disposal option for treated ISR waste fluids, the primary method of aquifer restoration will be reverse osmosis treatment with the injection of the reject brine (see SEIS Section 2.1.1.1.4.1.1). About 70% of the water withdrawn from the wellfields will be passed through high pressure reverse osmosis membranes and will be recovered as permeates. Before reinjection into the wellfields, the permeate will be supplemented with makeup water from wells in the Madison Formation and injected into the wellfields at an amount slightly less than the amount withdrawn to maintain the inward hydraulic gradient required to control wellfield injection zone fluids resulting in a small percent of restoration bleed. Although a 1% restoration bleed will typically be used to maintain hydraulic control of wellfields, higher bleed rates may be implemented to recover flare (i.e., outward spreading) of lixiviant from the wellfield pattern areas during aquifer restoration. If necessary, Powertech has proposed to increase the restoration bleed by withdrawing up to one pore volume of water through groundwater sweep over the course of aquifer restoration.

During the aquifer restoration phase, liquid wastes injected into the deep injection wells will consist of bleed fluids from operating wellfields and the reject brine from the reverse osmosis treatment system. Powertech estimates the maximum volume of liquid wastes injected into the deep injection wells during aquifer restoration will be 155 gpm (see Section 3.1.1 of this document).

The spill and leak detection program described in Section 5.0 of this document will also be maintained during aquifer restoration because the plant and wellfield infrastructure will be used and monitored during aquifer restoration. The potential for spills and pipeline leaks to impact soils are similar to impacts described for the operations phase.

7.4.2 Aquifer Restoration Phase Impacts from Land Application Disposal Method

If the deep injection wells are not able to be permitted or cannot dispose of the total volume of treated ISR waste fluids, Powertech will use the land application disposal method to dispose of treated ISR waste fluids. The primary method of aquifer restoration for the land application disposal option will be groundwater sweep, which involves pumping the wellfield wells to pull in clean groundwater from outside the aquifer exemption boundary to replace the wellfield groundwater impacted by lixiviant injection. Instead of reinjecting groundwater treated by reverse osmosis, Powertech will inject Madison Formation water. Powertech estimates that typical liquid waste flow rates during groundwater sweep under the land application option during aquifer restoration will be approximately 507 gpm as shown in Table 5, Section 3.1.2 of this document. None of the water recovered from the wellfields will be reinjected back into the wellfields. Makeup water for the Madison Formation will be injected into the wellfields at a flow rate sufficient to maintain the restoration bleed, which is typically 1% of the restoration flow rate.

If land application is used to dispose of liquid wastes, soils at the proposed Dewey-Burdock Project will be impacted during aquifer restoration activities as the liquid evaporates. During aquifer restoration, Powertech continues routine soil monitoring for contamination of land application areas and must ensure that radionuclide contaminant levels do not exceed the release standards in 10 CFR Part 20, Appendix B and the DENR Groundwater Discharge Permit requirements for land application of treated waste fluids. Routine monitoring in the land application areas during the decommissioning radiation surveys will assure that there is no long term impact from land application.

7.5 Decommissioning Phase Impacts

As indicated in the NRC's GEIS Section 4.4.3.4, the decommissioning of ISR facilities includes the following activities:

1. Dismantling process facilities and associated structures;
2. Removing buried piping; and
3. Plugging and abandoning injection and production wells according to the EPA UIC Area Permit requirements. Plugging and abandonment of monitoring wells must be in accordance with South Dakota requirements. The main impacts to the geology and soils at the project site during decommissioning will result from land reclamation activities and cleaning up contaminated soils.

The GEIS also states a licensee is required to submit a decommissioning plan to NRC for review and approval before decommissioning and final reclamation activities may begin. NRC regulations require an applicant to submit a final decommissioning plan to NRC for review and approval at least 12 months prior to the planned decommissioning of a wellfield or any portion of an ISR facility. Any soils that have the potential to be contaminated will be surveyed to identify and clean up areas with elevated radionuclide concentrations, in accordance with NRC regulations at 10 CFR Part 40, Appendix A, Criterion 6 (6).

The goal of reclamation is to return the site to preproduction conditions by replacing topsoil and reestablishing vegetation communities. As a result disruption and/or displacement of existing soils will be temporary and relatively small in scale. Changes in the size and location of impervious surfaces will include compacted soil beneath buildings and parking lots, which the NRC concluded is not a large enough area alter existing natural conditions. The EPA agrees with this conclusion.

7.5.1 Decommissioning Impacts from Deep Injection Well Disposal Method

Powertech will restore disturbed lands to their prior uses as livestock grassland and wildlife habitat as discussed in SEIS Section 2.1.1.1.5. The Burdock Central Processing Plant and Dewey satellite facilities will be decontaminated according to regulatory standards and Powertech's NRC-approved decommissioning plan. These structures will be demolished and trucked to an approved disposal facility or will be turned over to the landowner. Any structure or equipment than cannot be decontaminated to below regulatory standards will be trucked to a disposal facility licensed to received 11e.(2) byproduct material. Baseline readings of soils, vegetation, and radiological data will guide and provide a basis to evaluate final reclamation efforts. Powertech will survey areas where soils have the potential to be contaminated to identify and clean up areas with elevated radionuclide concentrations, in accordance with NRC regulations at 10 CFR Part 40, Appendix A, Criterion 6 (6). Powertech must dispose of any contaminated soils in a licensed disposal facility. As discussed in SEIS Section 2.1.1.1.5.5, stockpiled topsoil will be redistributed over disturbed surfaces, which will be recontoured to match existing topography. Final revegetation should consist of seeding the area with a seed mixture approved by the DENR, the local conservation district, BLM, and landowners.

7.5.2 Decommissioning Impacts from Land Application Disposal Method

If the land application disposal option is used, the environmental impacts of decommissioning the site will be similar to impacts described above for the deep injection well disposal option. Decommissioning of the site will follow an NRC-approved decommissioning plan, and all decommissioning activities must be carried out in accordance with 10 CFR Part 40 and other applicable federal regulatory requirements. If Powertech implements the land application liquid waste disposal option at the Dewey-Burdock site, the areas directly impacted by decommissioning will include the Central Processing Plant, Satellite Facility, wellfields and their infrastructure (i.e., pipelines and header houses), irrigation areas, ponds, and access roads. SEIS Section 2.1.1.1.5 describes the decommissioning activities that will be undertaken to return the site to its previous land use. These include conducting radiological surveys; removing contaminated equipment and materials; cleaning up disturbed areas; plugging and abandoning wells; decontaminating, dismantling, and removing buildings and other onsite structures; and restoring disturbed areas. Land application areas will also be included in decommissioning radiation surveys to ensure that soil concentration limits are not exceeded. When decommissioning is complete, the land surfaces will be returned to their pre-ISR condition.

7.6 Mitigation of Potential Soil Impacts

As stated in the Large Scale Mine Permit application submitted to the DENR, Powertech intends to implement the following measures to minimize the potential impacts to soil resources during construction activities:

1. Design of facilities to minimize surface disturbance.
2. Salvage and stockpile soil from disturbed areas (refer to Section 5.3.7 of the Large Scale Mine Permit Application).
3. Reestablish temporary or permanent native vegetation as soon as possible after disturbance utilizing the latest technologies in reseeding and sprigging, such as hydroseeding (refer to Section 6.4.3.4 of the Large Scale Mine Permit).
4. Decrease runoff from disturbed areas by using structures to temporarily divert and/or dissipate surface runoff from undisturbed areas (refer to Large Scale Mine Permit Section 5.3.9 and Section 7.0 of this document).
5. Retain sediment within the disturbed areas by using silt fencing, sediment ponds, and other Alternative Sediment Control Measures (ASCMs) (refer to Large Scale Mine Permit Section 5.3.9 and Section 7.0 of this document).
6. Fill pipeline and utility trenches with appropriate material and regrade and reseed surface soon after completion.
7. Drainage design will minimize potential for erosion by creating slopes less than 4 to 1 and/or provide rip-rap or other soil stabilization controls.
8. Construct roads using techniques that will minimize erosion, such as surfacing with a gravel road base, constructing stream crossings at right angles with adequate embankment protection and culvert installation.
9. Implement spill prevention and cleanup standard operating procedures to minimize soil contamination from vehicle accidents and/or wellfield spills or leaks; collect and monitor soils and sediments for potential contamination including areas used for land application, transport routes for yellowcake and ion-exchange resins, and wellfield areas where spills or leaks are possible.
10. Excavate contaminated soil as described in Section 6.3.3 of the Large Scale Mine Permit and replace with uncontaminated soil as needed.
11. Specific mitigation measures for potential soil impacts from land application are addressed in the proposed DENR Groundwater Discharge Permit and summarized as follows:
    a. The expected land application water quality is described in Section 5.4.1.1.4.1 of the Large Scale Mine Permit. With an anticipated total dissolved solids concentration of 1,000 to 5,000 mg/L, the water will pose a low to moderate risk to the growth of moderately salt-sensitive crops such as alfalfa. Soil salinity levels will be controlled by blending the land application water in the ponds and by leaching salts below the root zone during land application. The proposed DENR Groundwater Discharge Permit will require Powertech to operate the land application systems to

balance the downward migration of water, which has potential alluvial groundwater impacts, with the leaching that will be used to control salt buildup in the root zone.

b. The anticipated SAR levels in the land application water are 2 to 6, which should pose a low risk to soil infiltration rates. Should soil Sodium Adsorption Ratio increase and pose a risk to soil infiltration, Powertech will apply amendments such as sulfur or gypsum at agronomic rates.
c. Since proposed DENR Groundwater Discharge Permit will require Powertech to treat the land application water to meet effluent limits, including the 10 CFR 20, Appendix B, Table 2, Column 2 standards for release of radionuclides to the environment, it is unlikely that radionuclides will build up to potentially harmful levels. This will be verified through operational soil monitoring and additional radiation surveys during decommissioning.
d. During decommissioning, Powertech will conduct land cleanup in accordance with the NRC license and the proposed DENR Large Scale Mine Permit requirements. This includes cleaning up surface soils to standards for radium-226 and natural uranium that will be established as conditions in the NRC license as protective of human health and the environment. This applies to the entire permit area and is not limited to the land application areas.
e. The concentrations of metals and metalloids, including arsenic and selenium, are anticipated to be low as shown in Table 5.4-3 Nevertheless, there is potential for buildup of metals and metalloids over time in the land application areas. Potential impacts will be mitigated by monitoring soil concentrations during operations and implementing a contingency plan if concentrations approach trigger values. The contingency plan will consist of one or more of the following items:
    i. Verify sample results and precisely delineate affected areas through additional soil sampling and analysis.
    ii. Modify land application system operating parameters to reduce the discharge rate in specific pivots or throughout the land application area.
    iii. Implement water treatment if necessary for radionuclides, metals or metalloids.
    iv. Implement a phytoremediation plan to control buildup of selenium in soil.
    v. Excavate soil contaminated above the reclamation standards established in the NRC license and proposed DENR Large Scale Mine Permit and dispose excavated soil in an appropriately permitted disposal facility.
    vi. Powertech may apply fertilizer to the land application areas to maximize crop production and maintain adequate soil fertility.

7.7 Conclusions

As discussed in Section 7.1, most of the impacts to soils at the project site will occur during the construction phase. The mitigation measures discussed in Section 7.2 will prevent long-term impacts to soils. There may be soil impacts from spill and leaks during the operation and aquifer restoration phase. These impacts will be remediated as discussed in Section 5.0 of this document. The decommissioning phase will produce impacts to soils similar to that of the construction phase. However, the end result is to return the land to uses that existed before proposed ISR activities began. The temporary nature of the impacts on the land, the NRC license requirements that Powertech decommission and reclaim the site to preproduction conditions are mitigating factors to soil impacts. As a result, the EPA concludes that impacts to soil will be temporary during the life of the project and there should be no long term impacts after decommissioning is completed.

8.0 IMPACTS TO GEOLOGY

The EPA has analyzed the impacts to geology from the drilling and operation of the injection wells proposed under the UIC Area Permits. There should be minimal impacts to geology during the drilling of the Class III injection wells. These impacts will not extend beyond the well locations. The greatest impact to geology will be the changes in injection interval geochemistry from the injection of lixiviant into the Class III injection zones during the ISR operation phase. The EPA does not anticipate any ground subsidence from the recovery of uranium during the operation phase. The aquifer restoration phase will improve wellfield groundwater quality, but will not cause additional impact to geology. Impacts to geology during decommissioning will include the plugging and abandonment of the constructed injection, production and monitoring wells. The EPA finds that these geologic effects from the drilling and operation of the Class III injection wells should not result in negative environmental impacts. The impacts of the drilling and operation of the deep injection wells should not have an effect on geology beyond the well location sites. Therefore, the EPA concludes that the impacts to geology from the drilling and operation of the injection wells proposed under the UIC area permits for the Dewey-Burdock ISR Project should be limited to the wellfield injection intervals and not result in any negative environmental impacts.

8.1 Impacts during Well Construction

During the construction phase, the drilling of the injection, production and monitoring wells will impact the small area around the well bores where the wells are drilled, cased and cemented. The Class III injection, production and monitoring wells will have casing screen. Section 7.1 of the Class III Area Permit Fact Sheet describes Class III wellfield design in greater detail. Section 7.3 of the Class III Area Permit Fact Sheet describes the well construction procedures for injection, production and monitoring wells in greater detail. The deep injection wells will have additional casing and cementing requirements as discussed in Section 6.1 of the Class V Area Permit Fact Sheet and summarized in Table 16 of that section. The additional casing and cement will not impact the geology beyond the extent of the well bore.

8.2 Impacts during Well Operation

8.2.1 Impacts from Class III Injection Well Operation

As discussed in GEIS Section 4.4.3.2, during ISR operations, a non-uranium-bearing (barren) solution or lixiviant is injected through wells into the mineralized zone. The lixiviant moves through the host rock, dissolving uranium and other metals. Production wells withdraw the resulting “uranium-bearing” lixiviant, which now contains uranium and other dissolved metals, and pump it to a processing facility for further uranium recovery and purification. During ISR operations the removal of uranium and other metals will permanently change the composition of uranium-bearing rock formations. The impact of lixiviant on the geochemistiry of the injection interval will be similar to those that have occurred naturally up-gradient of the ore zones, e.g. oxidation of sulfides and other reduced mineral phases, however, the remnant depleted uranium ore deposits will be left in place.

As described in SEIS Section 2.1.1.1.3, Powertech’s operational activities at the facility are consistent with the operations analyzed in the GEIS. The removal of uranium from the target sandstones in the initial wellfields at the proposed project will occur at depths ranging from approximately 400 to 800 feet below ground surface (bgs) in the Dewey area and process and lixiviant chemistry will not remove rock matrix material in the ore-bearing sandstones. Therefore, no significant matrix compression will result from the proposed uranium recovery operations. Dewatering of the source uranium formations (i.e., the Fall River Formation and Chilson member of the Lakota Formation) during ISR operations is not expected.

Because rock matrix is not removed during the uranium mobilization and recovery process and dewatering of uranium source formations is not expected, no subsidence is expected from the collapse of overlying rock strata into the ore zone.

In accordance with 40 CFR 144.28(f)(6)(i), the UIC Class III Area Permit, Part VIII, Section E sets a limit on injection pressure at the wellhead to assure that the pressure during injection does not initiate fractures in the injection or confining zone. To ensure that formation fracture pressures are not exceeded, the UIC Class III Area Permit, Part II, Section J.1 requires Powertech to conduct step rate tests in areas outside the wellfield to determine the injection zone fracture pressure. Section 5.9 of the Class III Area Permit Fact Sheet describes this procedure in more detail. Section 9.1 of the Class III Area Permit Fact Sheet describes the injection pressure limitation in the Class III Area Permit. Section 9.1.1 discusses the determination of the maximum allowable injection pressure based on calculated fracture pressure. Table 17 of the Class III Area Permit Fact Sheet provides estimated fracture pressures for each injection interval based on the depth to the top of the injection interval.

The fracture pressure determination will be calculated according to Part II, Section J.2 of the UIC Class III Area permit. However, the pressure ratings of the well casing and injection piping and fittings, if they are rated lower than the fracture pressure, will also limit the maximum allowable injection pressure. In summary, the maximum estimated injection pressure permit limit will be the lowest value of the following:

1. The lowest value of maximum allowable wellhead pressure for all injection wells connected to the header house based on fracture pressure calculations;
2. The manufacturer-specified maximum operating pressure for the well casing; or
3. The manufacturer-specified operating pressure of the injection piping and fittings.

Powertech will also specify the maximum injection pressure for each header house. At each header house, the designated maximum injection pressure will be posted and monitored to ensure the formation fracture pressure is not exceeded. There will also be protective devices to automatically shut off injection if the injection pressure approaches the maximum allowable injection pressure.

8.2.2 Impacts from Deep Injection Well Operation

For Powertech to use deep injection wells for the disposal of treated ISR waste fluids, a UIC permit is required. UIC program regulations require a Class V permit for wells injecting into the Minnelusa Formation. Part II of the Class V area permit requires Powertech to conduct thorough evaluations of the suitability of Minnelusa injection zone. The EPA will authorize injection only where Powertech demonstrates injectate can be safely isolated within the Minnelusa injection zone. The EPA will review the information Powertech submits to confirm the information described in Section 5.0 of the Class V Fact Sheet meet permit requirements, verifying that confining zones and proper well construction will help prevent migration of fluids outside the injection zone.

The EPA and the NRC will require liquid wastes injected into the Class V injection wells to be treated to meet release standards at 10 CFR Part 20, subparts D and K, as wells as Appendix B, Table 2, Column 2. Before injection of fluids into the deep injection wells, Powertech must demonstrate:

1. The injection zone is not underground sources of drinking water by providing analytical results for total dissolved solids above 10,000 mg/L and

2. There are adequate confining zones above and below the proposed injection zone.

If the proposed injection zone is an underground sources of drinking water (have total dissolved solids concentrations below 10,000 mg/L), the deep injection well area permit will not allow injection without additional permit modification.

The deep well injection permit also place an injection pressure limit prohibiting injection pressures at or above the injection zone formation fracture pressure. Section 5.3.4.2 of the Class V Area permit Fact Sheet describe in more detail the procedures and calculation for determining the site-specific fracture pressure for the Minnelusa injection zone. The injectate will not chemically alter the geology of the Minnelusa injection zone as the Class III lixiviant is designed to do. So the impact on geology from deep well operation is expected to be minimal.

Induced seismicity is a concern during deep well injection. Induced seismicity is discussed in Section 8.1.2.1 of the Class V Area Permit Fact Sheet. Scientists believe that injection can cause seismicity when the pore pressure (pressure of fluid in the pores of the subsurface rocks) in the formation increases so such levels as to overcome the friction forces that keeps a fault stable. Pore pressure increases with increases in the volume and rate of injected fluid. Thus, the probability of triggering a significant seismic event during injection where a fault exists in the receiving formation increases with the volume and rate of fluid injected. In addition, the larger the volume injected over time, the more likely a fault could be intersected, because the fluid will travel farther within a formation. When injected fluid reaches a fault, frictional forces that have been maintained within that fault can be reduced by the fluid. At high enough pore pressure, the reduction in frictional forces can cause the formation to shift along the fault line, resulting in a seismic event. Therefore, limiting the rate and volume of fluids injected limits the potential for seismicity.

The Class V Area Permit requires seismic monitoring, even though the Class V injection wells are not expected to cause any induced seismic activity. The Class V injection zone, the Minnelusa Porosity zone is not expected to cause injection-induced because of its porosity and the fact that is occurs 990 vertical feet above the Precambrian basement at the Dewey-Burdock Project Site. Class V Area Permit Fact Sheet, Section 4.4.2 discusses the calculation of injection zone pressure rise resulting from injection activity and Section 5.4.3 discusses the calculation of maximum injection rate for each Class V injection well. The Class V Area Permit sets a limit on injection rate as discussed in Section 7.7.2 of the Class V Area Permit Fact Sheet. As discussed in these sections, in order to prevent fluid movement out of the injection zone, the Class V Area Permit includes a maximum limit on injection rate. The maximum injection rate permit limit should also contribute to the prevention of injection-induced seismicity.

8.3 Aquifer Restoration Impacts

8.3.1 Impacts to Class III Well Injection Zones

As described in GEIS Section 4.4.3.3, aquifer restoration programs typically use a combination of

1. groundwater transfer;
2. groundwater sweep;
3. reverse osmosis, permeate injection and recirculation;
4. stabilization; and
5. water treatment and surface conveyance (NRC, 2009a).

The groundwater sweep and recirculation process does not remove rock matrix or structure, nor will dewatering occur within the aquifer; therefore, no significant matrix compression or ground subsidence is expected. The water pressure in the aquifer decreases during restoration because a negative water balance must be maintained in the wellfield being restored to ensure water flows from the edges of the wellfield inward; this reduces the spread of contaminants outside of the wellfield. The influx of fluid will change the reservoir pressure but will not reactivate any local faults, because the change in reservoir pressure is limited by recirculation of treated groundwater. NRC staff concluded in the GEIS that ISR operations are unlikely to reactivate any local faults and are extremely unlikely to cause earthquakes.

Rock matrix is not removed by groundwater transfer or groundwater sweep during aquifer restoration. In addition, no significant matrix compression or ground subsidence is expected during aquifer restoration activities. For these reasons, the subsidence and collapse of overlying rock strata into the ore zone during the restoration phase is not expected.

8.3.2 Impacts to Deep Well Injection Zone

Once aquifer restoration begins, the deep well injection volume will increase during concurrent operation and groundwater restoration as discussed in Section 3.1.1 of this document. Table 12 shows the anticipated breakdown of deep well injectate volume from production and aquifer restoration bleed. During the usage of the groundwater sweep method, the bleed volume will more than double the production bleed volume.

Table 12. Volume of Groundwater Produced as Bleed during ISR Production and Groundwater Restoration

Deep Well Injectate Source	Volume (gpm)
Production Only	
0.875% bleed on 8,000 gpm gross pumping rate	70
Aquifer Restoration Only	
1% bleed on 500 gpm gross pumping rate	5
17% bleed during groundwater sweep	85
Concurrent Production and Restoration	
0.875% bleed on 8,000 gpm gross pumping rate and 1% bleed on 500 gpm gross pumping rate	75
0.875% bleed on 8,000 gpm gross pumping rate and 17% bleed during groundwater sweep	155

Increased bleed volume will result in increased injection rate at the deep injection wells and an increase in aquifer pressure. However, the injection rate permit limit will prevent the movement of injectate out of the injection zone. Aquifer pressure will dissipate once the project is decommissioned. As mentioned earlier, the deep well injectate is not expected to change the geochemistry of the injection zone unit. No impacts are expected to the deep well injection zone geology as a result of aquifer restoration.

8.4 Impacts to Geology during Decommissioning

By the time Powertech reaches the decommissioning phase, the wellfield groundwater will have been restored according to the requirements of the NRC license and the DENR Large Scale Mine Permit. Post-restoration monitoring must have demonstrated that no ISR contaminants have crossed the aquifer exemption boundary. Powertech must plug all injection wells according to the plugging and abandonment plans in the UIC area permits. The UIC permits require that the plugging and abandonment plan for injection wells protect USDWs from contamination. There will be no impact to geology from the plugging and abandonment of wells except for the cement or grout plug at the location of each injection well. Injection well plugs will not have a negative impact on geology.

8.5 Conclusions

The impact of lixiviant injection during ISR operation will change the mineralogy of the injection interval in the Class III wellfield areas. The aquifer restoration phase will improve wellfield groundwater quality, but will not cause additional impact to geology. The EPA has determined that this impact to geology does not result in any negative environmental effects. Therefore, the EPA concludes that the impacts to geology from the drilling and operation of the injection wells proposed under the UIC area permits for the Dewey-Burdock ISR Project should be limited to the wellfield injection intervals and not result in any negative environmental impacts.

9.0 POTENTIAL RADIOLOGICAL IMPACTS AND EFFLUENT CONTROL SYSTEM

9.1 Potential Radiological Impacts

The NRC discusses the potential sources of radiological emissions in Section 2.1.1.1.6.1.2 of the SEIS. Powertech modeled the potential radiological impacts on human and environmental receptors (e.g., air and soil) using site-specific radionuclide release estimates, meteorological and population data, and other parameters prepared in accordance with NRC guidance. Powertech compared the estimated radiological impacts resulting from routine site activities to applicable public dose limits as well as naturally occurring background levels. Powertech's complete analysis is available in Section 7.3 *Potential Radiological Effects* in the Technical Report submitted to the NRC as part of the license application. The EPA reviewed the NRC's summary of Powertech's model in following a brief summary of the results. The NRC discusses the radiological impacts from normal operations in SEIS Section 4.13.1.1.2.1 for the deep disposal well disposal option for treated ISR waste fluids and in Section 4.13.1.2.2.1 for the land application disposal option for treated ISR waste fluids. Both scenarios are very similar. The NRC concluded that calculated radiation doses from the releases of radioactive materials to the environment are small fractions of the limits in 10 CFR Part 20 that have been established for the protection of public health and safety. Based on review of the NRC discussion and the NRC license requirements for mitigation measures and radiological monitoring, the EPA concludes that the potential radiological related to the drilling and operation of the injection wells authorized under the UIC area permits for the Dewey-Burdock ISR Project are short-term, will not result in the exceedance of health or environmental regulatory limits and will not result in any long-term negative health or environmental impacts.

According to the NRC, the primary radioactive airborne effluent will be radon-222 gas. Radon-222 is dissolved in the uranium-bearing lixiviant that comes from the wellfield into the facility for separation of uranium. At the locations where the lixiviant solution is initially exposed to atmospheric pressure and ambient temperatures, radon gas will be evolved. The locations where this will occur (ion exchange vessels and shaker screens in the Central Processing Plant and ion exchange vessels in the Satellite Facility) will be provided with dedicated local exhaust, which will be vented outside of the buildings. Small amounts of radon-222 also may be released from the wellfield, solution spills, filter changes, reverse osmosis system operation during groundwater restoration, deep disposal well surge tanks, land application areas, and maintenance activities.

The potential radiological impact analysis that Powertech conducted considered all potential exposure pathways from all potential sources in the permit area. Atmospheric radon gas is expected to be the predominant pathway for impacts on human and environmental media. Impacts of radon-222 releases can be expected in all quadrants surrounding the site, the magnitude of which is driven predominantly by wind direction and atmospheric stability. As a noble gas, radon-222 itself has very little radiological impact on human health or the environment. Radon-222 has a relatively short half-life (3.2 days) and its decay products are short lived, alpha emitting, nongaseous radionuclides. These decay products have the potential for radiological impacts to human health and the environment. Potential exposure pathways include ingestion, inhalation, direct exposure, and adsorption. All exposure pathways, with the possible exception of absorption, can be important depending on the environmental media impacted. All of the pathways related to emissions of radionuclides are evaluated by modeling, including potential exposure from radionuclides in air, water, soil, flora and fauna.

The potential radiological impact analysis concludes that the primary sources of radon-222 releases will be production wellfields, the Central Processing Plant and Satellite Facility. Lesser releases are anticipated to occur from deep disposal wells, land application areas, and other minor activities. Modeling was used to simulate potential impacts to receptors including the nearest residence. The modeling shows that the maximum annual total effective dose equivalent (TEDE) for an adult at the nearest residence will be approximately 2% of the 10 CFR Part 20 public dose limit of 100 millirem per year. If land application is not used, the calculated TEDE is less than 2% of the public dose limit.

Powertech also evaluated the potential public and occupational doses for public exposure to radon decay products. Conservatively assuming that a worker not associated with the Dewey-Burdock Project (e.g., a rancher) is in the permit area for 2,000 hours per year, the expected annual occupational dose would be less than 2% of the of the public dose limit.

Modeled impacts to soils in the general permit area resulting from deposition of radium-226 indicate that the radium-226 concentration after ISR operations will be within the range of normal background variability observed during baseline characterization. In the land application areas, modeled impacts to soils show that the radiological impacts of the land application process will be minimal and meet the criteria for license termination for unrestricted use in 10 CFR § 20.1402.

9.2 Effluent Control System

Potential radiological impacts to human and environmental receptors will be mitigated through implementation of an effluent control system satisfying NRC license requirements and using best available control technology. The effluent control system is described in detail in Powertech's Technical Report submitted to the NRC as part of the license application. The effluent control system will include controls for radon and radon decay products as discussed in Technical Report Section 4.1.1 as well as controls for radionuclide particulates as discussed in Technical Report Section 4.1.2.

9.3 Radon

Potential impacts from radon will be controlled through use of pressurized, downflow ion exchange vessels and ventilation systems. The ion exchange vessels normally will operate as sealed, pressurized vessels, so that radon releases from the ion exchange vessels only will occur during resin transfer operations. Dedicated local exhaust at the ion exchange vessels and shaker screens will be directed to a manifold that is exhausted to the atmosphere outside the building via an induced draft fan. The primary release point will be located away from building intakes to prevent introducing exhausted radon back into the facility. Exhausting radon-222 gas to the atmosphere outside the plant minimizes opportunity for in-growth of radon particulate decay products in occupied work areas and therefore minimizes employee airborne exposure.

The general HVAC systems in the Central Processing Plant and Satellite Facility will reduce employee exposure further by removing radon from plant air. The general HVAC systems will be exhausted through separate vents. These systems will be connected via ductwork and manifolds to the process vessels. Airflow through any openings in the vessels will be from the process areas into the vessels and then into the ventilation systems, maintaining negative flow into the vessels and controlling any releases. Tank ventilation of this type has been utilized successfully at other ISR facilities and proven to be an effective method for minimizing employee exposure. Redundant exhaust fans will direct collected gases to discharge piping that will exhaust to the outside atmosphere. Fan redundancy will minimize employee exposure should any single fan fail.

The general building ventilation systems will be designed to maintain air flow from the process areas with the least potential for airborne releases to areas with the most potential for airborne releases and then exhaust to outside areas. Ventilation systems will exhaust outside the buildings and draw in fresh air. During favorable weather conditions, open doorways and convection vents in the roofs will provide supplemental work area ventilation.

The Central Processing Plant will be located near the center of the permit area, and the radon exhaust point will be located on or near the Central Processing Plant roof. Based on use of modern ISR equipment, engineering controls such as building ventilation, and routine sampling and monitoring described below, radon effluent and worker exposure to radon decay products will be maintained at levels that are ALARA.

An operational monitoring program will be utilized to measure radon-222 that may result in the atmosphere outside the buildings and other specified locations within the permit area as discussed in SEIS Section 7.2.1 and shown in SEIS Figure 7.2-1. This will be done in accordance with NRC license conditions. Potential release points as well as general air in the plant will be sampled routinely for radon decay products to assure that concentration levels of radon and decay products are maintained ALARA. Results of monitoring obtained during initial plant operation will be used to adjust monitoring programs (location, frequency, etc.) and upgrade ventilation and/or other effluent control equipment as may be necessary.

9.4 Radionuclide Particulates

Potential radiological air particulate effluents will be generated primarily from dried uranium concentrate in the yellowcake drying and processing areas. The yellowcake drying and packaging area will be serviced by a dedicated ventilation system. By design, vacuum dryers do not discharge uranium. The vacuum drying system is proven technology, which is being used successfully at several facilities where uranium oxide is being produced, including ISR facilities. The off-gas treatment system of the vacuum dryers will include a baghouse, condenser, vacuum pump, and packaging hood. The potential radionuclide particulate releases from the drying process and associated off-gas treatment system are discussed below.

The yellowcake will be dried at approximately 250°F in the rotary vacuum drying process. The off-gases generated during the drying cycle will be filtered through a baghouse, which will be located on the top of the dryer, to remove particles down to approximately 1 micron in size. The gases then will be cooled and scrubbed in a surface condenser to further remove the smaller size fraction particulates and the water vapor during the drying process. Two rotary vacuum dryers will be located in a separate building attached to the Central Processing Plant. This attached building will contain the dryers, the baghouses on the dryers, and a condenser scrubber and vacuum pump system for each dryer.

The vacuum dryers will be steel vessels heated externally and fitted with rotating plows to stir the yellowcake. Each drying chamber will have a top port for loading the wet yellowcake and a bottom port for unloading the dry powder. A third port will be provided for venting through the baghouse during the drying procedure. The baghouse and vapor filtration unit will be mounted directly above the drying chamber so that any dry solids collected on the bag filter surfaces can be batch discharged back to the drying chamber. The baghouse will be heated to prevent condensation of water vapor during the drying cycle. It will be kept under negative pressure by the vacuum system.

The condenser will be located downstream of the baghouse and will be water cooled. It will be used to remove the water vapor from the non-condensable gases emanating from the drying chamber. The gases will be moved through the condenser by the vacuum system. Dust passing through the bag filters will be wetted and entrained in the condensing moisture within this unit. The vacuum pump will be rotary water sealed, providing negative pressure on the entire system during the drying cycle. It also will be used to provide negative pressure during transfer of the dry powder from the drying chamber to 55-gallon steel drums. The water seal of the rotary vacuum pump will capture entrained particulate matter remaining in the gas streams.

The packaging system will be operated on a batch basis. When the yellowcake is dried sufficiently, it will be discharged from the drying chamber through a bottom port into 55-gallon steel drums. A level gauge, a weigh scale, or other suitable device will be used to determine when a drum is full. Particulate capture will be provided by a sealed hood that fits on the top of the drum, which will be vented through a sock filter to the condenser and the vacuum pump system when the powder is being transferred.

There will be three discharge locations associated with the yellowcake drying and packaging system. These include:

1. The yellowcake discharge valve located directly below the dryer, through which drums are filled with yellowcake,
2. The condensed water vapor that is removed from the condenser and recycled to the yellowcake thickener, and
3. Very small amounts of air that are drawn through the vacuum pump and are exhausted into the dryer room of the Central Processing Plant.

The system of treating gases emanating from the dryer chamber with baghouse filters and water condenser is designed to capture virtually all particles from the vapor stream leaving the dryer. Furthermore, NUREG-1569 states, “When a vacuum dryer is used for yellowcake, then dust emissions from drying may also be assumed to be negligible.”

The emission control system will be instrumented sufficiently to operate automatically and to shut itself down for malfunctions such as heating or vacuum system failures. The system will alarm if there is an indication that the emission control system is not performing within operating specifications. If the system is alarmed due to the emission control system, the operator will follow standard operating procedures to recover from the alarm condition, and the dryer will not be unloaded or reloaded until the emission control system is returned to normal service.

To ensure that the emission control system is performing within specified operating conditions, instrumentation will be installed that signals an audible alarm at the dryer and in the Central Processing Plant control room if the air pressure (i.e., vacuum level) falls below the specified threshold. The operation of this system will be monitored routinely during dryer operations. The operator will perform and document inspections of the vacuum level hourly or more frequently during dryer operations. Additionally, the air pressure differential gauges for other emission control equipment will be observed and documented at least once per shift during dryer operations.

The discharge locations associated with the yellowcake drying and packaging systems will be monitored routinely via filter collection and radiochemical analysis in accordance with NRC license conditions. General plant air also will be monitored routinely for airborne radionuclides.

9.5 Conclusions

The NRC finds Powertech's proposed effluent control systems are consistent with the applicable acceptance criteria of standard review plan (NUREG-1569) by describing (a) the airborne effluent control systems that are appropriate for the types of effluents generated and (b) performance specifications for the operation of the effluent controls that are consistent with those in Regulatory Guide 3.56, Section 1. In addition, the NRC finds Powertech's proposed design of the ventilation system and controls are sufficient to maintain airborne concentrations of radon and its progeny in the workplace to less than 25 percent of the Derived Air Concentration, which meets NRC regulations and recommendations in NRC guidance document, Regulatory Guide 8.31.

Based on review of NRC's discussion of the Dewey-Burdock Project's potential radiological emissions, Powertech's proposed effluent control system, and the mitigation measures and radiological monitoring required under the NRC license, EPA concludes that the from potential radiological impacts related to the drilling and operation of the injection wells proposed under the UIC area permits for the Dewey-Burdock ISR Project are short-term, will not result in the exceedance of health or environmental regulatory limits and will not result in any long-term negative health or environmental impacts

10.0 IMPACTS TO AIR QUALITY

To evaluate impacts to air quality from the drilling and operation of the injection wells proposed under the UIC Class III and V Area Permits, the EPA evaluated information related to air quality impacts in the SEIS the NRC prepared for the Dewey-Burdock uranium ISR project and supporting documents to the SEIS. This information included an anticipated project air emissions inventory, air modeling methodology and results and mitigation measures proposed by Powertech to reduce impacts to air quality. The EPA also reviewed the South Dakota DENR Air Program *Statement of Basis* documenting review of the project's air emissions inventory and state program permit determination. The EPA also reviewed the proposed DENR Large Scale Mine Permit. Based on evaluation of the NRC's air analysis, the mitigation measures proposed by Powertech as listed in Table 6.2-1 of the NRC SEIS and the mitigation measures required in the proposed DENR Large Scale Mine Permit, the EPA does not expect impacts to air quality from the drilling and operation of the UIC injection wells to affect the regional air quality or result in a violation of National Ambient Air Quality Standards (NAAQS). The EPA also finds that it would be beneficial for Powertech to implement the mitigation measures identified by the NRC as listed in Table 6.3-1 of the NRC SEIS.

10.1 Clean Air Act Applicable Requirements

10.1.1 Criteria Pollutants –National Ambient Air Quality Standards

In 40 CFR Part 50, National Primary and Secondary Ambient Air Quality Standards, the EPA established the NAAQS to protect public health with an adequate margin of safety and to protect public welfare. These standards define acceptable ambient air concentrations for the following “criteria pollutants”:

1. nitrogen dioxide (NO_2),
2. ozone (O_3),
3. sulfur dioxide (SO_2),
4. carbon monoxide (CO),
5. lead (Pb), and
6. particulate matter (PM_{10} and $PM_{2.5}$).

The CAA also directed EPA to develop regulatory programs aimed at reducing criteria pollutant emissions from stationary sources. EPA has developed regulations that apply to both large and small sources of criteria pollutants.

Large Sources of Criteria Pollutants

Large sources of criteria pollutants are called "major sources." The term "major source" means any stationary source that has the potential to emit 100 tons per year or more of any criteria pollutant from specifically identified sources and 250 tons per year or more for those sources not specifically listed by EPA.

Small Sources of Criteria Pollutants

Small sources of criteria pollutants are called "minor sources." The term "minor source" means any stationary source of criteria pollutants that is not considered a major source (see above).

EPA has developed requirements for specific categories of criteria pollutant emitting stationary sources at 40 CFR Part 60 of the EPA regulations. Approximately 100 different regulations have been developed for sources emitting criteria pollutants. These regulations apply to both major and minor sources.

10.1.2 Hazardous Air Pollutants (HAPs)

HAPs are regulated by EPA under authority of Title I, part A, Section 112 of the CAA. HAPs are those pollutants that are known to cause or are suspected of causing cancer, birth defects, reproduction problems, and other serious illnesses. Exposure to certain levels of some of these HAPs can cause difficulty in breathing, nausea or other illnesses. Exposure to certain HAPs can even cause death. The CAA identifies 189 individual HAPs and directs EPA to develop regulations to mitigate these HAPs. The list original list of HAPs can be found in the CAA at Section 112(b). EPA has developed regulations for both large and small sources of HAPs.

Large Sources of HAPs

Large sources of HAPs are called "major sources." The term "major source" means any stationary source that has the potential to emit 10 tons per year or more of any single HAP or 25 tons per year or more of all combined HAPs emitted from a stationary source.

Small Sources of HAPs

Small sources of HAPs are called "area sources." The term "area source" means any stationary source of HAPs that is not a considered a major source (see above). These are minor sources of HAPs, but are referred to as "area sources." EPA has developed requirements for specific categories of HAP emitting stationary sources at 40 CFR Part 63 of the EPA regulations. Approximately 118 different types of sources have HAP regulations that apply to them and each one of those regulations may have requirements for both major and area sources of HAPs.

10.1.3 Clean Air Act Permitting

The Clean Air Act has three different types of permits that are issued to stationary sources of air pollution:

1. Major source preconstruction permits (Major New Source Review (NSR) or more commonly called PSD);
2. Minor source preconstruction permits (Minor NSR); and
3. Major source operating permits (Title V).

Major NSR or PSD Permitting

Major NSR permitting is required for proposed new or modified major sources of criteria pollutants before the source has been constructed. Both EPA and States have the authority to issue these permits.

Minor NSR Permitting

Minor NSR permitting is required for proposed new or modified minor sources of criteria pollutants and new or modified area sources of HAPs before the source has been constructed. Minor NSR permitting can also be used by proposed major sources of criteria and HAP pollutants to create artificially minor sources. States have minor NSR permitting programs and those programs vary considerably from state to state. The EPA now also has a regulatory program for minor sources in Indian Country.

Title V Operating Permits

Title V permits apply emission limits, operational controls and practices, equipment requirements, reporting etc., to sources within the facility during day-to-day operations, after it has been built. Clean Air Act title V permits are required for stationary sources that, during operation, have the potential to emit more than 100 tons per year of any air pollutant as defined in section 302 of the Clean Air Act, or 10 tons per year of any single hazardous air pollutant, or 25 tons per year of all hazardous air pollutants combined. In some cases title V permits may be required for sources that emit less than these thresholds if a New Source Performance Standard (NSPS) or Maximum Achievable Control Technology (MACT) standard from the National Emission Standard for Hazardous Air Pollutants (NESHAP) has an applicable requirement and does not exempt the source from obtaining a title V permit.

Emission limits and requirements to install air pollution control equipment are generally not created in Title V permits. Unlike NSR permits, Title V permits generally do not create new requirements. Basically, the Title V permits consolidate all the federally enforceable applicable requirements from the CAA for a particular facility. This makes it easier for facilities to comply with their air quality obligations, for agencies to track compliance, and for the public to review permits and monitoring data for specific facilities.

10.1.3.1 Criteria Pollutants and Ambient Air Quality Standards

Attainment areas are those areas where air quality meets the National Ambient Air Quality Standards (NAAQS). In attainment area, PSD permits are required for major stationary pollutant sources that are new or making major modifications. Classification as a major source in an attainment area depends the type of facility. If a facility is considered to be one of the 28 named PSD source categories listed in Section 169 of the federal Clean Air Act, the threshold for classification as a major source is 100 tons per year of any regulated air pollutant, except for greenhouse gases. The major source threshold for all other source categories is 250 tons per year of any regulated air pollutant, except for greenhouse gases, and several other exceptions. For sources that are already major, significance thresholds apply that are lower than the thresholds for a newly permitted source

In nonattainment areas, Nonattainment NSR permits are required for major stationary pollutant sources that are new or making major modifications. Classification as a major source in a nonattainment area is generally based on the potential to emit more than 100 tons of a regulated pollutant. This threshold can be lower for areas with more serious nonattainment problems and for sources that are already major that make a modification (significance thresholds).

In addition to major source permitting programs states (and more recently federal permitting authorities) implement minor NSR programs to protect ambient air quality. The NSR permit provides regulators, such as the South Dakota DENR Air Program in the case of the Dewey-Burdock project, a method to implement permit conditions as needed to limit emissions from sources not covered by those two programs. When Powertech submitted its application information in November 2012, the DENR minor operating permit program was combined with the minor NSR program, and information regarding applicability to minor permits refers to a permit that would serve as both the minor NSR permit and a minor operating permit. South Dakota NSR regulations are found at ASRD 74:36:10.

10.1.3.2 Air Quality Designation

The EPA requires states to monitor ambient air quality and evaluate compliance with the NAAQS. Based on the results of these evaluations, EPA designates areas according to various NAAQS compliance classifications into attainment or nonattainment for each of the six criteria air pollutants. These classifications characterize the air quality within the defined area. The NAAQS and the State’s ambient air quality standards are shown in Table 13.

Table 13. The National Ambient Air Quality Standards

Pollutant		Primary/ Secondary	Averaging Time	Level	Form
Carbon Monoxide (CO)		Primary	8 hours	9 ppm	Not to be exceeded more than once per year
			1 hour	35 ppm	
Lead (Pb)		Primary and Secondary	Rolling 3 month average	0.15 μg/m^3	Not to be exceeded
Nitrogen Dioxide (NO_2)		Primary	1 hour	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		Primary and Secondary	1 year (annual)	53 ppb	Annual mean
Ozone (O_3)		Primary and Secondary	8 hours	0.070 ppm	Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years
Particle Pollution (PM)	$PM_{2.5}$	Primary	1 year (annual)	12.0 μg/m^3	Annual mean, averaged over 3 years
		Secondary	1 year (annual)	15.0 μg/m^3	Annual mean, averaged over 3 years
		Primary and Secondary	24 hours	35 μg/m^3	98th percentile, averaged over 3 years
	PM_{10}	Primary and Secondary	24 hours	150 μg/m^3	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide (SO_2)		Primary	1 hour	75 ppb	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		Secondary	3 hours	0.5 ppm	Not to be exceeded more than once per year

10.1.3.3 Existing Ambient Air Quality

As stated in Section 3.7.2 of the NRC SEIS, the EPA designates areas into various NAAQS compliance classifications (e.g., attainment or nonattainment) for each of the six criteria air pollutants. These classifications characterize the air quality within a defined area. These defined areas range in size from portions of cities to large Air Quality Control Regions composed of many counties. An Air Quality Control Region is a federally designated area for air management purposes. The proposed project area is located in the Black Hills-Rapid City Intrastate Air Quality Control Region, which is made up of Butte, Custer, Fall River, Lawrence, Meade, and Pennington Counties, South Dakota. The Black Hills-Rapid City Intrastate Air Quality Control Region meets all of the NAAQS regulations and, therefore, is classified as an attainment area for each criteria pollutant. Based on this attainment classification, the air quality in and around the proposed site can be considered good. Table 14 shows pollutant concentrations that represent the existing ambient air conditions in the Dewey-Burdock Project Area. The values were measured in 2010 at the locations indicated in Table 14.

Table 14. The Ambient Air Quality at the Dewey-Burdock Project Site

Pollutant	Averaging Period	Form	Data Period	Value	Percent NAAQS	Location
Carbon Monoxide	1 hour	Not to be exceeded more than once per year	2013	0.6 ppm	2	UC #1
	8 hour	Not to be exceeded more than once per year	2013	0.3 ppm	3	UC #1
Nitrogen Dioxide	1 hour	98th percentile, averaged over 3 years	2013-2015	4 ppb	4	Badlands
	Annual	Annual Mean	2015	1 ppb	2	Badlands
Ozone	8 hour	Annual fourth highest daily maximum averaged over 3 years	2013-2015	59 ppb	84	Wind Cave
$PM_{2.5}$	24 hour	98th percentile, averaged over 3 years	2013-2015	13 $\mu g/m^3$	37	Wind Cave
	Annual	Annual mean, averaged over 3 years	2013-2015	3.2 $\mu g/m^3$	27	Wind Cave
PM_{10}	24 hour	Not to be exceeded more than once per year on average over 3 years	2013-2015	48 $\mu g/m^3$	32	Wind Cave
Sulfur Dioxide	1 hour	99th percentile of 1 hour daily max averaged over 3 years	2013- 2015	6	8	Badlands

10.1.3.4 PSD Increments

The EPA also established PSD standards, or increments, that set maximum allowable concentration increases for particulate matter, sulfur dioxide, and nitrogen dioxide pollutants above baseline conditions in attainment areas for major stationary sources. The purpose of this requirement is to ensure that air quality is not significantly deteriorated due to the approval of preconstruction permits for major stationary sources. There are several different classes of areas for the purposes of air quality management, with Class I areas having the highest protection for air quality. Section 162 of the Clean Air Act defines the areas that were initially designated as Class I areas with all other areas being Class II. Areas that were originally designated Class I include: international parks, national wilderness areas larger than 5,000 acres, national memorial parks larger than 5,000 acres, and national parks larger than 6,000 acres (that existed on the date of enactment of the 1977 Clean Air Act Amendments).

Different maximum allowable standards were developed for these different classifications, with Class I areas having the most stringent requirements. The proposed site is located in a Class II area. The closest Class I area near the proposed project is Wind Cave National Park located in Custer County about 46.7 km [29.0 mi] away. The PSD Class I and Class II Increments are shown in Table 15. Figure 23 is a map displaying the locations of the

Dewey-Burdock Project Site, the Wind Cave National Park, and the other Class I area in South Dakota, which is Badlands National Park. In addition to these areas Mount Rushmore and Jewel Cave are Sensitive Class II areas that are proximal to Wind Cave, but assessment of impacts to these other areas has not been completed since Wind Cave is closer to the project and should be sufficient to estimate impacts at these proximal/adjacent Class II areas. Although the project is not a PSD major source, and a regulatory increment comparison is not necessary, a comparison of project impacts to the increments may be informative here when analyzing whether the project (including all emissions and phases of development) will significantly change air quality at areas with special designations and in sensitive locations.

Table 15. PSD Class I and Class II Standards (40 CFR 52.21(c))

Pollutant	Averaging Time	Class I Increment ($\mu g/m^3$)	Class II Increment ($\mu g/m^3$)
$PM_{2.5}$	Annual arithmetic mean	1	4
	24-hour maximum	2	9
PM_{10}	Annual arithmetic mean	4	17
	24-hour maximum	8	30
Sulfur dioxide	Annual arithmetic mean	2	20
	24-hour maximum	5	91
	3-hour maximum	25	512
Nitrogen dioxide	Annual arithmetic mean	2.5	25

Figure 23. The location of the Dewey-Burdock Project Area relative to Wind Cave National Park and Badland National Park Class 1 areas.

10.1.3.5 Air Quality Related Values

Protection of Class I air quality also includes consideration of Air Quality Related Values (AQRVs), which include visibility and atmospheric deposition of nitrogen and sulfur. For example, air pollutants can reduce visibility and therefore negatively impact air quality in Class I areas. Class I areas are areas of special national or regional natural, scenic, recreational, or historic value for which the PSD regulations provide special protection. The Federal Land Manager (FLM), including the State or Indian governing body, where applicable, is responsible for defining specific Air Quality Related Values (AQRVs) for an area and for establishing the criteria to determine an adverse impact on the AQRVs. If a FLM determines that a source will adversely impact AQRVs in a Class I area, the FLM may recommend that the permitting agency deny issuance of the permit, even in cases where no applicable increments would be exceeded. However, the permitting authority makes the final decision to issue or deny the permit.

In 1980, EPA adopted visibility protection regulations to address "reasonably attributable visibility impairment", or visibility impairment caused by one or a small group of man-made sources generally located in close proximity to a specific Class I area. In 1990 the Clean Air Act Amendments expanded these considerations to cover Regional Haze. Most visibility impairment occurs when pollution in the form of small particles scatters or absorbs light. Air pollutants are emitted from a variety of natural and anthropogenic sources. Natural sources can include windblown dust and smoke from wildfires. Anthropogenic sources can include motor vehicles, electric utility and industrial fuel burning, prescribed burning, and mining operations. More pollutants mean more absorption and scattering of light, which reduce the clarity and color of scenery. Some types of particles such as sulfates and nitrates scatter more light, particularly during humid conditions. Other particles like elemental carbon from combustion processes are highly efficient at absorbing light.

Commonly, visibility is observed by the human eye and the object may be a single viewing target or scenery. A common measure of visual resources is the haze index, expressed in deciviews (dv). The deciview is a metric used to represent normalized light extinction attributable to visibility-affecting pollutants.

The visibility threshold of concern is not exceeded if the 98th percentile change in light extinction (when utilizing the CALPUFF model) is less than 5% for each year modeled, when compared to the annual average natural condition value for that Class I area. A 5% change in light extinction is equivalent to a 0.5 dv change in visibility. When assessing visibility impairment from regional haze, EPA guidelines indicate that for a source whose 98th percentile value of the haze index, evaluated on a 24-hour average basis, is greater than 0.5 dv is considered to contribute to regional haze visibility impairment.

10.2 Air Quality Impacts at the Dewey-Burdock Project Site: Introduction and Summary

Nonradiological air emissions at the Dewey-Burdock Project Site will be primarily composed of fugitive road dust from vehicles traveling on unpaved roads and combustion engine emissions from vehicles and diesel equipment. The NRC expects that, in general, any nonradiological emissions from pipeline system venting, resin transfer, and elution will be expected to be at such low levels that they will be negligible and not considered in the analysis of air impacts. Radon could also be released from well system relief valves, resin transfer, or elution. EPA's analysis and proposed conclusions regarding potential radiological air impacts, including radon release impacts, are addressed in the Section 9.0 of this document. Additional background information, which EPA considered, is available in Section 4.13 of the NRC SEIS.

Powertech prepared a detailed emissions inventory for all phases of the ISR project (construction, operation, aquifer restoration, and reclamation/decommissioning) and provided the emissions inventory to the NRC and to the DENR Air Program. Powertech also submitted a title V air permit application to the DENR Air Program for stationary sources that will be located at the Project Site. The DENR evaluated the permit application and the emissions inventory and determined that the emissions from stationary sources do not require a title V permit issued by the DENR. The DENR developed a *Statement of Basis* to document the review of Powertech's title V permit application. The EPA reviewed the *Statement of Basis* and concludes that the DENR's evaluation of the stationary sources at the site was thorough and comprehensive.

The NRC also evaluated impacts to air quality from the ISR operations at the Dewey-Burdock Project Site. The NRC considered mobile and fugitive emissions sources, in addition to stationary sources. Powertech procured the services of the Air Science Division of Inter-mountain Laboratories to perform air quality impacts modeling using two models: AERMOD to model near-field effects to air quality and ambient concentrations at Wind Cave National Park, and CALPUFF to model the far-field AQRV impacts at Wind Cave National Park, the nearest Class I area. The NRC reviewed the modeling work performed for Powertech and discussed impacts to air quality in SEIS 4.7. The EPA's assessment of the modeling work is discussed below.

10.2.1 Emission Inventories

The NRC modeling was conducted using: (1) the peak year emission inventory listed in Table 16 (see SEIS Table 2.1-5), which included the stationary sources listed in Table 17 (see SEIS Table 2.1-1) (2) the mobile sources listed in Table 18 (see SEIS Table 2.1-2); and (3) fugitive dust sources listed in Table 19 (see SEIS Table 2.1-3). Note that the values shown in Table 18 incorporate some of the mitigation measures that Powertech has committed to performing during ISR operations. The mitigation measures assumed for purposes of developing the information in Table 18 include measures 1 through 6 in Section 10.6.1 of this document. Therefore, these values are valid only if these measures are implemented, which Powertech committed to as listed in SEIS Table 6.2-1. These commitments are found in Section 5.6 of the *Environmental Report* submitted to the NRC to fulfill requirements under the NEPA process, Section 5.6.10.2 of the DENR proposed Large Scale Mine Permit and the July 31, 2012 email and attachment from Powertech to the NRC.

Table 16. Total* (Peak Year) Nonradiological Emission Mass Flow Rate (Metric Tons† Per Year) Estimates for All Phases and Sources (SEIS Table 2.1-5)

Pollutant	Stationary Sources	Mobile Emission Sources	Fugitive Dust Sources‡	Peak Year Total
Particulate Matter PM10	0.083	3.51	415.43	419.0
Particulate Matter PM2.5	0.083	3.40	43.01	46.5
Sulfur Dioxide	0.0045	10.26	0	10.265
Nitrogen Oxides	1.54	62.11	0	63.65
Carbon Monoxide	0.87	53.43	0	54.30

Source: Modified from IML (2013).
*Total accounts for when all four phases occur simultaneously and represents the highest amount of emissions the proposed action will generate in any one project year. Project year 1 only includes the construction phase (i.e., no overlap with other phases), and facilities construction only occurs in project year 1. Therefore, the construction—wellfield only—is used when calculating the total.
†To convert metric tons to short tons, multiply by 1.10231.
‡Fugitive dust sources include on-site road, offsite road, and wind erosion (land application disposal).

Table 17. Nonradiological Combustion Emission Estimated Mass Flow Rates (Metric Tons* Per Year) from Stationary Sources at the Dewey-Burdock Project Site† (SEIS Table 2.1-1)

Emission Source	Emissions (Metric Tons/Year)					
	NO_X‡	CO‡	PM10‡	PM2.5‡	SO_2‡	TOC‡
Space Heater	0.67	0.39	0.036	0.036	0.0009	0.054
Dryer Thermal Fluid Heater	0.83	0.47	0.044	0.044	0.0009	0.063
Emergency Generator	0.00	0.00	0.000	0.000	0.000	0.00
Fire Suppression Pump	0.036	0.009	0.0027	0.0027	0.0027	0.00
Total	1.54	0.87	0.83	0.83	0.0045	0.12

Source: Modified from IML (2013).
*To convert metric tons to short tons, multiply by 1.10231.
†Except for project year 1, stationary emissions are assumed to be constant over the project lifespan.
‡NO_X = nitrogen oxides, CO = carbon monoxide, PM10 = particulate matter 10 micrometers, PM2.5 = particulate matter 2.5 micrometers, SO_2 = sulfur dioxide, TOC = total organic carbon.

Table 18. Nonradiological Combustion Emission Mass Flow Rate Estimates (Metric Tons per Year) from Mobile Sources for Various Phases of ISR Operations (SEIS Table 2.1-2)

Pollutant	Phase					Total or Peak Year‡
	Construction†		Operation	Aquifer Restoration	Decommissioning	
	Facilities and Wellfields	Wellfields Only				
Particulate Matter PM10	2.69	2.14	0.73	0.07	0.56	3.51
Particulate Matter PM2.5	2.61	2.07	0.72	0.07	0.54	3.40
Sulfur Dioxide	7.78	6.40	1.80	0.05	2.00	10.26
Nitrogen Oxides	46.34	37.12	12.6	1.12	11.26	62.11
Carbon Monoxide	44.50	37.8	8.45	0.71	6.45	53.43
Total Hydrocarbon	16.58	12.3	15.75	2.23	5.39	35.71
Formaldehyde	1.89	1.53	0.63	0.05	0.50	2.71

Source: Modified from IML (2013).
*To convert metric tons to short tons, multiply by 1.10231.
†Two types of construction phase emission estimates were provided. Construction (facilities and wellfields) only occurs in project year 1 (i.e., facility construction complete after project year 1). In subsequent project years, construction (wellfield only) occurs.
‡Total accounts for when all four phases occur simultaneously and represents the highest amount of mobile source emissions the proposed action will generate in any one project year. Project year 1 only includes the construction phase (i.e., no overlap with other phases), and facilities construction only occurs in project year 1. Therefore, the construction—wellfield only—is used when calculating the total.

Table 19. Total* (Peak Year) Fugitive Dust Mass Flow Rate (Metric Tons† per Year) Estimates for All Phases and Sources‡ (SEIS Table 2.1-3)

Source	Phase	Particulate Matter PM10	Particulate Matter PM2.5
On-Site Fugitive Emission from Vehicle Travel	Construction—Facilities and Wellfield	176.69	17.669
	Construction—Wellfield Only	138.48	13.848
	Operation	91.50	9.1499
	Aquifer Restoration	7.00	0.700
	Decommissioning	54.53	5.453
Off-Site Fugitive Emissions from Vehicle Travel	Construction—Facilities and Wellfield	51.63	5.163
	Construction—Wellfield Only	24.77	2.477
	Operation	37.98	3.798
	Aquifer Restoration	5.67	0.567
	Decommissioning	25.74	2.574
Wind Erosion§	Not applicable	29.76	4.4
Total		415.43	43.01

Source: Modified from IML (2013).
*Total accounts for when all four phases occur simultaneously and represents the highest amount of emissions the proposed action will generate in any one project year. Project year 1 only includes the construction phase (i.e., no overlap with other phases), and facilities construction only occurs in project year 1. Therefore, the construction—wellfield only—is used when calculating the total.
†To convert metric tons to short tons, multiply by 1.10231.
‡Fugitive dust sources include on-site road, off-site road, and wind erosion (land application disposal)
§Annual values varied slightly over the project lifetime. Reported values are maximums. Minimum values could be as much as 2.5 metric tons lower for PM10 and 0.4 metric tons lower for PM2.5

10.2.2 Potential to Emit Criteria Pollutants

The DENR uses stack test results to determine air emissions whenever stack test data is available from the source or a similar source. When stack test results are not available, the DENR relies on manufacturing data, material balance, the EPA's *Compilation of Air Pollutant Emission Factors* (AP-42, Fifth Edition, Volume 1), information submitted in the application, or other methods to determine potential air emissions. Potential emissions for each applicable pollutant are calculated by assuming the unit operates every day of the year at the maximum design capacity unless federally enforceable limits on operation have been applied.

The EPA has been publishing AP-42, *Compilation of Air Pollutant Emission Factors*, since 1972 as the primary compilation of EPA's emission factor information. This information contains emission factors and process information for more than 200 air pollution source categories. A source category is a specific industry sector or group of similar emitting sources. The emission factors have been developed and compiled from source test data, material balance studies, and engineering estimates. The Fifth Edition of AP-42 was published in January 1995. Since then, EPA has published supplements and updates to the fifteen chapters available in Volume I, Stationary Point and Area Sources. The latest emissions factors are available below on this EPA website: https://www3.epa.gov/ttn/chief/ap42/index.html. For basic information about emission factors, see this EPA website: https://www3.epa.gov/ttn/chief/efpac/abefpac.html.

The DENR analyzed emission factors for generators and emission factors for fire pump engines. For a more detailed explanation of the calculations, see section 4.1 of the DENR SOB, or Appendix C of the SEIS for a more complete listing of estimated emissions from the Dewey Burdock project. The potential emissions from the proposed generators and fire pumps that the DENR calculated are shown in Table 20.

Table 20. Potential Emissions Summary in tons per year (Table 4-1 in DENR's *Statement of Basis*)

Description	TSP	$PM_{10}/PM_{2.5}$	SO_2	NO_x	VOC	CO
Unit #1	0.002	0.002	0.0	0.03	0.002	0.02
Unit #2	0.002	0.002	0.0	0.03	0.002	0.02
Unit #3	0.05	0.05	0.05	0.8	0.06	0.2
Unit #4	0.05	0.05	0.05	0.8	0.06	0.2
Total	**0.1**	**0.1**	**0.1**	**1.7**	**0.1**	**0.4**

10.2.3 New Source Review Permits

Any source operating in South Dakota that meets the definition of a minor source under the South Dakota regulation ARSD 74:36:01:01(38) is required to obtain a minor air quality permit. At the time this action was reviewed by DENR the program was a merged minor NSR program and minor operating permit program (which is not a title V operating permit program). In accordance with ARSD 74:36:04:02.01, a minor source is exempt from obtaining a minor source permit if the source has the potential to emit 25 tons per year or less of any criteria pollutant, except lead, before the application of control equipment. Powertech's projected stationary source emissions of criteria air pollutants at the Dewey-Burdock Project Site are less than 25 tons per year; therefore, a merged minor air quality construction/operating permit would not be required.

The emergency generators and the fire pump engines are subject to the opacity limit in ARSD 74:36: 12. In accordance with ARSD 74:36: 12:01, the units may not emit air emissions of a density equal to or greater than that designated as 20% opacity.

10.3 South Dakota DENR Review of Powertech's Title V Permit Application

Powertech submitted an air quality operating permit application to the DENR Air Program received on November 5, 2012 under title V of the Clean Air Act. The DENR Air Program documented their reviewed in a *Statement of Basis.* Title V applies only to stationary sources, and does not include fugitive emissions for this source category. Powertech enlisted Inter-Mountain Laboratories, Inc., Air Science Division (IML) to develop a project emissions inventory. Powertech provided this detailed emissions inventory for all ISR project lifecycle phases (construction, operation, aquifer restoration, and reclamation/decommissioning) to the DENR Air Program.[9]

Powertech plans to operate a Thermal Fluid Heater, propane heaters and two emergency generators and two fire pumps, which will be the only stationary sources in the Project Area. Due to the low emissions from the heaters they were not necessary for inclusion in the DENR's SOB. However, the engines have applicable requirements and were the only units potentially regulated under a title V permit. The emergency generators combust propane and the fire engines combust distillate fuel. Additional information about each unit is provided in Table 21.

[9] IML (Inter-Mountain Laboratories, Inc). "Ambient Air Quality Final Modeling Protocol and Impact Analysis Dewey-Burdock Project Powertech (USA) Inc., Edgemont, South Dakota." ML13196a061, ML13196a097, ML13196a118. Sheridan, Wyoming: Inter-Mountain Laboratories, Inc., IML Air Science. July 11, 2013.

Table 21. Powertech's Proposed Stationary Source Units (Table 1-1 in the DENR Statement of Basis)

Identification	Description	Maximum Operating Rate	Control Device
Unit #1	2013 emergency generator fired with propane	125 horsepower	Not Applicable
Unit #2	2013 emergency generator fired with propane	125 horsepower	Not Applicable
Unit #3	2013 fire pump fired with distillate oil	100 horsepower	Not Applicable
Unit #4	2013 fire pump fired with distillate oil	100 horsepower	Not Applicable

Powertech's estimations of particulate matter, sulfur dioxide (S02), nitrogen oxides (NOx), carbon monoxide (CO) and volatile organic compound (VOC) emissions are less than 100 tons per year, carbon dioxide equivalent (C02) emissions that will be produced by ISR operations at the Dewey-Burdock Project Site are less than 100,000 tons per year and hazardous air pollutant emissions are less than 10 tons per year for a single hazardous air pollutant and 25 tons per year of a combination of hazardous air pollutant. Based on the emission estimates, the Dewey-Burdock Project Site is considered a minor source. However, even a minor source may require a title V permit if it is subject to an NSPS or a MACT standard.

10.3.1 New Source Performance Standard (NSPS)

The DENR reviewed the NSPS to determine if the EPA regulations found at 40 CFR Part 60, subpart IIII are applicable to the Dewey-Burdock Site stationary sources. Subpart IIII applies to owners and operators of stationary compression ignition internal combustion engines that meet specific date criteria. Units # 1 and #2 are classified as spark ignition engines, so subpart IIII does not apply to them. Units #3 and #4 are classified as stationary compression ignition engines and are fire pump engines meeting the date criteria under subpart IIII. Therefore, this subpart applies to Units #3 and #4 and the units must meet the EPA emission requirements and operational standards of this subpart.

The DENR reviewed the NSPS to determine if the EPA regulations found at 40 CFR Part 60, subpart JJJJ are applicable to the Dewey-Burdock Site stationary sources. Subpart JJJJ applies to owners and operators of stationary spark ignition internal combustion engines meeting specific date criteria. Units #1 and #2 are fired with propane and are considered spark ignition engines. The engines will also be manufactured after the 2009 NSPS deadline; therefore, subpart JJJJ is applicable.

The DENR determined that the Dewey-Burdock Project Site is subject to the NSPS standard subpart IIII and Subpart JJJJ. However, the South Dakota regulations ARSD 74:36:07:88 and 74:36:07:90 state that an area source (minor) is not required to obtain a title V permit if the only reason for the title V permit is that the source is subject to requirements under 40 CFR subpart IIII and subpart JJJJ. Based on these South Dakota regulations, Powertech does not require a title V permit for the Dewey-Burdock Project Site.

10.3.2 National Emission Standard for Hazardous Air Pollutants - Maximum Achievable Control Technology (40 CFR part 63)

10.3.2.1 Potential Hazardous Air Pollutant Emissions

The DENR used emission factors for hazardous air pollutants from the propane fired generators (0.078 pounds per million BTUs) and the distillate fuel fired fire engines (0.00379 pounds per million BTUs) from AP-42, Table 3.2.1 July 2000 and AP-42 3.3-1, October 1996 respectively. The DENR calculated the potential emissions of hazardous air pollutants in tons per year shown in Table 22. Based on these emission values, the DENR determined that Powertech is a minor source of hazardous air pollutants. A minor source of hazardous air pollutants is a facility with the potential to emit less than 10 tons of a single hazardous air pollutant and less than 25 tons per year of all hazardous air pollutants combined. A minor source of hazardous air pollutant is considered an area source.

Table 22. Potential Emissions Summary for Reciprocating Internal Combustion Engines in tons per year (Table 6-1 in DENR's Statement of Basis)

Description	Hazardous Air Pollutants
Unit #1	0.0
Unit #2	0.0
Unit #3	0.005
Unit #4	0.005
Total	0.01

HAP emissions represented by the NRC SEIS for the maximum emission year are 3.7 tons of formaldehyde, which includes mobile and stationary source emissions (SEIS table 2.1-2).

10.3.2.2 ARSD 74:36:08:40 - 40 CFR 63, Subpart ZZZZ

The EPA regulations found at 40 CFR part 63, subpart ZZZZ, which are in DENR's regulations at ARSD 74:36:08:40, establish national emission limitations and operating limitations for hazardous air pollutants (HAPs) emitted from stationary reciprocating internal combustion engines (RICE) located at major and area sources of HAP emissions. This subpart also establishes requirements to demonstrate initial and continuous compliance with the emission limitations and operating limitations.

Units # 1 - #4 are considered new affected sources. For these affected sources that are new or reconstructed stationary RICE located at an area source the operator of the source must meet the requirements of subpart ZZZZ by meeting the requirements of 40 CFR Part 60, Subpart IIII, for compression ignition engines or 40 CFR Part 60, subpart JJJJ, for spark ignition engines. No further requirements apply for such engines under this part. Powertech is considered an area source of HAP emissions. As previously stated, Units #1 and #2 are subject to 40 CFR Part 60, subpart JJJJ and Units #3 and #4 are subject to subpart IIII. No other requirements under the MACT are applicable.

10.3.3 National Emission Standards for Hazardous Air Pollutants (40 CFR part 61)

40 CFR Part 61 National Emission Standards for Hazardous Air Pollutants, subpart A – General Provisions; and subpart W – National Emissions Standard for Radon Emissions from Operating Mill Tailings. Subpart W applies to "owners or operators of facilities licensed to manage uranium byproduct material during and following the processing of uranium ores, commonly referred to as uranium mills and their associated tailings" (40 CFR § 61.250). Subpart W defines "uranium byproduct material or tailings" as "the waste produced by extraction or

concentration of uranium from any ore processed primarily for its source material content" (40 CFR § 61.251(g)). Thus, any type of uranium recovery facility that is managing uranium byproduct material or tailings is subject to subpart W. Based upon the information contained in the Final SEIS, it appears that the requirements of subpart W may apply to the impoundments or ponds at the proposed Dewey-Burdock uranium recovery facility that will be used to contain the uranium byproduct material. This includes all impoundments or ponds where uranium byproduct material is stored or treated, including those storing uranium byproduct prior to either land application or deep well injection.

As required by 40 CFR § 61.252(c), these impoundments or ponds must be in compliance with the provisions in 40 CFR 192.32(a). In addition, the requirements in 40 CFR Part 61 subpart A apply to subpart W regulated structures. Subpart A requires owners or operators to submit to the EPA an application for approval for either construction or modification of subpart W regulated structures (i.e., all ponds holding uranium byproduct material, whether treated or not) before the construction or modification is planned to commence. (40 CFR § 61.07). As you are aware, the EPA is considering revisions to 40 CFR Part 61, subpart W, however, currently the regulations outlined here currently apply to the Dewey-Burdock facility.

If designed, constructed, and installed as described in the application, it appears that several of the proposed ponds will not be in compliance with these regulations or with 40 CFR Part 61, Subpart W, which requires that there be no more than two ponds, each with a surface area of no more than 40 acres that are in operation at any given time to minimize radon emissions. In accordance with the provisions of 40 CFR 61.07, Subpart A, the EPA must also approve the design of the ponds prior to construction. If the ponds are constructed as described in the SEIS, the Dewey-Burdock project will not meet these regulatory requirements[12].

10.4 The Nuclear Regulatory Commission Evaluation of Dewey-Burdock Project Impacts to Air Quality
For this cumulative impact analysis, we propose using the NRC's NEPA information because the NRC's NEPA analysis provides a context for understanding the magnitude of the ISR project nonradiological air emissions. The NRC analysis includes mobile and fugitive emission sources, as well as stationary sources in evaluating air impacts.

The EPA proposes to use the NRC analysis that characterized the magnitude of air effluents from the proposed project throughout SEIS Section 4.7.1, in part, by comparing:

1. The emission levels to PSD and title V thresholds, and
2. The modeled concentrations to regulatory standards such as National Ambient Air Quality Standards (NAAQS).

[12] The final NRC license includes an overarching provision that the licensee (Powertech (USA), Inc.) must obtain all necessary permits, licenses, or approvals before commencing operations, (license condition 12.1).

We also proposed to apply the factors the NRC used in determining the magnitude of the potential impacts include whether:

1. The air quality of the site's region of influence (ROI) is in and projected to be in compliance with the NAAQS,
2. The facility can be classified as a major source under the New Source Review or operating (title V of the Clean Air Act) permit programs, and

The presence of Class I areas within the region could be impacted by emissions from the proposed action.

In order to evaluate the maximum impacts to air quality, the NRC analyzed the impacts on air quality during the peak year. The peak year accounts for the time when all four ISR project life-cycle phases (construction, operations, aquifer restoration, and decommissioning) are occurring simultaneously and represents the highest amount of emissions the project will generate in any one year. Powertech identifies two years when all four phases will occur simultaneously and seven years when construction and operation phases will occur simultaneously. Appendix C of the NRC SEIS describes nonradiological air emissions information for the proposed project including emission inventories and air dispersion modeling.

10.4.1 Modeling of Emission Impacts on Air Quality: Modeling Protocol and Methodology

The NRC requested that Powertech perform an assessment of the potential air quality impacts of the Dewey-Burdock Project Site as part of the NRC license application and SEIS and since it is available, EPA has evaluated it to assist in informing the cumulative analysis for this UIC permit. However, since EPA did not conduct the modeling and expressed concerns to the NRC during the SEIS process, we have outlined those issues that we have taken into consideration when using this analysis. Powertech enlisted Inter-Mountain Laboratories, Inc., Air Science Division (IML) to develop a project emissions inventory and to model the potential impacts of the emissions on ambient air quality. IML also assessed the potential project impacts on AQRVs at the nearby Wind Cave National Park, a Class I area. The two separate modeling scenarios included:

1. Modeling for ambient air quality impacts at the project boundary, nearby residences, at locations within 50 km of the project, and at Wind Cave National Park (a Class I area); and
2. Modeling for AQRV impacts, including visibility and atmospheric deposition impacts, at Wind Cave National Park, the nearest Class I area.

The air impact analysis includes two types of modeling: AERMOD and CALPUFF. The AERMOD dispersion model was used to predict NAAQS and PSD pollutant concentrations within 50 kilometers of the development locations (i.e., near-field impacts) and the CALPUFF model was used to assess impacts to AQRVs at Wind Cave National Park. Additional information concerning the Dewey-Burdock emission inventory, the modeling protocol, and the results for both the AERMOD and CALPUFF analyses is available in the document entitled *Ambient Air Quality Final Modeling Protocol and Impact Analysis Dewey-Burdock Project Powertech (USA) Inc., Edgemont, South Dakota*, which was developed by IML[10] and will be referred to as the "IML Report."

As explained below, the model options and approach for the air quality impact assessment selected by NRC for inclusion in the SEIS did not align with EPA's Guidelines on Air quality Models (40 CFR Part 51, Appendix W), and the EPA made the NRC aware of this during the SEIS review process.

[10] Ibid.

Specifically, the NRC decided to deviate from the regulatory default options and recommended approaches for both AERMOD and CALPUFF. For both modeling analyses, the NRC: did not use the most recent regulatory-approved version of the model software platforms; configured the models with non-default options; and did not conservatively model PM_{10} particles for the final runs used by NRC in their determination of impacts. These deviations can impact the final model results by potentially under-estimating the predicted impacts from the project.

First, the primary concern EPA had with the NRC's Dewey-Burdock air quality analysis was the manner in which PM_{10} particles were modeled for the AERMOD analysis. As stated in Section 4.7.1 of the SEIS, The NRC approved use of the dry depletion (i.e., dry deposition) non-default option available in the model and only modeled a predetermined selection of receptors in the PM_{10} air quality analysis. Basically, the dry depletion option accounts for the partial settling and deposition of PM_{10} particles as the dust plume disperses away from the source, or the option removes particle mass as the plume disperses from the source based on the input assumptions of the particle properties. The dry depletion option may be appropriate to use in AERMOD when sufficient data are available to determine the particle size distribution and other particle information reasonably well for each source. However, EPA did not find that NCR provided sufficient information to support the use of dry depletion in the AERMOD analysis. Further, if an adequate basis had been provided, dry depletion should have been applied to all receptors within the model domain. Because deposition fundamentally removes mass, deposition of PM_{10} particles which subsequently impacts the distribution of the modeled concentrations. To ensure that the distribution of the modeled concentrations is captured properly over the entire domain, all of the receptors should be modeled with deposition. Therefore, it may be more appropriate for this review to rely on the modeling results that are presented without the use of the dry depletion option.

Second, as the NRC explained in Section 4.7.1 of the SEIS, the NRC also *excluded* all PM_{10} emissions in the final CALPUFF model analysis. Similar to the dry depletion option in AERMOD, it may be appropriate to exclude certain PM_{10} emissions in the far-field analysis because some modeling studies have found that mechanically generated fugitive dust emissions of particles larger than $PM_{2.5}$ (e.g., production and construction traffic emissions) tend to deposit out rapidly near the emissions source and do not transport over long distances. As a result, a model like CALPUFF that predicts impacts at distances beyond 50 kilometers may not be capable of modeling this phenomenon. However, EPA had concerns with the approach used in the Dewey-Burdock air quality analysis because without providing an adequate justification, NRC determined that there was precedent for excluding all ground-level, fugitive particle emission in the $PM_{2.5}$ to PM_{10} range from the assessment of project impacts on visibility at Wind Cave National Park. Eliminating all PM_{10} emissions from the CALPUFF analysis was not EPA's preference, and the approach used by NRC will not account for the diesel engine exhaust PM_{10} particles that will not settle out as quickly as the mechanically generated fugitive dust emissions. Further, EPA is also not aware of other NEPA projects that have excluded PM_{10} emissions from visibility assessments. For disclosure purposes under NEPA, EPA recommended that the final air quality impacts be based on modeling that includes all PM_{10} emissions. And as such, for the purposes of this review, the EPA is relying on the PM_{10} values that do not use dry deposition.

Additional details on the IML/NRC rationale for using dry depletion in the final AERMOD simulations are included in Section 3.9 of the IML Report and Appendix C Section C.2.3.1, pages C-22 and C-23 of the SEIS. In addition, the rational for excluding sources of PM_{10} is discussed in Section 7.2.3 of the IML Report and Section C2.3.2, page C-23 of SEIS Appendix C.

10.4.2 Air Modeling Results

10.4.2.1 Results from AERMOD Model

The AERMOD modeling was conducted using one year of peak year emissions data where all four ISR lifecycle phases are active, which represents the maximum emission levels or reasonable worst case scenario for source emissions. The model also used three years of hourly meteorological data, in accordance with EPA recommendations that AERMOD be run with a minimum of three years of meteorological data.[11] Table 23 is SEIS Table 4.7-1, which is based on SEIS Appendix C, Table C-9. Table 23 presents the AERMOD modeling results with respect to the NAAQS. Table 24a is SEIS Table 4.7-2, which is based on SEIS Appendix C, Table C-10, however Table 4.7-2 includes results as interpreted by NRC. Table 24b is IML Analysis Table 6-2 and presents results in a slightly different manner, explained in more detail below. Tables 24a and 24b present the results with respect to the PSD increments. Note that the PM_{10} results from the initial run, not using dry depletion, and the final results utilized by the NRC in their conclusions, using dry depletion for the top 50 receptors are included.

Powertech identified three years during which all four phases would be occurring simultaneously. In Tables 19 and 23, the NRC SEIS also examined emissions associated with each of the four individual phases in an effort to depict expected contributions to potential impacts based on what sources emit the majority of a pollutant. This information indicates that almost all PM_{10} is associated with fugitive emissions and the majority of combustion emissions result from drill rig engine operation.

[11] 40 CFR Part 51, Appendix W

Table 23. Nonradiological Concentration Estimates (i.e., AERMOD Modeling Results) From Stationary, Mobile, and Fugitive Sources for the Peak Year* Compared to the National Ambient Air Quality Standards (NAAQS) (SEIS Table 4.7-1)

Pollutant	Averaging Time	Modeling Results Form†	Modeling Results (ug/m^3)	Background Concentration (ug/m^3)	Total Concentration (ug/m^3)	NAAQS Limit (ug/m^3)	% of NAAQS Limit
Carbon Monoxide	1 hour	Not to be exceeded more than once per year	2101.1	1097.3	3198.4	40000	8.0
	8 hour	Not to be exceeded more than once per year	262.6	315.5	578.1	10000	5.8
Nitrogen Dioxide	1 hour	98th percentile, averaged over 3 years	156.9	5.6	162.5	187	86.9
	Annual	Annual mean‡	3.3	0.4	3.7	100	3.7
Particulate Matter $PM_{2.5}$	24 hour	98th percentile, averaged over 3 years	6.9	10.9	17.8	35	50.9
	Annual	Annual mean, averaged over 3 years	1.0	4.8	5.8	12§	48.3
Particulate Matter PM_{10} Initial Run‖	24 hour	Not to be exceeded more than once per year on average over 3 years	187.2	41.0	228.2	150	152.1
Particulate Matter PM_{10} Final Run¶	24 hour	Not to be exceeded more than once per year on average over 3 years	83.6	41.0	124.6	150	83.1
Sulfur Dioxide	1 hour	99th percentile of 1-hour daily maximum concentrations	48.3	15.7	63.9	200	31.9
	3 hour	Not to be exceeded more than once per year#	100.1	20.9	121.0	1300	9.3

Source: Modified from IML (2013a) and Powertech (2013c)
*Peak year accounts for when all four phases occur simultaneously and represents the highest amount of emission.
†the form expresses both the statistic (e.g., maximum, average, or 98th percentile) and the time period (e.g., once per year, over one year, or over 3 years) associated with the numerical value. Unless otherwise noted, the modeling results form and the NAAQS form are the same.
‡Initial modeling form (maximum annual average over a three year period) is not the same as the NAAQS form (maximum annual average over a single year). The value in this table has a form that matches the NAAQS form and was calculated from the initial model result as described in Appendix C Section C2.3.
§The table identifies the primary standard limit. The secondary standard limit is larger (i.e., 15 $\mu g/m^3$). Results that meet the primary standard will automatically meet the secondary standard.
‖Initial modeling run without dry depletion for all receptor locations.
¶Final modeling run with dry depletion for the top 50 receptor locations.
#The model result form (the highest value over any single calendar year) is not the same as the prevention of significant deterioration increment form (not to be exceeded more than once per year). The value in this table has a form that matches the NAAQS form and was calculated from the initial model result as described in Appendix C, Section C2.3.

Table 24a. Nonradiological Concentration Values From Stationary, Mobile, and Fugitive Sources for the Peak Year* Compared to the Class I and Class II Increments (SEIS Table 4.7-2)

Pollutant	Averaging Time	PSD Increment Form†	Class I Value‡ (μg/m³)	Class I Increment (μg/m³)	Class I Percentage of PSD Increment	Class II Value‡ (μg/m³)	Class II PSD Increment (μg/m³)	Class II Percentage of PSD Increment
Nitrogen Dioxide	Annual	Not to be exceeded during the year at any one location	0.03	2.5	1.2	3.3	25	13.2
Particulate Matter $PM_{2.5}$	24 hour	Not to be exceeded more than once per year at any one location	0.45	2	22.5	7.9	9	87.8
	Annual	Not to be exceeded during the year at any one location	0.03	1	3.0	3	4	75
Particulate Matter PM_{10} Initial Run§	24 hour	Not to be exceeded more than once per year at any one location	8	8	100	187.2	30	624
	Annual	Not to be exceeded during the year at any one location	0.15	4	3.7	9.22	17	54.1
Particulate Matter PM_{10} Final Run‖	24 hour	Not to be exceeded more than once per year at any one location	3.6	8	45	83.126	30	279
	Annual	Not to be exceeded during the year at any one location	0.15	4	3.7	6.1	17	35.9
Sulfur Dioxide	3 hour	Not to be exceeded more than once per year at any one location	1.64	25	6.6	100.1	512	19.5
	24 hour	Not to be exceeded more than once per year at any one location	0.25	5	5	12.6	91	13.8
	Annual	Not to be exceeded during the year at any one location	0.00	2	0	0.6	20	3

Source: Modified from IML (2013a and b) and Powertech (2013c)
*Year accounts for when all four phases occur simultaneously and represents the highest amount of emission the proposed action would generate in any one project year
†Form expresses both the statistic (e.g., maximum, average, 98th percentile, etc) and the time period (e.g., once per year, over 1 year, over 3 years, etc.) associated with the numerical value.
‡None of the forms for the modeling results (see Table C-10) are the same as the PSD increment forms. Values were generated as described in Appendix C, Section C2.3.1 to create numbers appropriate to comparison to PSD increments.
§Initial run without dry depletion for all receptor locations.
‖Final run with dry depletion for the top 50 receptor locations.

Table 24b. Nonradiological Concentration Values From Stationary, Mobile, and Fugitive Sources for the Peak Year* Compared to the Class I Increments (IML Report)

Pollutant	Averaging Interval and Statistic	Class I Impact	Allowable Class I PSD Increment
PM_{10} Initial Run (No Dry Depletion)	Annual Average	0.05	4
	4th High 24-Hr Maximum	1.95	8
PM_{10} Final Run (Top 50 Receptors With Dry Depletion)	Annual Average	--	4
	4th High 24-Hr Maximum	--	8
$PM_{2.5}$	Annual Average	0.01	1
	24-Hr High	0.05	2
NO_2	Annual Average	0.01	2.5
	98th Percentile of Daily 1-Hr Highs	1.16	--
SO_2	Annual Average	0.00	2
	24-Hr	0.25	5
	3-Hr	1.64	25
	99th Percentile of Daily 1-Hr Highs	0.51	--
CO	8-Hr High	4.12	--
	1-Hr High	19.48	--

The total pollutant concentrations (i.e., the modeling results for the project emissions when added to the background concentration levels) for the initial modeling run without dry depletion as represented in the NRC SEIS, reveal that the peak year pollutant concentrations are below the NAAQS, except for the PM_{10} 24-hour estimate (see Table 23). These concentrations include the stationary sources from Table 17, the mobile sources from Table 18, and the fugitive sources from Table 19. To better interpret these model results it is informative to refer to the IML Report. This analysis includes more in depth information of year-by-year impacts and receptors for which elevated pollutant concentrations were predicted. It is important to note when reviewing modeling analyses that there is inherent uncertainty in the results and the impacts presented may not be in accord with actual impacts. Table 6-1 of the IML Report (Table 25 of this report) shows the yearly impacts rather than impacts that have been averaged over multiple years. These results show the potential for exceedances of the 24-PM_{10}, and 1-hour NO_2 standards. In the case of 1-hour NO_2 the table shows that only for the first highest concentration during one year was the concentration above the NAAQS. However, the presentation of these results did not entirely conform with the standard of the NAAQS, which utilizes the eight highest value for each receptor for each year, and as such, can be somewhat misleading. Figure 6-12 of the IML Report is informative however, and shows that these elevated concentrations would be seen at the project boundary and the concentrations reduce rapidly as distance increases. Considering the limitations of this analysis and the projected extent of the impacts actual violations of the 1-hour NO_2 NAAQS would expected to be unlikely and elevated pollutant concentrations would not be expected beyond the project boundary.

Twenty-four-hour PM_{10} impacts are represented in Figures 6-5 and 6-6 of the IML Report. Figure 6-5 is shown at Figure 24 in this document. These figures show the spatial extent of the predicted PM_{10} impacts as well as the top 10 model receptors that showed elevated concentrations. IML Report Table 6-4 shows the 50 receptors that after the addition of background concentration, were above the level of the NAAQS. These elevated concentrations were within 500 meters of the project boundary and the access road. Vehicle travel on unpaved roads is known to have the potential to cause elevated dust levels, however, the applicant has committed to watering more than twice per hour, which would result in much higher levels of fugitive dust control than the 60% control assumed by the analysis. As such, and considering the limitation of the analysis and uncertainty associated with estimating emissions from fugitive dust sources it is very likely that the mitigating measures listed in Table 6.2-1 of the NRC SEIS are implemented PM_{10} concentrations should be below levels of concern. The mitigating measures to reduce fugitive particulates are required under the proposed DENR Large Scale Mine Permit.

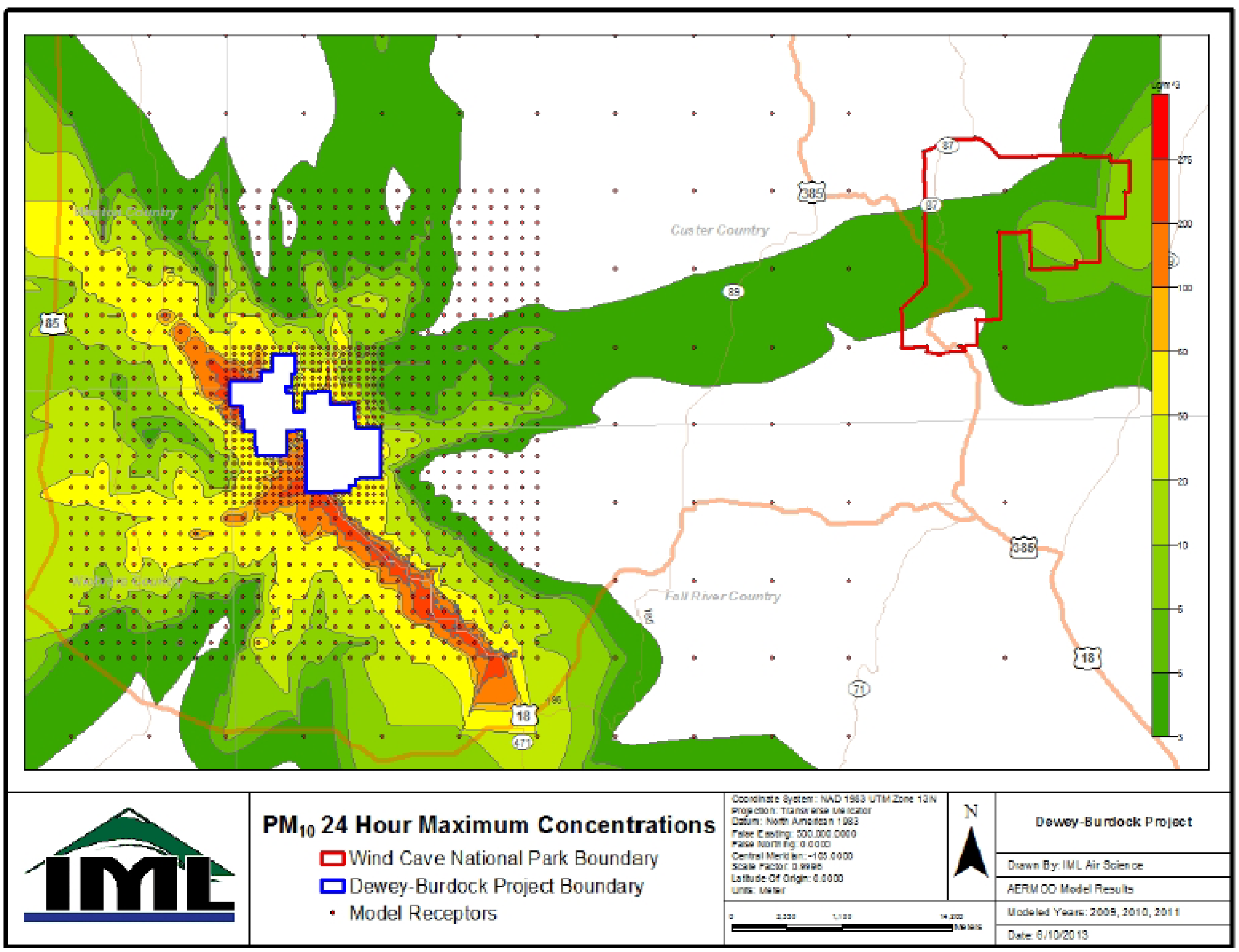

Figure 24. An isopleth map of the predicted maximum 24-hr concentrations attributable to the Dewey-Burdock Project. (Figure 6-5 from the IML Report)

Table 25 summarizes the year-by-year results as well as multi-year average results of the AERMOD model runs for all pollutants and relevant averaging intervals. Predicted total ambient concentrations are computed as the sum of the modeled impacts and the background concentrations. For 24-hr PM_{10}, the three columns correspond to the top three daily averages over the 3-year period. These top three daily averages do not necessarily fall in separate years and as a result do not conform entirely to EPA modeling Guidance or the form of the standard. For the annual PM_{10} and all other pollutants, the columns correspond to modeled values in years 2009, 2010 and 2011. The separate contexts implied by the column headings reflect the way the overall statistic was calculated in the IML Report. For 24-hr PM_{10}, the results are presented in the IML and NRC analysis as the 4th high over 3 years, so the top 3 values are of interest regardless of when they occurred. This differs slightly from the method for calculating design values for comparison to the NAAQS, but is sufficient to inform this analysis. In all other cases, the results are presented as an average of the value from each year.

Table 25. Summary of Predicted Near-field Pollutant Concentrations from the AERMOD Model (IML Report Table 6-1)

Pollutant	Averaging Interval and Statistic	Ambient Impact ($\mu g/m^3$)	Back-ground ($\mu g/m^3$)	Total Ambient Concentration ($\mu g/m^3$)	NAAQS Limit ($\mu g/m^3$)	Receptor (UTM Easting, Northing)	1st Year Statistic (1st High for 24-Hr PM_{10})	2nd Year Statistic (2nd High for 24-Hr PM_{10})	3rd Year Statistic (3rd High for 24-Hr PM_{10})
PM_{10} Initial Run (No Dry Depletion)	Annual Average	8.8	--	--	--	582358, 4810210	--	--	--
	4th High 24-Hr Maximum	187.2	41.0	228.2	150	590758, 4801610	263.1	217.9	194.4
PM_{10} Final Run (Top 50 Receptors With Dry Depletion)	Annual Average	5.8	--	--	--	590758, 4802110	5.5	6.1	6.0
	4th High 24-Hr Maximum	83.6	41.0	124.6	150	589258, 4802410	116.1	94.9	84.2
$PM_{2.5}$	Annual Average	1.0	4.8	5.8	12	577137, 4815932	--	--	--
	24-Hr High	6.9	10.9	17.8	35	577137, 4815932	7.9	7.5	5.3
NO_2	Annual Average	1.1	0.4	1.5	100	576358, 4816510	--	--	--
	98th Percentile of Daily 1-Hr Highs	156.9	5.6	162.5	187	577137, 4815932	191.6	159.8	119.2
SO_2	Annual Average	0.2	--	--	--	577137, 4815932	--	--	--
	24-Hr	12.6	--	--	--	576358, 4816510	--	--	--
	3-Hr	100.1	20.9	121.0	1300	576358, 4816510	--	--	--
	99th Percentile of Daily 1-Hr Highs	48.3	15.7	63.9	200	577137, 4815932	58.5	50.1	36.2
CO	8-Hr High	262.6	315.5	578.1	10000	576358, 4816510	--	--	--
	1-Hr High	2101.1	1097.3	3198.4	40000	576358, 4816510	--	--	--

10.4.2.2 Increment Comparison

While the NAAQS primarily relate to an area's attainment classification, the PSD increments relate to pollution levels generated by individual projects. The modeling domain for the Dewey-Burdock Project Area included both a Class I area, Wind Cave National Park, and Class II areas which comprises all other areas within the model domain. Wind Cave National Park is located about 29.0 miles northeast of the proposed project area, and the predominant wind direction is from the northwest (see Figure 23).

Although this project is not subject to PSD permitting requirements, as explained above, a comparison to PSD increments was conducted during the NEPA process and may be informative when trying to understand whether the project will significantly change air quality at sensitive locations. For the peak year, utilizing the revised emission inventory no impacts are exceeding the Class I increment at wind cave, see Table 11a. For 24-hour PM_{10} results presented by the NRC are equivalent to the Class I increment of 8 µg/m^3. This is due to the fact that the modeling presented to the NRC did not conform to the Class I increment directly. Appendix C Page C-21 explains that the modeled results were output for the highest values at each receptor over the modeled timeframe as well as the fourth highest concentrations. Neither of these outputs match the metric for comparison to the increment, which is the highest-second-high value. Therefore, NRC made the assumption that the value would be below or equivalent to the increment. Tables 24a and 24b show the impacts as presented by the SEIS and the IML Report.

10.4.2.3 Results from CALPUFF Model: AQRVs

The purpose of AQRV modeling is to identify and disclose impacts on Class I area resources (i.e., visibility, flora, fauna, etc.) by the projected emissions from a proposed project. AQRVs are resources which may be adversely affected by a change in air quality. Based on its proximity to the Wind Cave National Park, a federally mandated Class I area, the Dewey-Burdock Project was modeled to determine its potential AQRV impacts at Wind Cave. Species to be modeled included PM_{10}, $PM_{2.5}$, SO_2, SO_4, NOx, $NHNO_3$ and NO_3.

AQRVs that are generally evaluated for the federal mandatory Class I areas include:

- Visibility
- Nitrogen and sulfur deposition

10.4.2.4 Visibility Analysis Results

IML and NRC determined there is evidence and precedent that supports excluding ground-level, fugitive PM_{10} emissions from the assessment of project impacts on visibility at Wind Cave (see discussion below). However, EPA did not support this approach for the SEIS and results here will be discussed that include coarse particulates.

As shown in Table 26, the 98% percentile impacts with coarse particulate matter included in the model were below the 0.5 dv threshold of concern, or significance level. Considering modeled impacts above the 98% percentile, there were 11 days during the modeled three-year period with Δdv over the significance level, however in accordance with FLAG 2010 guidance the determination of impact should be based on the 98% percentile when utilizing CALPUFF. The maximum 24-hr Δdv was 0.83 dv.

The analyses reveal that the annual peak year results are below the threshold. The individual phase results, as a fraction of the peak year results, are also below the threshold. In addition, the visibility result is a value computed from several pollutants with varying contributions rather than just a single pollutant. This complicates any attempt to generate phase specific contribution values.

Table 26. Visibility Modeling Results for the Peak Year at Wind Cave National Park (SEIS Table 4.7-3)

Scenario	Statistic	Modeled 3-Year Result	Contribution Threshold	Modeled Results 2009	2010	2011
Modeled with Particulate Matter PM_{10}	98th percentile Δdv†	0.35	0.50	0.33	0.31	0.40
	Number of days > 0.5 Δdv	11	NA‡	3	4	4
	Number of days > 1 Δdv	0	NA	0	0	0
	Maximum Δdv	0.83	NA	0.55	0.83	0.58

10.4.2.5 AQRV Modeling Results: Nitrogen and Sulfur Deposition Analysis

Table 27 (SEIS Table 4.7-4) presents the total (i.e., wet and dry) deposition peak year results for the Wind Cave National Park. The modeled results for the 3-year average are below the Deposition Analysis Threshold (DAT) or 0.005 kg/hc-yr. The annual peak year results are below the threshold. The individual phase results, as a fraction of the peak year results, will also be below the threshold.

Table 27. Total (Wet and Dry) Nitrogen and Sulfur Deposition Modeling Results for the Peak Year* at Wind Cave National Park (SEIS Table 4.7-4)

Parameter		Sulfur (kg/ha/yr)†	Nitrogen (kg/ha/yr)	Sulfur and Nitrogen (kg/ha/yr)
Modeled Results (3-Year Average)		0.0010	0.0016	0.0026
Concern Threshold (annual)		0.005	0.005	0.010
Wind Cave Nation Park Measurements	2009	1.00	2.72	3.72
	2010	1.16	3.56	4.72
	2011	0.90	2.87	3.77
	3-year average	1.02	3.05	4.07
Estimated Critical Load (Annual)		12	5	17

Source: IML (2013a).
*Peak year accounts for when all four phases occur simultaneously and represents the highest amount of emission the proposed action will generate in any one project year.
†Units only expressed in metric form.

The deposition impacts are modeled under one scenario using the complete emission inventory. Deposition impacts are modeled as the deposition of a variety of compounds containing nitrogen and sulfur. The sulfur dioxide and nitrogen oxides emissions from the proposed project constitute the potential sources of deposition.

Table 26 (SEIS Table 4.7-3) presents the visibility analysis results and Table 27 (SEIS Table 4.7-4) presents the deposition analysis results. Modeled impacts are compared to thresholds useful for characterizing the magnitude of the potential impacts. Both tables compare the project specific results to appropriate thresholds. The visibility analysis in Table 26 specifies a threshold parameter identified by EPA, U.S. Forest Service (USFS), and FWS. This threshold indicates that a visibility impact on a Class I area is considered significant when the source's contribution to visibility impairment, modeled as the 98th percentile of the daily (i.e., 24-hour), results in changes in deciviews that are equal to or greater than the contribution threshold of 0.5 deciviews (IML Report). Expressed in another way, a source can be reasonably anticipated to cause or contribute to visibility impairment if the 98th percentile change in light extinction (i.e., the scattering of light) is greater than 0.5 deciviews.

Two different thresholds are presented in Table 27 for comparison to the project acid deposition results. The first threshold is a concern threshold, also called the DAT. Below this threshold, deposition impacts from a source are considered negligible. The second threshold is the estimated critical loads for Wind Cave National Park. The term critical load describes the threshold of air pollution deposition below which significant harmful effects on sensitive resources in an ecosystem are not expected to occur. The critical load threshold is an emerging guideline to help in the protection of Class I areas. Table 27 also presents the measured deposition rates at Wind Cave National Park. Additional information concerning these thresholds is available in the IML Report. Since the time of the NRC SEIS, information regarding the appropriate critical loads for specific areas has evolved and the critical loads used by the NRC are likely too high. In consultation with the National Park Service, more appropriate critical loads for Wind Cave National Park are 2.5 kg/hc-yr for Nitrogen and 5 kg/hc-yr for sulfur. Applying these revised critical loads it can be seen that nitrogen deposition at Wind Cave may be of concern, but the project contribution to total deposition is negligible.

10.5 Greenhouse Gases

All phases of the proposed Dewey-Burdock ISR Project will produce greenhouse gas emissions. For disclosure purposes and to help inform the Climate Change impact analysis, Table 28 presents the carbon dioxide emission estimates for the proposed action for each of the four phases and for the various source categories. The only greenhouse gas included in the emission estimates is carbon dioxide. NRC staff consider the exclusion of other greenhouse gases from the inventory acceptable because carbon dioxide is the primary greenhouse gas emitted by the proposed action and the analysis in this SEIS is for disclosure purposes rather than a formal regulatory determination. SEIS Appendix C Section C3 contains additional information on the greenhouse gas emission estimates presented in Table 28.

Table 28. Annual Carbon Dioxide Estimates in Metric Tons/Year * for the Proposed Action (SEIS Table 2.1-6)

	Facility				
Phase	Stationary Sources†	Fugitive from Uranium Recovery Process	Mobile Sources	Electrical Consumption	Total
Construction	1,439	0	3,990	542	5,970
Operation	1,439	440	1,490	22,097	25,466
Aquifer Restoration	1,439	0	110	6,685	8,234
Decommissioning	1,439	0	1,286	542	3,267
Peak Year‡	1,439	440	6,876	29,865	38,621§

Source: Modified from IML (2013).
*To convert metric tons to short tons, multiple by 1.10231.
†Except for project year one, stationary emission are assumed to be constant over the project lifespan. Therefore the peak year calculation would only need to include the stationary source emission value one time rather than for each phase.
‡Peak year accounts for when all four phases occur simultaneously and represents the highest amount of emissions the proposed action will generate in any one project year.
§This value is for the peak year total which only includes the stationary source emission value of 1,586 once (Note †). This value is not the total of the individual phase totals in the column because each phase totals includes the stationary source emission value.

10.6 Conclusions

Based on the EPA's evaluation of the emission inventory information, Clean Air Act requirements, and modeling efforts discussed in this document and Powertech's commitment to implement the mitigation measures listed below and in SEIS Table 6.2-1, the EPA finds that the air quality impacts related to the drilling and operation of the UIC injection wells as described in Section 10 should not affect the regional air quality or result in a violation of NAAQS. Powertech committed to NRC that it will implement the measures 1 through 8 listed under Section 10.6.1. Measures 3 through 8 under Section 10.6.2 below are required under the proposed DENR Large Scale Mine Permit. The EPA noted that the models were run using emission values that already take into account measures 1 through 6 under Section 10.6.1 below that Powertech has committed to implement. The actual effectiveness of these measures may be greater than the modeling results demonstrated. The PM_{10} results in the initial AERMOD model represent a reasonable worst case scenario. The actual impacts for PM_{10} would likely be less during a majority of the life of the project than those modeled for the maximum emission years. If Powertech does not implement one or more of these measures properly (especially measure 3 which is expected to result in a 60% or better reduction in emissions generated from onsite unpaved roads).

10.6.1 List of Mitigation Measures Proposed by Powertech

Powertech committed to implementing the following measures to mitigate fugitive dust and combustion emissions from construction equipment and vehicles[12]:

1. Use drill rigs with engines no larger than 300 horsepower (except for deep well drill rig) to limit combustion emissions.
2. Use Tier 1 or higher drill rig engines and Tier 3 or higher construction equipment engines (see SEIS Section 4.7.1.1.1 for an explanation of "Tiers") to limit combustion emissions.
3. Spray water to mitigate fugitive dust accounting for a 60 percent reduction in emissions generated from onsite unpaved roads.
4. Impose speed limits for travel on unpaved roads and areas.
5. Implement an employee carpooling policy.
6. Restore or reseed disturbed areas promptly to limit the exposed/disturbed area at any given time.
7. Coordinate construction and transportation activities to reduce maximum dust levels.
8. Maintain vehicles to meet applicable U.S. Environmental Protection Agency (EPA) emission standards.

Cumulative impacts to air are examined on a regional level, rather than at the source site itself and the Dewey-Burdock project has not been shown to greatly effect regional cumulative air quality.

10.6.2 List of Additional Mitigation Measures Identified by the NRC

The NRC identified the following additional mitigation measures listed in SEIS Table 6.3-1 that Powertech could consider implementing to further reduce impacts to air quality from Construction Equipment and Vehicles: Implement fuel saving practices such as minimizing vehicle and equipment idle time.

1. Utilize fossil-fuel vehicles that meet the latest emission standards.
2. Utilize newer, cleaner running equipment.
3. Minimize unnecessary travel.
4. Ensure that diesel-powered construction equipment and drill rigs are properly tuned and maintained.

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[12] Powertech (Powertech (USA) Inc.). "Dewey-Burdock Project Emissions Inventory Revisions."
Email (July 31) from R. Blubaugh to Bradley Werling, Southwest Research Institute®.
ML12216A220. South Dakota: Powertech. 2012.

5. Limit access to construction sites, staging areas, and wellfields to authorized vehicles only, through designated treated roads.
6. Pave or put gravel on dirt roads and parking lots if appropriate.
7. Cover trucks carrying soil and debris to reduce dust emissions from the back of trucks.
8. Burn low-sulfur fuels in all diesel engines and generators.
9. Train workers to comply with speed limits, use good engineering practices, minimize disturbed areas, and employ other BMPs as appropriate.
10. To the extent practicable, avoid conducting soil-disturbing activities and travel on unpaved roads during periods of unfavorable meteorological conditions (e.g., high winds).
11. Limit the numbers of hours in a day that effluent generating activities can be conducted.
12. Perform road maintenance (i.e., promptly remove earthen material on paved roads).
13. Apply erosion mitigation methods on disturbed lands.

11.0 CLIMATE CHANGE IMPACTS

The EPA evaluated projected greenhouse gas (GHG) emissions and climate change considerations related to the proposed Dewey-Burdock ISR project. Generally, this evaluation includes consideration of potential effects of proposed ISR operations on climate change as indicated by an estimation of project-related GHG emissions, discussion of ongoing and projected climate change impacts in the Dewey-Burdock Project Area and discussion of adaptation and mitigation measures that Powertech has proposed. The EPA's climate change evaluation includes an estimation of carbon dioxide (CO_2) emissions generated by the construction, operation, aquifer restoration and decommissioning activities associated with the ISR of uranium at the site. The scope of these activities includes the CO_2 emissions related to the generation of electricity for use at the site, the mobile sources emissions during site activities, including transportation of the yellowcake offsite during ISR operations and the transport of both solid and byproduct waste offsite during the decommissioning phase. In addition, the analysis discusses CO_2 considerations associated with downstream activities that are part of the uranium fuel cycle.

11.1 Global Impacts from Climate Change

As reported in the US Global Change Research Program, *Third National Climate Assessment* released in 2014, climate change is already affecting people in far-reaching ways. Certain types of extreme weather events with links to climate change have become more frequent and/or intense, including prolonged periods of heat, heavy downpours, and, in some regions, floods and droughts. In addition, warming is causing sea level to rise and glaciers and Arctic sea ice to melt, and oceans are becoming more acidic as they absorb carbon dioxide.

Heat-trapping gases (also called greenhouse gases) make the planet warmer. The most important greenhouse gases directly emitted by humans include CO_2, methane (CH_4), nitrous oxide (N_2O), and several other fluorine-containing halogenated substances. Although CO_2, CH_4, and N_2O occur naturally in the atmosphere, human activities have changed their atmospheric concentrations. From the pre-industrial era (i.e., ending about 1750) to 2014, concentrations of these greenhouse gases have increased globally by 43, 160, and 21 percent, respectively. With respect to U.S. emissions of GHGs, the dominant gas emitted is CO_2, mostly from fossil fuel combustion. Methane is the second largest component of U.S. emissions, followed by N_2O and the fluorinated gases (HFCs, PFCs, and SF6). Electricity generation is the largest emitting sector (34% of total U.S. greenhouse gas emissions), followed by transportation (28%) and industry (19%)[13].

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[13] EPA (2016) U.S. Environmental Protection Agency. *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2014*, EPA 430-R-16-002. https://www3.epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2016-Chapter-Executive-Summary.pdf

As discussed in Section 2.1.1.1.6.1.1 of the NRC SEIS, the ISR operations at the Dewey-Burdock Project Site will require the use of electricity and proposes to utilize fossil fuels for energy generation. The extracted uranium will be used in a nuclear power plant, producing electricity with a reduced rate of greenhouse gas emissions as compared to fossil fuel combustion. The EPA recognizes that the uranium produced at the Dewey-Burdock Project Site may be used in a location outside the U.S. This issue is beyond the regulatory authority of the UIC Program. However, greenhouse gases, once emitted, can remain in the atmosphere for decades to centuries, meaning that 1) their concentrations become well-mixed throughout the global atmosphere regardless of emission origin, and 2) their effects on climate are long lasting.

11.2. Local Effects of Climate Change

The US Global Change Research Program released *The Third National Climate Assessment* in 2014. Chapter 19 presents the projected climate change impacts in the Great Plains region under different modeling scenarios. The modeled scenarios are bracketed by a best-case scenario resulting from a projected lower emission of greenhouse gases, identified as the B1 model, and a higher emission scenario identified as the A2 model, which potentially represents a “worst-case” scenario for climate change impact.

For an average of seven days per year, maximum temperatures reach 95˚F in the Northern Plains. These high temperatures are projected to occur much more frequently, even under a scenario of substantial reductions in greenhouse gas emissions (the B1 model), with days over 100˚F projected to double in number in the north by mid-century. Similar increases are expected in the number of nights with minimum temperatures higher than 60˚F in the Northern Plains, but cooler in mountain regions. These increases in extreme heat will have many negative consequences, including increases in surface water losses, heat stress, and demand for air conditioning. These negative consequences will more than offset the benefits of warmer winters, such as lower winter heating demand, less cold stress on humans and animals, and a longer growing season, which will be extended by mid-century an average of 24 days relative to the 1971-2000 average. More overwintering insect populations are also expected.

Winter and spring precipitation is projected to increase in the northern states of the Great Plains region, relative to the 1971-2000 average. Projected changes in summer and fall precipitation are small. The number of days with heavy precipitation is expected to increase by mid-century. Changes are projected to be minimal in the north with regard to longer dry spells (up to 5 more days on average by mid-century). The Northern Plains will remain vulnerable to periodic drought because much of the projected increase in precipitation is expected to occur in the cooler months while increasing temperatures will result in additional evapo-transpiration (Chapter 19, p. 447).

In western South Dakota, the increased precipitation has been observed as an increase in the number of flood events as discussed in Section 4.3.2 of this document. Winter and spring precipitation and very heavy precipitation evens are projected to increase in the northern plains, leading to increased runoff and flooding that will reduce water quality and erode soils. Increased snowfall, rapid spring warming, and intense rainfall can combine to produce devastating floods (Chapter 19, p. 446). Impacts to surface water from ISR operations at the Dewey-Burdock Project Site are discussed in Section 4.0 of this document.

The increase in precipitation events may result in increased recharge of the Inyan Kara and Madison aquifers discussed in Section 3.1 of this document. However, if spring precipitation occurs only as large-volume, high-velocity surface run-off events, there may not be time for surface infiltration to increase aquifer recharge. An increase in winter snowfall events followed by slow melting are more likely to result in aquifer recharge. However, quick thawing of snow will also result in a large-volume, high-velocity surface run-off event that may not result in increased aquifer recharge.

11.3 Sources of Greenhouse Gases Related to the Dewey-Burdock Project Site

The NRC summarizes the three categories of sources of greenhouse gases from the Dewey-Burdock Project Site in Section 2.1.1.1.6.1.1 of the SEIS. The first category consists of facility sources, which is further separated into stationary sources and facility fugitive emissions from the uranium recovery process. The second category consists of mobile sources, which include construction and drilling equipment and other mobile sources, including commuter vehicles. The third category consists of indirect emissions from electricity consumption (i.e., emissions associated with the production of the electricity that the proposed project consumes). SEIS Table 2.1-6 presents the carbon dioxide gas emission estimates for the proposed action and is included as Table 29. Estimates are provided for each of the three source categories for each of the four phases of the proposed action: construction, operation, aquifer restoration and decommissioning. The peak years are those years when all four phases are occurring simultaneously as shown in Figure 25. The NRC determined that the annual estimated greenhouse gas emissions for a peak year is 38,621 metric tons (42,572 short tons).

Table 29. Annual Carbon Dioxide Estimates in Metric Tons/Year * for the Proposed Action (SEIS Table 2.1-6)

Phase	Facility: Stationary Sources†	Facility: Fugitive from Uranium Recovery Process	Mobile Sources	Electrical Consumption	Total
Construction	1,439	0	3,990	542	5,970
Operation	1,439	440	1,490	22,097	25,466
Aquifer Restoration	1,439	0	110	6,685	8,234
Decommissioning	1,439	0	1,286	542	3,267
Peak Year‡	1,439	440	6,876	29,865	38,621§

Source: Modified from IML (2013).
*To convert metric tons to short tons, multiple by 1.10231.
†Except for project year one, stationary emission are assumed to be constant over the project lifespan. Therefore the peak year calculation would only need to include the stationary source emission value one time rather than for each phase.
‡Peak year accounts for when all four phases occur simultaneously and represents the highest amount of emissions the proposed action will generate in any one project year.
§This value is for the peak year total which only includes the stationary source emission value of 1,586 once (Note †). This value is not the total of the individual phase totals in the column because each phase totals includes the stationary source emission value.

The NRC determined that the majority of greenhouse gas emissions from the Dewey-Burdock Project Site will be carbon dioxide. Some methane and nitrous oxide emissions will occur, but chlorofluorocarbon and hydrochlorofluorocarbon greenhouse gas emissions are not expected from the project.

More detailed information about CO_2 emissions at the project site is available in the report prepared by Inter-Mountain Laboratories, Inc., Air Science division (IML), (IML Report)[14] which includes a detailed air emissions inventory as discussed in Section 10 of this document. Appendix A of the IML report includes an estimate of CO_2 emissions produced at the power plant used to generate the electricity used during each phase of the project. Appendix A also includes a detailed list of mobile equipment CO_2 emissions for each year of the project life, a total annual value of CO_2 emitted from stationary equipment sources and annual CO_2 emissions from the yellowcake production process that will occur in the central processing plant during the years of the operation phase. The emissions inventory included in the IML report is the information on which the NRC based its findings related to GHG emissions in the Dewey-Burdock SEIS. This information is summarized in the sections below.

11.3.1 Estimated CO_2 Emissions from Electrical Power Consumption

Table 29 shows the largest contribution to CO_2 emissions during the project will result from the consumption of electricity for the project (i.e., "electrical consumption"). Table 30 shows the expected CO_2 emissions from the projected demand for electricity during each phase of the ISR project operation.

Table 30. Annual Estimated CO_2 Emissions from Electrical Power Consumption

Phase	Metric tons/yr CO^2	Years per Phase	Total CO_2 (metric tons)	Total CO_2 (short tons)
Construction	542	8	4,336	4,780
Operation	22,097	8	176,776	194,862
Aquifer Restoration	6,685	7	46,795	51,583
Decommissioning	542	8	4,336	4,780
Life of Permit			232,243	256,004

Figure 25 shows the project timeline for each of the four phases included in Table 30 above from Appendix A of the IML Report. Based on the number of years estimated for each phase, the EPA calculated the "Life of Permit" total for CO_2 emissions from electrical power consumption.

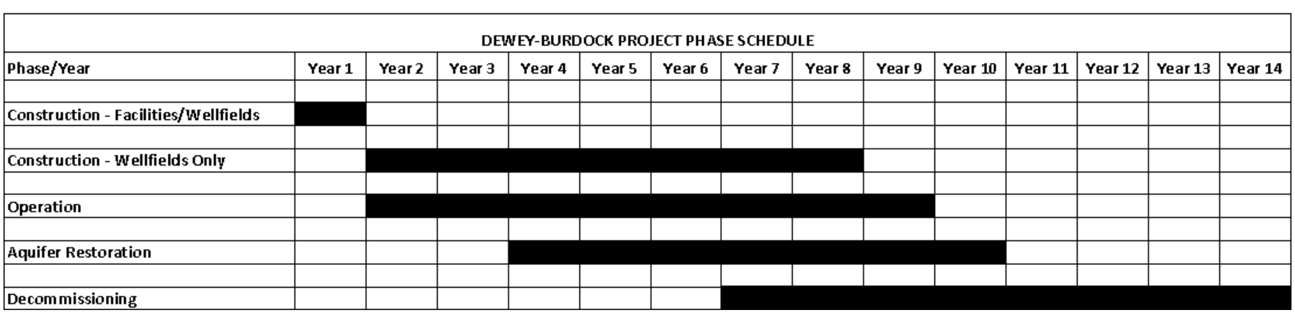

Figure 25. Projected Construction, Operation and Decommissioning Schedule at the Dewey-Burdock Project Site

[14] IML (Inter-Mountain Laboratories, Inc). "Ambient Air Quality Final Modeling Protocol and Impact Analysis Dewey-Burdock Project Powertech (USA) Inc., Edgemont, South Dakota." ML13196a061, ML13196a097, ML13196a118. Sheridan, Wyoming: Inter-Mountain Laboratories, Inc., IML Air Science. July 11, 2013.

The NRC SEIS notes that the construction phase in project year one consists of two main activities: facilities construction and wellfield construction. For the purposes of emissions inventory, Powertech is assuming that facilities construction will be completed at the end of project year one. The construction phase associated with the remaining life of the project is limited to wellfield construction. This distinction is reflected in Figure 25 and is taken into account for the estimation of CO_2 emissions from mobile sources, as shown in Table 31. However, the year one facility construction does not appear to be distinguishable in the estimation of CO_2 emissions related to electrical power consumption during the construction phase. The year 1 facility construction activities do not affect the estimates of CO_2 emissions for stationary sources and for yellowcake production.

The Black Hills Energy Corporation, which provides power to Edgemont and Custer, is the local power provider for the area where the Dewey-Burdock Project Site is located. The Black Hills Electric Coop (BHEC) provides power to smaller towns of Dewey and Pringle, but the BHEC most likely purchases wholesale electricity from the Black Hills Energy Corporation. The Black Hills Energy Corporation website (https://www.blackhillscorp.com/learn-about-energy/electricity/generation-production) provides information about the power generation facilities it owns or co-owns. Except for the Busch Ranch Wind Project located 30 miles south of Pueblo, in Huerfano County, Colorado, all the facilities burn fossils fuels to generate electricity. Five facilities use natural gas, five burn coal, four burn diesel, and one facility uses both diesel and natural gas.

11.3.2 Estimated CO_2 Emissions from Mobile Sources including Transportation

The CO_2 emissions from mobile sources as shown in Table 31 includes the emissions for the transportation vehicles for each phase of the ISR operations. SEIS Section 2.1.1.1.7 states that Powertech proposes using trucks to transport construction equipment and materials, operational processing supplies, ion-exchange resins, yellowcake product, and waste materials. Powertech proposes transporting the yellowcake produced at the Dewey-Burdock Project Site to conversion facilities in located in wither Metropolis, Illinois, or Port Hope, Ontario, Canada. Powertech anticipates that a truckload of yellowcake will be transported every two weeks. Similarly, once decommissioning begins, Powertech will transport solid waste to nearby landfills and solid byproduct waste to the White Mesa Mill in Blanding, Utah. SEIS Table 2.1-7 lists the estimated daily vehicle round-trips for the proposed Dewey-Burdock Project. Appendix A of the IML Report provides a detailed inventory of the mobile sources and the CO_2 emissions from each mobile source for each of the 14 years of the estimated project time.

In Appendix A of the IML report, the tons per year of CO_2 emissions from mobile sources are presented for each of the 14 years of the project life. The values in the IML Report are expressed in short tons per year. The table also provides a list of each of the mobile sources, including transportation sources. Table 31 presents the total CO_2 emissions from mobile sources for each year, in both short tons (as presented in the IML Report) and in metric tons, and provides a total for CO_2 emissions from mobile sources for the life of the project.

Table 31. Total Estimated CO_2 Emissions from Mobile Sources for Each Project Year and for the Life of the Project

Project Year #	CO_2 (metric tons per year)	CO_2 (short tons per year)
1	5068	5587
2	5481	6042
3	5481	6042
4	5590	6162
5	5590	6162
6	5590	6162
7	6876	7580
8	6876	7580
9	2887	3182
10	1396	1539
11	1286	1418
12	1286	1418
13	1286	1418
14	1286	1418
Total for life of project	55,982	61,710

11.3.3 Estimated CO_2 Emissions from Stationary Sources

The estimated CO_2 emissions from stationary sources is expected to be constant for each project phase and for each year of the project life. Therefore, the total life of project emissions from stationary sources is calculated simply by multiplying 1,429 metric tons (or 1,586 short tons) by 14 years of project life as shown in Table 32.

Table 32. **Estimated CO_2 Emissions from Stationary Sources**

	CO_2 emissions (metric tons)	CO_2 emissions (short tons)
Per year	1,429	1,568
Over 14 years Life of Project	24,476	22,204

11.3.4 Estimated CO_2 Emissions from Yellowcake Production

Pregnant lixiviant will be pumped from the wellfields into the ion exchange columns in the Central Processing Plant and the Satellite Processing Plant. The ion exchange columns contain uranium-specific ion-exchange resin beads. Then as the pregnant lixiviant passes through the resin columns, the resin beads become loaded with uranyl carbonate complexes. Powertech plans to have the loaded resin vessels from the Satellite Processing Plant transported by truck to the Central Processing Plant located in the Burdock Area.

An elution process removes the uranyl dicarbonate and uranyl tricarbonate ions from the resin and restores the resin to its chloride form for reuse. Fresh eluant will be prepared by combining saturated chloride (salt) solution and saturated sodium carbonate (soda ash) solution with water, forming a solution that is approximately 10 percent sodium chloride and 2 % sodium carbonate. Powertech estimates that the proposed elution process will remove more than 95 % of the uranyl carbonate complexes from the resin.

A uranium-rich eluate solution is produced by this process. The rich eluate flows to a precipitation tank where precipitation and drying will be initiated by adding sulfuric or hydrochloric acid to the rich eluate to breakdown the carbonate portion of the dissolved uranyl carbonate complex. The proposed process uses hydrogen peroxide to precipitate out the uranium as uranium peroxide (UO_4). Next, sodium hydroxide is added to adjust the pH before the precipitated uranyl peroxide or yellowcake slurry settles. After settling, the yellowcake slurry is pumped to a gravity thickener. The thickened slurry is pumped to a filter press to remove excess water. The yellowcake slurry is washed with fresh water to remove impurities, especially chloride, and air dried to further reduce the moisture content.

The CO_2 emissions occur during the acidification of the uranium-rich eluate prior to precipitation of uranyl peroxide. CO_2 emissions from type of uranium carbonate complex is documented in the Appendix A of the IML Report and summarized here in Table 33. The total CO_2 emissions estimated for this process is 485 short tons per year or 535 metric tons per year. Total life of project CO_2 emissions during yellowcake production is calculated by multiply ton per year of CO_2 emissions by eight years of operations as shown in Figure 25.

Table 33. Estimated CO_2 Emissions from Yellowcake Production

	CO_2 emissions (metric tons)	CO_2 emissions (short tons)
Per year	535	485
Over 8 years of Operation	4,277	3,880

11.3.5 Total Estimated CO_2 Emissions Calculated for the Life of the Project

Table 34 shows the estimated total estimated emissions for the 14 year life of the proposed Dewey-Burdock uranium ISR project represented as both metric tons and short tons.

Table 34. Total Estimated CO_2 Emissions Calculated for the Life of the Project

CO_2 Emissions Source	CO_2 Emissions (metric tons)	CO_2 Emissions (short tons)
Electrical Power Consumption	232,243	256,004
Mobile Sources	61,710	55,982
Stationary Sources	20,006	22,204
Yellowcake Production	4,277	3,880
Total	318,236	338,070

11.4 Uranium Processing

Powertech plans to produce uranium yellowcake at the Central Processing Plant at the Dewey-Burdock project site. The April 21, 2015 NI 43-101 Technical Report Preliminary Economic Assessment for the Dewey-Burdock Project estimates the overall potential yellowcake production to be 9.69 million pounds. According to SEIS Section 2.1.1.1.7, after the yellowcake is produced at the Central Processing Plant, Powertech will transport it to a conversion facility. One possible conversion facility is the Honeywell International, Inc. in Metropolis, Illinois; the second is the Cameco Corporation Port Hope Uranium Conversion Facility located Port Hope, Ontario, Canada. The Dewey-Burdock Project emissions inventory in the IML report includes a CO_2 emissions estimate for shipping the yellowcake to a conversion facility. The distance from Burdock, South Dakota to Metropolis, Illinois is 1,134 to 1,230 miles depending on route taken. The distance from Burdock, South Dakota to Port Hope, Ontario, Canada is 1,585 to 1,704 miles depending on route taken. Powertech anticipates sending out a truckload of yellowcake to a conversion facility every two weeks.

At the conversion facility, the yellowcake is converted into pure uranium hexafluoride (UF_6) gas suitable for use in enrichment operations. The UF_6 gas is cooled to a solid form, then shipped to an enrichment plant. The emissions inventory in the IML report does not include any information about CO_2 emissions for the conversion process.

Before the uranium can be used as fuel for nuclear reactors, the UF_6 must be enriched in the U^{235} isotope. According to the NRC, the enrichment process separates the UF_6 gas into two streams using the difference in weight between U^{235} and the heavier, more plentiful U^{238}. Today, this is process is accomplished by gas centrifuge. Until recently, gaseous diffusion was also used. A third method – laser enrichment – has been proposed for use in the United States. The NRC has licensed three gas centrifuge plants.

In 2006, the NRC issued a license to Louisiana Energy Services (also known as Urenco USA) to construct and operate the National Enrichment Facility in Eunice, New Mexico. This plant opened in 2010. In 2004, the NRC licensed the United States Enrichment Corporation (USEC) to construct and operate a demonstration and test facility known as the Lead Cascade in Piketon, Ohio. This test facility has been operating since 2007. The NRC also issued a license to USEC in 2007 to build and operate the American Centrifuge Plant also located at Piketon, Ohio. (USEC now operates as Centrus.)

The SEIS documents the NRC developed for these facilities do not include any information about GHG emissions. The SEIS for the URENCO facility estimates the process would require approximately 30 megawatts of electricity to process the annual expected full production of 8,600 metric tons (9,480 tons) of UF_6. There is also the potential for fugitive fluorine gas leaks from the facility, which would also contribute to greenhouse gas emissions from the uranium enrichment facility. A portion of these emissions would be considered part of the Dewey-Burdock downstream CO_2 emissions calculations, but are not included in the emissions inventory in the IML report.

The last step in the uranium fuel cycle is Fuel fabrication for light (regular) water power reactors (LWR) typically begins with receipt of low-enriched uranium (LEU) hexafluoride (UF_6) from an enrichment plant. The UF_6, in solid form in containers, is heated to gaseous form, and the UF_6 gas is chemically processed to form LEU uranium dioxide (UO_2) powder. Three LEU fuel fabrication plants are currently licensed by the NRC: Global Nuclear Fuels-Americas in Wilmington, North Carolina; Westinghouse Columbia Fuel Fabrication Facility in Columbia, South Carolina; and Areva, Inc., in Richland, Washington.
After the fuel fabrication process is completed, the fuel would be transported to the nuclear power plant.

11.5 Nuclear Power Plant Operation

For the purposes of the GHG reporting rule, the EPA considers only GHG production at the point at which the emissions occur. For power plants, this point would be where the fuel is combusted to produce the electricity. Therefore, the EPA considers nuclear power plants to be net neutral GHG emitters.

The US GHG Inventory examines GHG emissions at the point at which the emissions occur, therefore, the EPA considers nuclear power plants to be net zero GHG emitters. The GHG reporting rule does not include nuclear power plants in the list of the 41 industrial sectors that must report GHG emissions under the rule.

For electricity generation, the activity that drives GHG emissions is the consumption and combustion of fossil fuels. The EPA GHG emission inventory report can be viewed at: https://www.epa.gov/ghgemissions/us-greenhouse-gas-inventory-report-1990-2014.

The inventory report contains extensive information on emissions from power plants, focusing on the fuel consumed to generate that electricity (e.g., coal combusted in boilers, natural gas combusted in turbines, etc.). The Fast Facts fact sheet for the US GHG Inventory report provides a summary of information from the inventory report. The Fast Facts Sheet can be viewed at:
https://www.epa.gov/sites/production/files/2016-06/documents/us_ghg_inv_fastfacts2016.pdf

The last page of the Fast Facts Sheet presents the CO2 emission conversion factors used to calculate CO2 produced for each fuel type per energy unit produced by the fuel type. The list contains a list of fuel types, energy units and conversion coefficient for each Fuel Type combusted for energy purposes like electricity generation.

The US GHG Inventory examines GHG emissions at the point they are emitted and the report contains a wealth of useful information on GHG emissions rates from various activities. https://www.epa.gov/ghgemissions/us-greenhouse-gas-inventory-report-1990-2014

11.6 Climate Change and Adaptation

As mentioned in Section 11.2, the effects of climate change in western South Dakota have resulted, and are projected to continue to result in, an increase in number and severity of precipitation events. Powertech conducted a flood analysis as part of the Large Scale Mine permit application submitted to the South Dakota DENR. The flood analysis includes estimates of peak flood discharges and water levels produced by floods in the drainage areas located within the Dewey-Burdock Project Area. Powertech's Flood Analysis is discussed in Section 4.3.1 of this document.

Powertech defined the 100-year flood inundation boundaries and potential flood water elevation levels for the Project Area. Large Scale Mine Permit Plate 3.5-1 depicts the modeled flood inundation areas for all surface water features during the 100-year, 24-hour storm event in relation to proposed facilities and infrastructure.

Powertech also evaluated a much less likely flood event referred to as an upper-bound flow or an extreme flow. The final model results for the spatial representation of the extreme condition floodplains for Beaver Creek and Pass Creek within the permit area are shown in Large Scale Mine Permit Figures 3.5-10 and 3.5-11, respectively. The figures indicate the relationship of the maximum extent of the extreme condition floodplain to the locations of the primary facility zones and the known ore bodies. The sole purpose of including the extreme condition flood in the analysis for flood and erosion potential is to illustrate that there is very little additional land area inundated by the extreme condition floods compared to the 100-year floods. The risk of flood or erosion damage to the permit area facilities from Beaver and Pass Creeks is extremely low.

Except for an occasional unavoidable situation, Powertech plans to construct facilities outside of the 100-year flood plain boundaries to avoid potential impacts to facilities from flooding and potential impacts to Beaver Creek and Pass Creek in the event of any potential spills or leaks. Pipelines will be buried below the frost line and will be isolated from impacts of surface flooding. Pipeline valve stations will be located outside of the 100-year flood inundation boundaries.

As discussed in NRC SEIS Section 3.5.1, some wellfields and storage ponds located in Sections 29 and 32, T6S, R1E in the Dewey area will be located within the 100-year floodplain boundary of an ephemeral drainage to Beaver Creek. In addition, some wellfields, the main access road, and the plant-to-plant pipeline in the Burdock area are located within the 100-year floodplain boundary of ephemeral drainages to Pass Creek. These locations are shown on Large Scale Mine Permit Plate 3.5-1. To protect facilities and infrastructure from flood damage and avoid discharges from storage ponds that are located within the 100-year inundation boundary, Powertech will implement the Water Management and Erosion Control Plan described in Section 4.2 of this document.

The more frequent and more severe precipitation events observed in the northern Great Plains area as a result of climate change could result in an increased volume of stormwater runoff and increased flooding potential exacerbating effects to surface water. Section 4.2 of this document discusses the South Dakota DENR proposed Large Scale Mine Permit Water Management and Erosion Control Plan. This plan must be implemented during and after ISR operations to reduce soil loss within the permit area. The proposed plan includes the use of ditches, diversions, sediment traps/ponds, culverts, and other BMPs to be used to control surface water flow within the permit boundary. Large Scale Mine Permit Plates 5.3-6 through 5.3-19 show the proposed structures included in the plan for water control and erosion control.

11.7 Climate Change and Mitigation

11.7.1 Powertech's Proposed Mitigation Measures to Reduce Greenhouse Gas Emissions

As discussed in Section 10.6.1 of this document Powertech proposes the following mitigation measures to reduce Combustion Emissions from Construction Equipment and Vehicles:

1. Use drill rigs with engines no larger than 300 horsepower (except for deep well drill rig) to limit combustion emissions.
2. Use Tier 1 or higher drill rig engines and Tier 3 or higher construction equipment engines (see the NRC SEIS Section 4.7.1.1.1 for an explanation of "Tiers") to limit combustion emissions.
3. Implement an employee carpooling policy.
4. Maintain vehicles to meet applicable U.S. Environmental Protection Agency (EPA) emission standards.

The NRC proposed these additional measures that the EPA considers to be beneficial:

1. Implement fuel saving practices such as minimizing vehicle and equipment idle time.
2. Utilize fossil-fuel vehicles that meet the latest emission standards.
3. Utilize newer, cleaner running equipment.
4. Minimize unnecessary travel.
5. Ensure that diesel-powered construction equipment and drill rigs are properly tuned and maintained.

11.7.2 Potential Mitigation Measures to Protect Groundwater

Climate change effects are projected to increase the demand for water resources. While winter and spring precipitation events are projected to be more frequent, increased temperatures and longer dry spells will reduce the amount of available surface water, increasing the demand for groundwater supplies. EPA's permitting and aquifer exemption proposed actions for this project will take into consideration the projected increased demand on surface and groundwater resources. The UIC Class III Area Permit requires protective measures to minimize the impact of ISR operations on groundwater. These measures include monitoring requirements for the early detection of potential ISR contaminant migration out of the injection zone to prevent contamination of underground sources of drinking water before it occurs. Monitoring requirements are discussed in Section 12.0 of the Class III Area Permit Fact Sheet. The UIC Class III Area Permit also requires characterization of the hydrogeologic conditions to verify that ISR operations can be conducted at each wellfield without contaminating underground sources of drinking water. These requirements are discussed in Class III Area Permit Fact Sheet Section 4.0. Area of Review Requirements and Section 5.0 Requirements for Authorization to Commence Injection.

The UIC Class V Area Permit requires characterization of hydrogeologic conditions at the location of each deep injection well to verify that the confining zones above and below the Minnelusa injection zone will contain the treated ISR waste fluids within the injection zone. The UIC Class V Area Permit also requires evaluation of hydrogeologic conditions to ensure the injection pressures and flow rates at each well will not result in the movement of injection zone fluids out of the injection zone. In the Class V Area Permit Fact Sheet, these requirements are discussed in Section 3.3.3 Additional Hydrologic Evaluation of the Lower Minnelusa Confining Zone, Section 4.4 AOR Evaluation, and Section 5.0 Information to Submit to Receive Authorization to Commence Injection. The Class V Area Permit requires protective Class I well construction standards, as discussed in Section 6.0 of the Class V Area Permit Fact Sheet. Section 7.0 of the Class V Area Permit Fact Sheet discusses protective operating requirements such as the ongoing demonstration of mechanical integrity, injection pressure limit, injectate specific gravity limit and injection flow rate limit.

11.7.3 Potential Mitigation Measures to Protect Surface Water

The following procedures are proposed in the DENR Large Scale Mine Permit to prevent or minimize the potential impacts to surface waters and wetlands:

1. Minimize disturbance of surface areas and vegetation, which, in turn, will minimize erosion and runoff rates.
2. Minimize physical changes to drainage channels unless changes are made to upgrade drainage.
3. Use erosion and runoff control features such as proper placement of pipe, grading to direct runoff away from water bodies, and use of riprap (broken rock and/or concrete) at these intersections to make bridges or culverts more effective, if necessary.
4. Use sediment trapping devices such as hay or straw bales, fabric fences, and devices to control water flow and discharges to trap sediments moved by runoff.
5. Maintain natural contours as much as possible, stabilizing slopes and avoiding unnecessary off-road travel with vehicles; maintaining natural contours as much as possible, stabilizing slopes and avoiding unnecessary off-road travel with vehicles.
6. The land application of treated wastewater will occur at agronomic rates to avoid irrigation runoff into surface water; catchment areas also will prevent land application water from entering surface water.
7. Facilities will be constructed outside the 100-year flood inundation areas to the extent practicable.
8. BMPs will be utilized during ISR operations.

11.8 Conclusions

The EPA has evaluated the potential effects of the proposed ISR project on climate change as indicated by estimating projected GHG emissions; the ongoing and projected effects of climate change at the Dewey-Burdock Project Site; and potential adaptation and mitigation measures that Powertech has proposed. More specifically, the adaptation and mitigation measures contained in the Water Management and Erosion Control Plan under the proposed DENR Large Scale Mine permit, if implemented as required, should be effective in minimizing impacts to surface water from the increase in the severity of precipitation events that is occurring in the area as a result of climate change impacts. The UIC permits include protective measures to minimize or prevent impacts to groundwater, which may become an increasingly important resource as drought impacts surface water availability as a result of climate change.

12.0 TRANSPORATION IMPACTS

The EPA examined impacts of increased transportation resulting from the drilling and operation of injection wells at the Dewey-Burdock Project Site. The EPA reviewed the detailed description that the NRC provided of the transportation activities anticipated during the construction, operation, aquifer restoration and decommissioning phases at the Dewey-Burdock Project Site in Section 2.1.1.1.7 of in the SEIS. Transportation activities include workers commuting to and from the site, and road transportation of construction equipment and materials, operational processing supplies, ion-exchange resins, yellowcake product, and waste materials.

The roads that provide the most immediate access and the most efficient travel time to the Dewey-Burdock Project Site have been evaluated for impacts related to traffic increase due to vehicles accessing the site. These roads include US Highway 18, State Highway 89 and US Highway 385 shown in Figure 26 and the Dewey Road, which is also known as Fall River County Road 6463 and Custer County Road 769, shown in Figure 27. Roads such as US Highway 16, US Highway 85 (in Wyoming), Dewey Road extending east from US 85 to the South Dakota state line, and Whoopup Canyon Road extending south from US 16 to the Dewey Road also provide access to the Dewey-Burdock site, but traveling these roads to the site adds considerably to the travel time. For that reason it is unlikely that these roads will be used for site access. Therefore, impacts due to traffic increase were not analyzed for these roads.

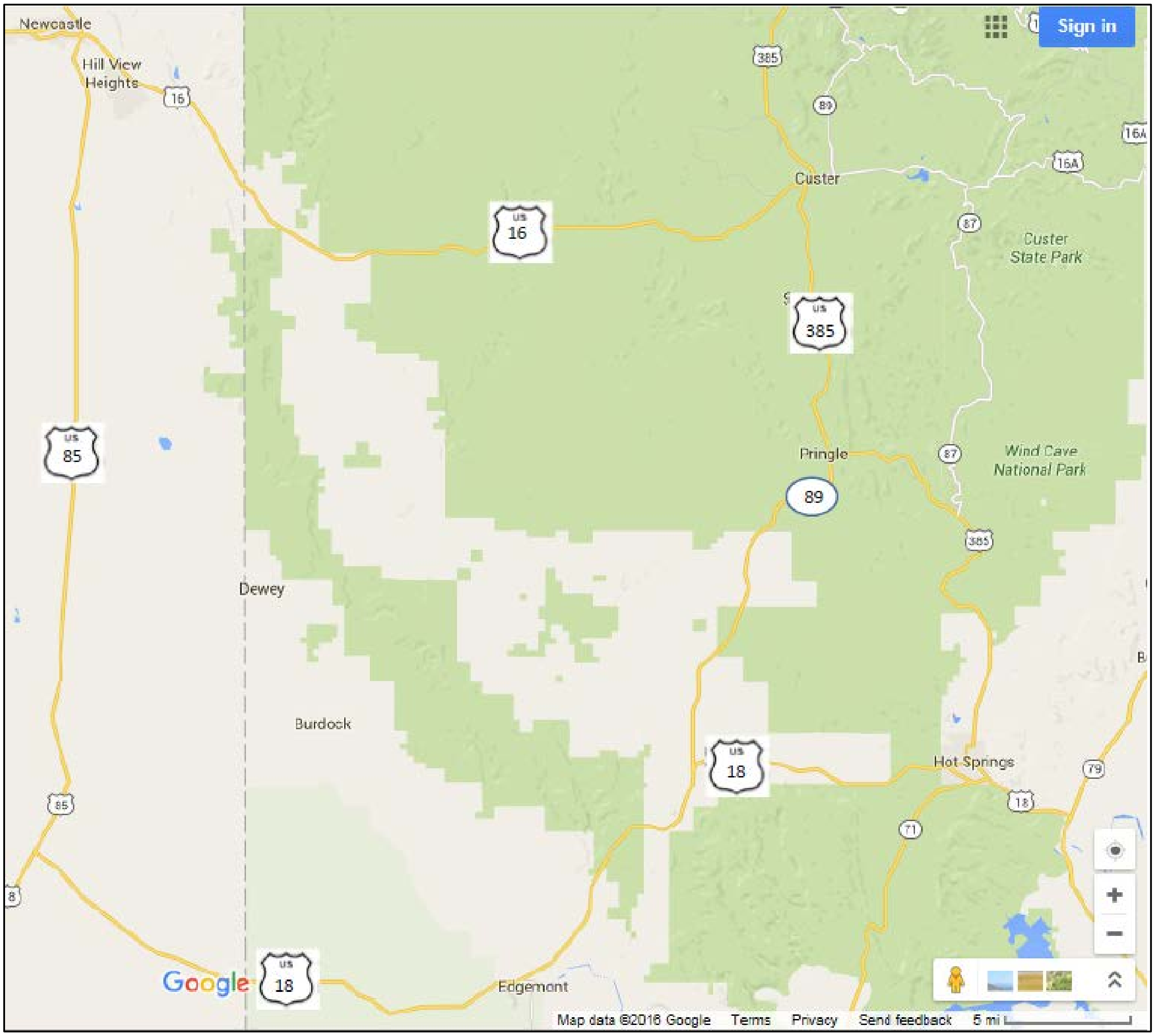

Figure 26. Public Roads Providing Access to the Dewey-Burdock Project Site

Figure 27. Map Showing the Location of the Dewey Road

Figure 28 shows the Fall River and Custer County portion of the South Dakota 2014 Statewide Traffic Flow Map. The highways are color-coded according the level of traffic use. US Highway 18 west of Edgemont and State Highway 89 are gold, indicating the Average Daily Traffic flow ranges between 551 and 1,500 vehicles. The numbers on the map show the actual daily average on the road for 2014. The smaller number below actual daily average shows the total number of trucks included in the count. For example, US Highway 18 west of Edgemont has an average of 1,370 vehicles per day, with 573 being trucks.

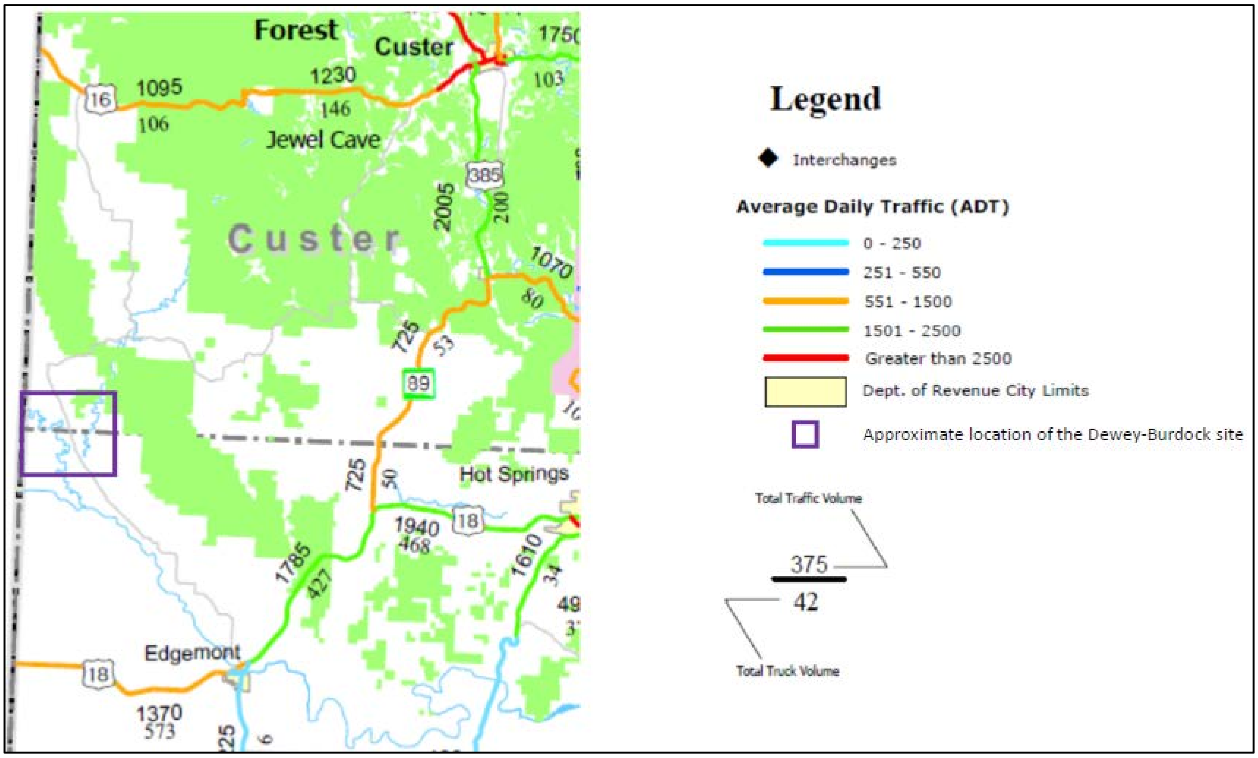

Figure 28. The Fall River and Custer County Portion of the South Dakota 2014 Statewide Traffic Flow Map

Section 4.3 of the NRC SEIS discusses transportation impacts, which are summarized in the following sections. SEIS Table 2.1-7 shows the estimated daily vehicle round trips for each phase of the proposed Dewey-Burdock ISR Project and is included as Table 35 in this document.

Table 35. Estimated Daily Vehicle Round-Trips for the Proposed Dewey-Burdock In-Situ Recovery Project Waste Management Options (from SEIS Table 2.1-7)

Cargo	Land Application Option	Deep Class V Injection Well Option
Construction Equipment/Supplies	9	9
Construction/Employee Commuting	38	38
Remote Ion-Exchange Shipments	1	1
Processing Chemicals	0.92	0.92
Processing Byproduct Material	0.0085*	0.0037*
Yellowcake	0.1†	0.1†
Operations Employee Commuting	27	27
Aquifer Restoration Employee Commuting	5	5
Decommissioning Nonhazardous Solid Waste	1.0‡	0.87‡
Decommissioning Byproduct Material	0.13‡	0.12‡
Decommissioning Recycle/Reuse Equipment	0.07§<	0.07§<
Decommissioning Employee Commuting	7	7

Source: Powertech, 2009b, 2010a, 2013a,b. The applicant's reported vehicle trips from these references were not reported for each waste disposal option, and therefore the NRC staff assumed that the reported vehicle trips applied to both disposal options.
*The NRC staff divided the applicant's annual byproduct material estimate by the reported truck capacity and an assumed 260 shipping days per year.
†The NRC staff divided the applicant's annual yellowcake production rate by the reported truck capacity and an assumed 260 shipping days per year.
‡The NRC staff divided the estimated waste for each option by the proposed 2-year decommissioning period, by the proposed truck capacity, and by an assumed 260 shipping days per year.
§The NRC staff divided the applicant's estimated shipments by the proposed 2-year decommissioning period and an assumed 260 shipping days per year.

12.1 Transportation Impacts during the Construction Phase

Commuting workers constitute the majority of road traffic Powertech described for the construction phase. Powertech estimates 38 worker trips to the site daily for the proposed project. Powertech has estimated the initial facility construction requiring these workers will take approximately 1 year. Powertech's proposed equipment and supply shipments were estimated at nine one-way trips per day for the proposed project. Table 29 compares the magnitude of the NRC staff's estimated local traffic counts from proposed construction activities with existing traffic counts on regional/local roads. Considering Table 29, the proposed traffic, if allocated completely to the individual road segments, will noticeably increase the existing traffic on low-traffic roads, such as unpaved Dewey Road (Fall River County Road 6463 and Custer County Road 769) and State Highway 89 but will not substantially increase traffic on more heavily traveled road segments, such as U.S. Highway 18 traveling from Edgemont or near Hot Springs or State Highway 79 at the junction with U.S. Highway 18. The projected daily traffic on Dewey Road, the road nearest the proposed site, represents a 42% increase over existing traffic considering both autos and trucks. State Highway 89 auto traffic was projected to increase by 13% if all workers commuted on that route and truck traffic was projected to increase 33%. Similarly, based on the traffic count information in Table 36, State Highway 89 is not a commonly used route for trucks; therefore, the projected increase in truck traffic from the proposed action is considered less likely to be concentrated there relative to other routes. While the projected increase in traffic on some road segments is a noticeable change in conditions, the NRC staff further evaluated the projected increases in traffic by considering the ability of the roads to accommodate the increased traffic.

Table 36. Estimated Daily Traffic on Regional Roads for the Construction Phase of the Proposed Dewey-Burdock *In-Situ* Recovery Project (Table 4.3-1 from the NRC SEIS)

Road Segment	Traffic Count*			Projected Traffic†		Percent Increase‡	
	All Vehicles	Auto	Truck	Auto	Truck	Auto	Truck
Dewey Road	225	225	—	301	18	34	—
U.S. Highway 18 (Edgemont to State Highway 89)	1,782	1,361	421	1,437	439	6	4
U.S. Highway 18 (Hot Springs to State Highway 79)	5,075	4,725	350	4,801	368	2	5
State Highway 89 (U.S. Highway 385 to U.S. Highway 18)	659	604	55	680	73	12	33
State Highway 79 (at U.S. Highway 18)	3,172	2,569	603	2,645	621	3	3

Sources: Powertech (2013a,b); SDDOT (2011)

*Traffic counts are annual average daily traffic for both directions of travel (Supplemental Environmental Impact Statement Section 3.3). The U.S. Nuclear Regulatory Commission calculated the auto traffic count as the difference between the all vehicle count and reported truck count; for Dewey road, the auto count was assumed equal to the all vehicle count. Data for all roads are for year 2011 and are from SDDOT (2011), except the Dewey count is from 2012 (Powertech 2013a).

†Projected traffic is the sum of the proposed action daily two-way traffic and the applicable traffic count. Proposed construction phase two-way traffic is double the round-trips reported in Table 2.1-7.

‡This analysis assumes all projected traffic will travel on each road. If proposed action traffic used multiple routes then this analysis overestimates impacts to each road segment.

12.2 Transportation Impacts during the Operation Phase

The proposed transportation activities during the operation phase for the Dewey-Burdock ISR Project include employee commuting and truck shipments of yellowcake, ion-exchange resins, hazardous chemical supplies, and byproduct material. GEIS Section 4.2.2.2 discusses the potential hazards associated with the transportation yellowcake, ion-exchange resins, byproduct material, and hazardous materials. This information is discussed in Section 5.0 of this document.

Powertech has estimated the proposed uranium recovery activity will result in approximately 25 yellowcake shipments per year, averaging of one shipment every 2 weeks. This estimate is based on the proposed 1 million-pound annual yellowcake production rate and an assumed 40,000-pound capacity per yellowcake shipment. Table 37 compares the current traffic conditions roads surrounding the Dewey-Burdock Project Site, the NRC's estimated increase in local traffic counts from proposed operation activities and the resulting percent of increase. Based on the analysis, the yellowcake shipment volume will not significantly affect the project-related traffic relative to the expected commuting workforce.

Table 37. Estimated Daily Traffic on Regional Roads for the Operations Phase of the Proposed Dewey-Burdock *In-Situ* Recovery Project (Table 4.3-2 from the NRC SEIS)

Road Segment	Traffic Count*			Projected Traffic†		Percent Increase‡	
	All Vehicles	Auto	Truck	Auto	Truck	Auto	Truck
Dewey Road	225	225	—	279	4	24	—
U.S. Highway 18 (Edgemont to State Highway 89)	1,782	1,361	421	1,415	425	4	<1
U.S. Highway 18 (Hot Springs to State Highway 79)	5,075	4,725	350	4,779	354	1	1
State Highway 89 (U.S. Highway 385 to U.S. Highway 18)	659	604	55	658	59	9	7
State Highway 79 (at U.S. Highway18)	3,172	2,569	603	2,623	605	2	<1

Sources: Powertech (2013a,b); SDDOT (2011)
*Traffic counts are annual average daily traffic for both directions of travel (Supplemental Environmental Impact Statement Section 3.3). The U.S. Nuclear Regulatory Commission calculated the auto traffic count as the difference between the all vehicle count and reported truck count; for Dewey road, the auto count was assumed equal to the all vehicle count. Data for all roads are for year 2011 and are from SDDOT (2011) except the Dewey count is from 2012 (Powertech, 2013a).
†Projected traffic is the sum of the proposed action daily two-way traffic and the applicable traffic count. Proposed operations phase two-way traffic is double the round- trips reported in Table 2.1-7.
‡This analysis assumes all projected traffic will travel on each road. If proposed action traffic used multiple routes, then this analysis overestimates impacts to each road segment.

The proposed ion-exchange transportation activities for the Dewey-Burdock ISR Project described in SEIS Section 2.1.1.1.7 are similar to the activities evaluated in the GEIS. Powertech plans to transport one loaded resin truck per day from the Satellite facility to the Central Processing Plant. Ion-exchange resin transported onsite between the Dewey site and the Burdock site Central Processing Plant will traverse approximately 5.0 miles of road (primarily on Dewey Road). Powertech must comply with the applicable NRC and USDOT regulations for shipping ion-exchange resins, which are enforced by NRC onsite inspections, should ensure that these materials are safely shipped across the site area. A resulting spill will be properly removed and disposed of, and the affected area will be reclaimed in accordance with applicable NRC and state regulations and as described in the project spill response plan under the Large Scale Permit as discussed in Section 5.0 of this document.

The potential impacts from operational byproduct material shipments were evaluated in GEIS Section 4.2.2.2 as cited by GEIS Section 4.4.2.2. The proposed operational byproduct material transportation activities for the Dewey-Burdock ISR Project are described in SEIS Section 2.1.1.1.7. Powertech proposes to store temporarily operational byproduct material and then ship the material to an offsite disposal facility that is licensed to accept byproduct material. Byproduct material disposal facility options are described in SEIS Section 3.13.2. Powertech's estimated annual generation of 29 cubic yards of byproduct material (including reverse osmosis reject solids, spent ion-exchange resins, and tank and pond sediments) will comprise approximately one shipment per year (SEIS Section 2.1.1.1.7). Transportation safety will be maintained by Powertech's proposed adherence to applicable NRC and USDOT transportation requirements, Powertech's proposed use of licensed third-party carriers, and Powertech's proposed emergency response measures.

Powertech proposes to store, use, and receive shipments of the following chemicals: sodium chloride (NaCl), sodium carbonate ($NaHCO_3$), sodium hydroxide (NaOH), hydrochloric acid (HCl), hydrogen peroxide (H_2O_2), carbon dioxide (CO_2), oxygen (O_2), anhydrous ammonia (NH_3), diesel fuel, gasoline, and bottled gases. Transportation risks associated with incoming, onsite, and outgoing shipments involve potential in-transit accidents. The process chemicals described in Powertech's proposal are commonly used in industrial applications, and they will be transported following applicable USDOT hazardous materials shipping provisions. If an accident occurs, spill response will be handled via emergency response procedure. A spill of hazardous materials will be reportable to the appropriate state agency, EPA, and USDOT. Spill material will be recovered or removed and the affected areas reclaimed. The release of anhydrous ammonia, a compound that Powertech may use in the precipitation circuit, could be hazardous to the public if released near a populated area. However, the proposed project is not situated in a populated area and the likelihood of such an accident on NUREG–0706 accident data. Powertech proposes to maintain transportation safety by following applicable USDOT hazardous materials transportation requirements and the proposed use of licensed third-party carriers.

12.3 Transportation Impacts during the Aquifer Restoration Phase

At the proposed Dewey-Burdock ISR Project, commuting workers constitute the majority of road traffic Powertech proposes for the aquifer restoration phase. Powertech estimated the number of worker trips per day to the site will be five. To evaluate the potential traffic impacts, the NRC staff assumed remote ion-exchange and processing chemical shipments will be similar to the operations phase and bounded by the GEIS values.

Table 30 compares the magnitude of the NRC staff's estimated increase in local traffic counts from proposed aquifer restoration activities. The projected auto traffic for the aquifer restoration phase for all road segments evaluated is lower than the projected traffic from the construction and operation phases, and the projected truck traffic is similar to the operation phase.

Table 38 compares the current traffic conditions roads surrounding the Dewey-Burdock Project Site, the NRC's estimated increase in local traffic counts from proposed aquifer remediation activities and the resulting percent of increase. Based on the information in Table 38, the proposed traffic, if allocated completely to the individual road segments, will increase the existing traffic on low-traffic roads, such as the unpaved Dewey Road (Fall River County Road 6463 and Custer County Road 769), but will not substantially increase traffic on the remaining road segments in the table. The projected daily traffic on Dewey Road, the road nearest the proposed site, is a 4% increase over existing traffic.

Table 38. Estimated Daily Traffic on Regional Roads for the Aquifer Restoration Phase of the Proposed Dewey-Burdock *In-Situ* Recovery Project (from Table 4.3-3 of the NRC SEIS)

Road Segment	Traffic Count*			Projected Traffic†		Percent Increase‡	
	All Vehicles	Auto	Truck	Auto	Truck	Auto	Truck
Dewey Road	225	225	—	235	4	4	—
U.S. Highway 18 (Edgemont to State Highway 89)	1,782	1,361	421	1,371	425	<1	<1
U.S. Highway 18 (Hot Springs to State Highway 79)	5,075	4,725	350	4,735	354	<1	1
State Highway 89 (U.S. Highway 385 to U.S. Highway 18)	659	604	55	622	59	2	7
State Highway 79 (at U.S. Highway 18)	3,172	2,569	603	2,579	607	<1	<1

Sources: Powertech (2013a,b); SDDOT (2011)
*Traffic counts are annual average daily traffic for both directions of travel (Supplemental Environmental Impact Statement Section 3.3). The U.S. Nuclear Regulatory Commission calculated the auto traffic count as the difference between the all vehicle count and reported truck count for Dewey road, the auto count was assumed equal to the all vehicle count. Data for all roads are for year 2011 and are from SDDOT (2011), except the Dewey count is from 2012 (Powertech, 2013a).
†Projected traffic is the sum of the proposed action daily two-way traffic and the applicable traffic count. Proposed aquifer restoration phase two-way traffic is double the round-trips reported in Table 2.1-7.
‡This analysis assumes all projected traffic will travel on each road. If proposed action traffic used multiple routes, then this analysis overestimates impacts to each road segment.

12.4 Transportation Impacts during the Decommissioning Phase

The proposed decommissioning traffic estimates for the Dewey-Burdock ISR Project are described in SEIS Section 2.1.1.1.7. NRC staff derived these estimates from information that Powertech provided. The magnitude of estimated truck transportation for the proposed decommissioning phase is about two times greater than what is estimated in the NRC GEIS Table 2.8-1, due to the larger amount of estimated nonhazardous solid waste (e.g., facility demolition and equipment removal) from the proposed action that will need to be shipped offsite for disposal. Despite this increase, the overall level of transportation is still low at about one truck per day (two trips when both directions are included) based on the information in SEIS Section 2.1.1.1.7.

12.5 Conclusions

Based on the EPA's review of the transportation impacts conducted by the NRC, the traffic increase from workers commuting to the site will be the largest component in traffic impacts. As discussed in Section 10.0, Powertech has committed to encouraging carpooling of workers commuting to the site as a mitigation measure for air impacts. The anticipated increase in traffic around the Dewey-Burdock Project Site will incrementally accelerate degradation of the road surface, increase the generation of dust, and increase the potential for traffic accidents and wildlife or livestock kills. The percent increases in traffic volume shown in Tables 36, 37 and 38 are small increases except for the anticipated increase in traffic on the Dewey Road, which is estimated to bear a 34% increase during the construction phase and a 24% increase during ISR operations. Because the Dewey Road is a county road, presumably it is maintained by Custer and Fall River Counties. The Project Site resides in both of those counties and should generate increased tax revenues for both counties, which should offset the cost of increased road maintenance for the Dewey Road. The increase in dust was discussed addressed in the Section 10 Impacts to Air Quality**.** The potential for increase in traffic accident and wildlife or livestock kills that exists for any increase in traffic load along a road can be mitigated by increased signage, which would serve to increase public awareness of potential driving hazards along the Dewey Road. The increase is traffic will be comprised of the local population, which should be already aware of the hazards of driving along rural roads in the area with open range for livestock and the presence of wildlife.

13.0 IMPACTS FROM POTENTIAL ACCIDENTS

13.1 Transportation Accidents

The NRC has evaluated the impacts and risks related to potential transportation accidents involving shipments of ion-exchange resins, yellowcake slurry, chemicals, fuels, and radioactive wastes during ISR operations at the Dewey-Burdock Project Site. In the license application, Powertech identified several procedures and actions to prevent transportation accidents, including maintaining vehicles in good operating condition, using properly trained and licensed drivers, inspecting vehicles prior to shipment, and following USDOT hazardous materials shipping provisions. The EPA has reviewed the NRC's evaluation and conclusions about risk and long term impacts from potential accidents. Based on the review of the NRC's assessment of risk and long term impacts from potential accidents, the EPA concludes that the impact from potential accidents, both on and off the Dewey-Burdock Project Site, in connection with the drilling and operation of the injection wells authorized under the UIC area permits for the Dewey-Burdock ISR Project are potential environmental and public safety concerns. If Powertech properly implements the preventative procedures discussed in this section, the EPA finds the potential environmental and public safety concerns are within a reasonable range of acceptable risk.

13.1.1 Yellowcake Shipments

Powertech intends that all shipments to and from the Dewey-Burdock Project will be transported by only licensed and certified commercial drivers and subject to both federal and state transportation regulations. Yellowcake will be transported in 55-gallon drums to a conversion facility in Metropolis, Illinois or Port Hope, Ontario, Canada, for refining and conversion. Shipping yellowcake to Canada requires a separate export license under 10 CFR Part 110. Yellowcake shipments will be classified as Low Specific Activity (LSA) material and will be handled in accordance with NRC and USDOT regulations. Powertech has committed to using a specialized third-party transportation company to transport the yellowcake from the project to a conversion facility. Specific routes are to be determined upon agreements made within the transportation companies' contract. This company must meet all safety controls and regulations promulgated by 10 CFR § 71.5.

The worst case accident scenario involving yellowcake shipments would involve the release of yellowcake into the environment due to the breach of one or more drums containing yellowcake during transportation. Powertech will develop an Emergency Preparedness Program that will be implemented should a transportation accident occur. Powertech will provide training that includes technical instruction on field monitoring, sampling, decontamination procedures, communication, and other related skills necessary to safely handle a transportation emergency concerning shipments of yellowcake.

13.1.2 Accidents with Resin-hauling Trucks

Powertech plans to have resin stripping capabilities at the Dewey-Burdock Project Site; therefore, only shipments involving the barren or eluted resin will be transported to this site. Consequences are likely to be lower for trucks transporting barren or eluted resin because the risk of contamination is minimal. Both barren and eluted resin shipments will be handled in accordance with NRC and USDOT regulations. Procedures for resin shipping will be the same general as those for yellowcake shipments.

The Burdock central processing plant will house the resin stripping equipment, but the Dewey satellite plant will not. Consequently, Powertech must transport uranium-loaded resin from the satellite plant to the central processing plant ion-exchange system for processing. The uranium-loaded ion-exchange resin will be shipped in a tank truck. The NRC analyzed this scenario, along with other transportation scenarios, and determined that the consequences of accidents involving such shipments are low. The NRC calculated the probability of high-level contamination resulting from an accident involving a truck transporting uranium-loaded resin from a satellite facility to a central processing plant at 0.009 in any year. This low probability is primarily because the uranium is chemically bonded to the resin and the resin is wet, which prevents air dispersion. The potential environmental impacts from an accident involving the shipment of ion-exchange resin would impact primarily the top soil in the area contaminated by the spill and the subsequent modification to the vegetation structure and the salvage of the top soil. This scenario would only take place if tanker trucks ruptured. Such spills are easily remediated by standard excavation and removal.

Powertech must develop procedures for such spills, as required by a standard NRC license condition. NRC staff must review and approve this procedure during the preoperational inspection of the facility.

Based on its review of potential accident scenarios, the NRC concluded that Powertech's assessment of transportation accidents is accurate. Powertech has adequately assessed the risks and the potential contamination impacts from transportation accidents. The NRC found that Powertech provided reasonable transportation accident scenarios and commitments to develop procedures and train responsible personnel in mitigating transportation accidents. Furthermore, NRC staff's assessments, as documented in NUREG/CR-6733, determined that transportation accidents pose risks of cancer mortalities approximately 70 percent below general cancer mortality rate of 0.002. Therefore, the NRC found that this information is consistent with the acceptance criteria in standard review plan Section 7.5.3 and complies with 10 CFR § 40.32(c).

13.2 Other Types of Potential Accidents

Additional accident scenarios that could potentially occur at the Dewey-Burdock Project are those typical of other ISR facilities. These scenarios have been evaluated in NUREG/CR-6733, *A Baseline Risk-Informed, Performance-Based Approach for In Situ Leach Uranium Extraction Licensees.* The more serious accidents, with the potential for the highest contamination potential, are discussed below.

The more serious potential accident scenarios that could occur at an ISR facility as evaluated in NUREG/CR-6733 include the following:

- Yellowcake thickener failure and spill
- Pregnant lixiviant spills
- Loaded resin spills
- Radon release in enclosed process areas
- Yellowcake dryer hazard analysis

In addition to contamination impacts, the estimated radiological consequence resulting from these accidents are evaluated. Potential radiological exposures ranged from not significant, in the case of the thickener failure and pregnant lixiviant and uranium-loaded resin spill, to a significant radiological exposure from the other two accident scenarios, which could result in doses to workers exceeding those allowed in 10 CFR part 20. Due to the short-term nature of the above scenarios and assuming spills and releases are mitigated promptly, no scenario was expected to result in a significant radiological dose to members of the public.

If an accident occurs, Powertech is required to have administrative controls in place such as standard operating procedures for spill response and cleanup, programs for radiation and occupational monitoring, and training for workers in radiological health and emergency response. Administrative controls coupled with proper use of Personal Protective Equipment such as respirators are the best tools to reduce worker doses. Powertech is required to provide the required PPE along with worker training on proper use and fit of PPE. Powertech will also implement engineering controls to prevent accidental releases of yellowcake, radon and pregnant lixiviant. Three primary engineering controls will include the following.

1. Downflow, pressurized ion exchange columns:
   The ion exchange system operates as a closed loop under low downstream pressure, pulling the solution through the resin columns. This downstream pressure keeps the uranium solution contained, reducing the potential for release of radon gas to the atmosphere. As a result, radon releases in the plant would occur only when individual ion exchange columns are disconnected from the pressurized recirculation system and opened to remove or elute the resins.
2. Building ventilation:
   The heating, ventilating and air conditioning (HVAC) systems in the Satellite Facility and Central Processing Plant will be designed to provide routine heating, cooling and air changes in occupied areas of the plants, to prevent the buildup of fugitive radon emissions
3. Use of a vacuum yellowcake dryer:
   In a vacuum dryer, the heating system is isolated from the yellowcake so that no radioactive materials are entrained in the heating system or its exhaust. The drying chamber that contains the yellowcake slurry is under vacuum. Therefore, any potential leak would cause air to flow into the chamber. Moisture in the yellowcake is the only source of vapor. Emissions from the drying chamber are normally treated in two steps: first, vapor is passed through a bag filter to remove yellowcake particulates with an efficiency in excess of 99 percent. Any captured particulates are returned to the drying chamber. Next, any water vapor exiting the drying chamber is cooled and condensed. This process captures virtually all escaping particles.

Also included in the engineering controls will be alarms to indicate suboptimal operating conditions of the effluent control systems and concrete curbs and sumps to contain any process spills. Administrative controls such as training for emergency scenarios will be in place to provide appropriate worker protection in the event that the effluent control systems fail under an emergency situation. In brief, the engineering controls coupled with appropriate administrative controls will mitigate any potential health and safety impacts of system failures at the facility.

The NRC license and the proposed DENR Large Scale Mine permit also require Powertech to implement the following measures to prevent or mitigate system failures that could potentially result in exceeding exposure limits:

1. A team of responders, trained for radiation health and emergency response, will be available. Specific training will include: response monitoring, PPE use and response to fires, large lixiviant spills or ion exchange system failure.
2. Powertech will train local emergency response personnel in the potential hazards present within the permit area.
3. A yellowcake thickener failure and spill would result in the immediate evacuation of normal operating personnel within the spill area and cleanup of the saturated product prior to drying. Employees

performing the cleanup would utilize the appropriate PPE to minimize exposure to any product that may dry during cleanup. Yellowcake residue that may remain within the thickener area would be washed into a sump, thus mitigating the potential for exposure to employees.

4. Unplanned radon release into an enclosed area would result in manual shutdown of the release point (if automated shutoff system failed) and promotion of ventilation within the area manually (if automated ventilation system failed). Employees performing manual shutdown within the area of the release would utilize the appropriate PPE (such as atmosphere-supplying respirators designed to protect against gases) to minimize exposure to radon and radon decay products. Radon samples would be taken and if above normal working levels, normal operating workers would be evacuated and only return to normal duties within the release area upon re-establishment of normal working levels.
5. A pregnant lixiviant spill would be mitigated in a manner consistent with the location and degree of spill. Trained response personnel would wear the appropriate PPE to protect against radon and radon decay products exposure as discussed above and would clean up the spill according to the procedures in the emergency response plan.
6. A yellowcake dryer upset response would be dictated by the severity of the upset. Mitigation response may include a combination of additional site-specific response actions such as:
    a. Workers, including the spill response team, will have access to respiratory equipment in the yellowcake dryer area.
    b. All practicable measures will be taken to control emissions at the source. The operator will reduce exposure to airborne effluent releases by implementing emission controls (such as wetting) and institutional controls (such as extending the area of upset so as to exclude any personnel not responding to the upset).
    c. Siting of the Central Processing Plant near the center of the proposed license area will serve to protect against off-site exposures in the event of a yellowcake dryer upset.
    d. Individual dose standards will be strictly implemented to assure exposures are limited and reduced to the maximum extent reasonably achievable and to limit contamination to the designated upset area.
    e. All drying and packaging operations will terminate until cleanup is complete, the area has been cleared for potential exposure, and equipment has been restored to proper operating conditions and efficiencies.

Operation cessations due to accidents, subsequent corrective actions and restarts must be reported to NRC within 10 days of the upset or off-normal performance.

The EPA concludes that the NRC has properly evaluated the potential risks and impacts associated with each type of accident described in NUREG/CR-6733. The NRC license and the proposed DENR Large Scale Mine Permit both require Powertech to develop Emergency Preparedness Program which includes employee training in response actions should any of these potential accidents occur. Therefore, the EPA concludes that the potential impacts of any of these accidents should be quickly contained, remediated and result in temporary impacts.

14.0 IMPACTS TO ECOLOGICAL RESOURCES

The EPA is in the process of evaluating impacts to ecological resources including federally-listed and state-listed species and species of tribal concern. The EPA evaluation process includes compliance with section 7 of the Endangered Species Act, 16 U.S.C. 1531 et seq. The EPA has also reviewed the wildlife and vegetation surveys commissioned by Powertech, Section 4.7 of the NRC SEIS, which assesses impacts to ecological resources, and Section 5.6.11 of the Large Scale Mine Permit. Section 5.6.11.2 of the proposed DENR Large Scale Mine Permit lists proposed measures to avoid or mitigate potential impacts to ecological resources at the site. If Powertech implements these mitigation measures, the EPA will be able to conclude that Powertech is effectively mitigating potential ecological impacts during ISR operations. Because Powertech will return the Dewey-Burdock Project Area to its original land use, as discussed in Section 6.0, there should be no long term ecological impacts.

14.1 Federally-listed Threatened and Endangered Species Evaluated under the Endangered Species Act
Section 7(a)(2) of the Endangered Species Act (ESA), 16 U.S.C. § 1536 (a)(2), requires federal agencies to ensure that actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of federally-listed endangered or threatened species or result in the destruction or adverse modification of designated critical habitat of such species. Accordingly, the EPA will comply with these regulations by determining what, if any, effects our actions will have on any federally-listed endangered or threatened species or their designated critical habitat and by following any required ESA procedures.

The federally-listed threatened and endangered species under review include the endangered whooping crane, the threatened northern long-eared bat, the endangered black-footed ferret and the threatened rufa red-knot. Accordingly, the EPA will comply with these regulations by determining what, if any, effects this action will have on any federally-listed threatened and endangered species or their designated critical habitat and by following any required ESA procedures. The EPA's determination will be documented as part of the administrative record supporting the final UIC area permit decisions.

14.2 Species of State and Tribal Interest: The Short-Horned Lizard
During EPA's tribal consultation process, a tribal member mentioned sighting a short-horned lizard while visiting the Dewey-Burdock Project Site. The short-horned lizard, genus *Phrynosoma*, which means "toad body," is also called "horny toad" because of the wide flat body.

The short-horned lizard is listed as rare in South Dakota and, as such, is protected from collection, capture, and disturbance. Population numbers are monitored and habitats protected through the South Dakota Natural Heritage Program. Threats to the short-horned lizard include the loss of habitat to development and agriculture, the loss of prey species from agricultural practices, and human exploitation.

The short-horned lizard *Phrynosoma hernandesi* is listed under Rare Animals Tracked by the South Dakota Natural Heritage Program at http://gfp.sd.gov/wildlife/threatened-endangered/rare-animal.aspx. The short-horned lizard is found in the western South Dakota in Butte, Fall River, Harding, Meade, Perkins, and Shannon Counties.

The report entitled *Short-Horned Lizard (Phrynosoma hernandesi) Survey in South Dakota* documents a study by the Department of Biology at Black Hills State University. The report states that the short-horned lizard is considered secure range-wide, but imperiled within South Dakota due to its rarity. The report states that the major concern regarding threats to this species in South Dakota is the conversion of native prairie into cropland or densely-planted pasture. Other conservation concerns include widespread insecticide use killing lizard food sources, heavy use of sand or dirt roads through short-horned lizard habitat, and the potential for commercial collection. The lizards are thought to range broadly in Fall River County across much of the remaining natural prairie within and south of the Cheyenne River basin. The lizards like sand or dirt roads and are found dead on these roads. There is a concern that increased vehicle traffic is detrimental to short-horned lizard populations.

The short-horned lizard is important in some tribal cultures. Known as *Che* or the grandfather to some cultures, the horned lizard represents permanence, good health, and strength. Named "Ptehe Agleska" in Lakota, the horny toad represents secrecy, mystery and the keeper of valuable secrets. The short-horned lizard is often depicted in Native American artwork.

The area that will be impacted by ISR operations within the Dewey-Burdock Project Area is shown in Figure 22. As discussed in Section 6.0 of this document, this land is used as rangeland for cattle grazing and agricultural cropland, so is no longer native prairie. Because the habitat of the short-horned lizard is native prairie, the EPA does not expect the short-horned lizard or its habitat will be impacted by ISR activities. Once construction activities begin at the site, the EPA expects that the any short-horned lizards that were in the area will seek less disturbed locations.

14.3 Tribal Concerns about Impacts to Vegetation

During EPA's tribal consultation activities, several tribes expressed concerns about impacts to ceremonial and medicinal plants. The concerns were related to proper identification of ceremonial and medicinal plants, documentation of locations in areas where the plants may be disturbed and the reclamation of the plants upon decommissioning of the project site.

The NRC GEIS noted that tribal populations in the Great Plains still engage in hunting and wild plant gathering. Herbs gathered for subsistence, medicinal and ritual/ceremonial uses remain important to maintaining traditional cultural practices. Traditional use areas claimed by the tribes are places in which traditional subsistence practices and the procurement of animals and plants for ritual, ceremonial, medicinal and other traditional needs should be considered in assessing impacts from ISR operations.

Climate Change Impacts in the United States, *Chapter 19, Great Plains* notes that tribal members have reported the decline or disappearance of culturally important animal species, changes in the timing of cultural ceremonies due to earlier onset of spring, and the inability to locate certain types of ceremonial wild plants due to climate change impacts. For this reason, it is important to take into account impacts to ceremonial and medicinal plants**.** As discussed in Chapter 19, climate change impacts in the northern Great Plains include projected increases in winter and spring precipitation, which should be favorable to vegetation.

14.4 Proposed Mitigation Measures

The proposed DENR Large Scale Mine Permit requires Powertech to implement the following list of mitigation measures to prevent or minimize potential impacts:

1. Design fencing to permit big game passage to the extent practicable.
2. Use existing roads when possible and limit construction of new access roads to provide for access to more than one well site or well field, if possible.
3. Enforce speed limits to minimize collisions with wildlife, especially during the breeding season.
4. Adhere to timing and spatial restrictions within specified distances of active raptor nests during the breeding season as determined by appropriate regulatory agencies.
5. Develop a bald eagle mitigation/management plan for review and approval by the USFWS. The plan also will be provided to the SDGF&P for review and input, although the USFWS will have the final

approval authority. The approved plan and any associated permits will be incorporated into the LSM permit. The bald eagle mitigation/management plan is anticipated to address the following:

a. Ensure that annual bald eagle monitoring and survey data for nest and winter roost sites are available within the permit area and buffer area for the life of mine to:
    i. determine normal habitat use and movements,
    ii. determine the location and status of nests and winter roost sites, and
    iii. document the occurrence and outcome of nesting bald eagle pair(s).
b. Establish buffer zones protecting important bald eagle habitat where necessary and stipulating seasonal restrictions on ISR-related disturbances within buffer areas in order to avoid jeopardizing bald eagles during any project phase. Such buffer zones and their associated seasonal restrictions would be established:
    i. in keeping with current USFWS recommendations,
    ii. around nest sites, and
    iii. around documented winter roost sites).
c. If necessary, obtain a USFWS-issued permit and any necessary State permits for eagle take and/or nest relocation or removal, the application for which would address the following:
    i. demonstration that the proposed activity meets the requirements of 50 CFR § 22.26 or § 22.27, which contain the federal requirements for take and removal/relocation of eagle nests, respectively;
    ii. methods to relocate the nest(s) or construct an alternate nest and/or improve conditions at alternate nest sites, if mitigation measures are required around documented winter roost sites);
    iii. a demonstration that suitable nesting and foraging (including winter) habitat is available to the area nesting population of bald eagles that could accommodate any bald eagles displaced by the take or nest removal/relocation; and
    iv. implementation of monitoring and reporting procedures to determine the response of bald eagles to the take or nest relocation(s).

6. If direct impacts to raptors or other migratory bird species of concern occur, a Monitoring and Mitigation Plan for those species will be prepared and approved by the USFWS, including one or more of the following provisions:
    a. Relocation of active and inactive raptor nests that could be impacted by construction or operation activities in accordance with the approved raptor monitoring and mitigation plan.
    b. Creation of raptor nests and nesting habitat through enhancement efforts such as nest platforms to mitigate other nest sites impacted by ISR operations.
    c. Obtaining appropriate permits for all removal and mitigation activities.
    d. Establishing buffer zones protecting raptor nests where necessary and restricting ISR-related disturbances from encroaching within buffers around active raptor nests from egg-laying until fledging to prevent nest abandonment, or injury to eggs or young.
    e. Reestablishing the ground cover necessary to attract and sustain a suitable raptor prey base after drilling, construction, and future ISR operations and site reclamation/decommissioning
    f. Required use of raptor-safe construction for overhead power lines according to current guidelines and recommendations by the USFWS
7. Restore pre-mining native habitats for species that nest and forage in those vegetative communities.
8. Restore diverse landforms, replace topsoil, and construct brush piles, snags, and/or rock piles to enhance habitat for wildlife.

9. Conduct weed control as needed to limit the spread of undesirable and invasive, non-native species on disturbed areas.

Adjusting the timing of various construction, operational, and reclamation activities to avoid the breeding season can also be an effective way to minimize impacts related to such activities in the permit area. As a practical matter, worker crews conducting construction or reclamation activities typically work during daylight hours, so potential impacts to year-round residents, particularly more nocturnal species such as bats, rodents and others, should not be increased significantly. Following completion of construction in a given area, access roads would be blocked with berms or fencing to prevent use by casual traffic. Site reclamation/ decommissioning, including surface reclamation, will be completed in the same manner, with activities timed to minimize disturbance to nesting or migrating species. Relevant agency standards for reclamation will be followed and this phased, systematic approach will allow more mobile wildlife species to relocate into adjoining, undisturbed habitat and then return following completion of construction or reclamation in a particular area. Thus, the sequential, phased nature of this approach will decrease potential direct and indirect impacts on all wildlife species and their habitat.

The EPA recognizes that these mitigation measures are part of the proposed Large Scale Mine Permit and may be subject to change before the final Large Scale Mine Permit is approved. If the DENR requires these mitigation measures as part of the final Large Scale Mine Permit and Powertech implements the mitigation measures listed above, the EPA will be able to conclude that Powertech is effectively mitigating potential ecological impacts during ISR operations. Because Powertech will return the Dewey-Burdock Project Area to its original land use, as discussed in Section 6.0, there should be no long term ecological impacts.

During tribal consultation, one tribe expressed concerns to the EPA about the potential for small wildlife to pass through the chain link fence, come into contact with the liquid byproduct waste fluids in the ponds and then subsequently enter the food chain, thus potentially impacting wildlife outside the project area. The tribe requested that layer of finer wire mesh be placed at ground level around the pond fences in addition to the fencing and netting already proposed for the ponds.

15.0 IMPACTS FROM WASTE MANAGEMENT

The EPA reviewed the NRC's evaluation of impacts from waste management generated by the proposed ISR operations at the Dewey-Burdock Site in Section 4.14 of the SEIS. As described in NRC's GEIS Section 4.4.12, environmental impacts on waste management could occur during all phases of the ISR lifecycle. The proposed project will generate radiological and nonradiological liquid and solid materials that must be handled and disposed of properly. The primary radiological materials that must be disposed are process-related liquids and process-contaminated structures, equipment, and soils, all of which are classified as 11e.(2) byproduct material as defined under the Atomic Energy Act, as revised in 1978 and in 2005 by the Energy Policy Act The definition of byproduct material in section 11e.(2) of the Act is the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content.

15.1 Waste Disposal Methods

Before operations commence at the Dewey-Burdock Site, the NRC license requires Powertecch to have an agreement in place with a licensed disposal facility to accept byproduct material from the site. The NRC requires by license condition that the disposal agreement be in place before the initiation of operations. Lack of a signed disposal agreement will be grounds for a cessation of operations until a signed agreement is obtained.

The primary radiological materials the proposed Dewey-Burdock ISR Project will dispose of are process-related liquid effluent and process-contaminated structures, equipment, and soils, all of which are classified as 11e.(2) byproduct material under the Atomic Energy Act. As described in SEIS Section 2.1.1.1.6.3, Powertech has identified White Mesa for disposal of solid byproduct material. Powertech's preferred method for disposal of liquid byproduct material is by deep injection wells. If the EPA does not issue a final permit for the deep injection wells, Powertech will use land application of treated liquid effluent as the liquid waste disposal method under the Groundwater Discharge Permit proposed by the DENR. If the deep injection wells do not have the capacity to dispose of the total volume of waste fluids produced by the project, Powertech will pursue a combination of both deep injection wells and land application.

15.2 Waste Disposal during Construction

The primary wastes to be disposed of during this the construction phase of the ISR facility lifecycle will be nonhazardous solid waste, such as building materials and piping. As discussed in SEIS Sections 2.1.1.1.6.3 and 3.13.2, Powertech has proposed to the NRC to dispose of nonhazardous solid wastes at the Custer-Fall River Waste Management District landfill located at Edgemont, South Dakota, located approximately 15 miles southeast of the proposed Dewey-Burdock ISR Project site or at the Newcastle, Wyoming, landfill, located approximately 40 miles north of the proposed project site if additional capacity is needed. As described in SEIS Section 3.13.2, these landfills were not at or near capacity when the NRC was performing analyses for the SEIS in 2012 through 2013. Powertech will have to have an agreement set up with a landfill prior to commencing operations as a matter of sound business practice.

SEIS Section 2.1.1.1.6 discusses Powertech's proposed waste management methods. Construction activities at the facility are expected to generate a volume of 188 cubic yards of nonhazardous solid waste annually according to SEIS Section 2.1.1.1.6.3. This volume is expected to be the same for both the deep injection well disposal option and the land application disposal option. This volume is 1% or less of the annual volume of waste received at either the Custer-Fall River Waste Management District landfill or the Newcastle landfill according to SEIS Section 3.13.2. Nonhazardous solid waste generated at the proposed annual rate for the duration of the construction phase will account for 1% or less of the capacity of either landfill. As shown in Figure 29, Powertech expects that construction activities at the Dewey Burdock Project Site will continue for eight years.

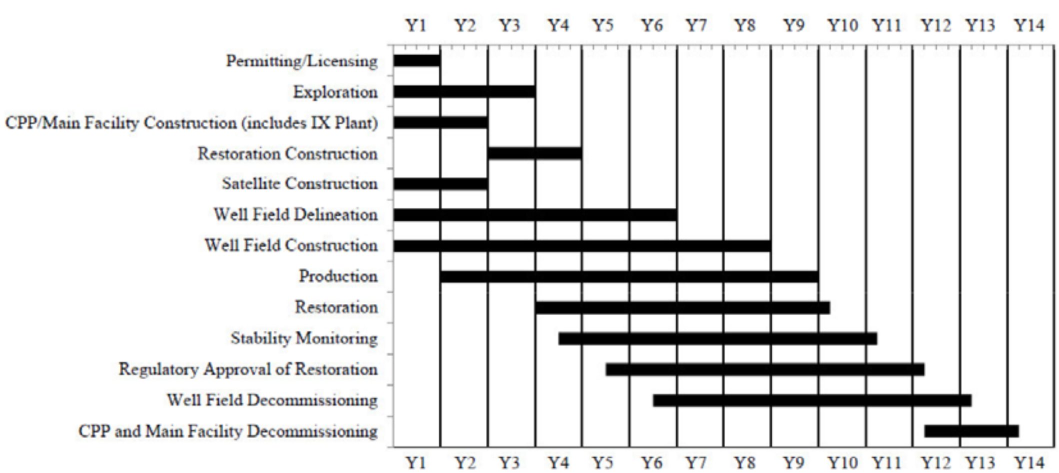

Figure 29. Projected Construction, Operation and Decommissioning Schedule at the Dewey-Burdock Project Site.

15.3 Waste Disposal during Operations

15.3.1 Liquid Byproduct Material during Operations, Deep Injection Well Disposal Option

SEIS Section 2.1.1.1.6.2 provides information about the liquid byproduct material generated during ISR operations, which will be composed of production bleed, waste brine streams from elution and precipitation, resin transfer wash, laundry water, plant washdown water, and laboratory chemicals. Powertech estimates the maximum production of liquid byproduct material at any time considering concurrent uranium recovery operations and aquifer restoration activities is **197 gpm** for the deep injection well disposal option. Powertech proposes to treat this combined liquid byproduct material stream onsite to remove radium and uranium by radium settling and ion exchange, respectively as described in SEIS Section 2.1.1.1.6.2. These two treatment methods are expected to reduce radionuclide activities below the established NRC limits under 10 CFR Part 20, Appendix B, Table 2, Column 2 prior to injecting the material into the deep injection wells. 10 CFR Part 20, Appendix B, Table 2, Column 2 includes effluent concentration limits for natural uranium, Ra-226, Pb-210 and Th-230. As stated in SEIS Section 2.1.1.1.6.2, Powertech will have to meet applicable EPA and NRC regulations, including radioactive waste and hazardous waste standards before injection into a deep injection well begins.

The EPA classifies the deep wells injecting into the Minnelusa Formation aquifer as Class V because these wells are injecting into a formation that lies above a USDW. Powertech proposed the construction of two Minnelusa injection wells, DW No. 1 in the Burdock Area and DW No. 3 in the Dewey Area. The EPA calculated injection pressure in the MInnelusa injection zone resulting from the injection of treated ISR waste fluids into each well using the aquifer properties that Powertech provided in the Class V Permit Application. The EPA compared the calculated injection zone pressure values to the pressure that would cause injection zone fluids to move out of the injection zone along the Dewey Fault, in the case of DW No. 3, and along any potential fluid migration pathways at the nearest plugged and abandoned oil and gas well in the Burdock site, in the case of DW No. 1. Based on these calculations, the EPA determined that the maximum injection rates that Powertech will be able to use at each injection well are 110 gpm DW No. 1 is and 97 gpm DW No. 3. These pressure calculations are discussed in more detail in Section 4.4 of the UIC Class V Draft Area Permit Fact Sheet.

As discussed in Section 7.7.1 of the UIC Class V Draft Area Permit Fact Sheet, Powertech anticipates needing a waste fluid disposal capacity of 232 gpm. Powertech proposed an injection rate of 75 gpm for each of the four wells proposed in the Class V Permit Application. As discussed in Section 4.4.2.2 of the Class V Area Permit Fact Sheet, the EPA calculated a maximum injection rate for of 110 gpm DW No. 1 and 97 gpm for DW No. 3, based on available hydrologic information. Based on these injection rate calculations, the two deep injection wells will have a total disposal capacity of 217 gpm, indicating that Powertech may need to install a third injection well in the Minnelusa Formation injection zone to dispose of the expected volume of fluid waste. If Powertech installed a third well in the Minnelusa injection zone, the average maximum injection rate that would be needed for three wells to dispose of 232 gpm of ISR waste fluids is 77.33 gpm. Based on available hydrogeologic data, this anticipated injection rate would be low enough to prevent a pressure rise in the injection zone that would cause injection zone fluids to move out of the injection zone along the Dewey Fault or the nearest plugged and abandoned oil and gas well. The Class V Area Permit requires Powertech to perform these calculations using data based on the actual hydrogeologic conditions present at the site obtained from the logging and testing of each injection well.

15.3.2 Liquid Byproduct Material during Operations, Land Application Disposal Option

Powertech estimates the maximum production of liquid byproduct material at any time, considering concurrent uranium recovery operations and aquifer restoration activities, is **547 gpm** for the land application option. Powertech proposes to treat this combined liquid byproduct material stream onsite using ion exchange and radium settling prior to land application. Powertech proposes to treat the liquid waste (SEIS Section 2.1.1.1.6.2) to reduce radionuclide activities below the established NRC limits under 10 CFR Part 20, Appendix B, Table 2, Column 2 for discharge of radionuclides to the environment. 10 CFR Part 20, Appendix B, Table 2, Column 2 includes effluent concentration limits for natural uranium, Ra-226, Pb-210 and Th-230. As stated in SEIS Section 2.1.1.1.6.2, the land application must be carried out under a Groundwater Discharge Permit approved by SDDENR).

In accordance with permit program objectives, Powertech's proposed land application operations will have to meet applicable state groundwater quality standards. Additionally, NRC will require:

1. liquid byproduct material be treated prior to injection and
2. treatment systems be approved, constructed, operated, and monitored to ensure release standards in 10 CFR Part 20, Subparts D and K and Appendix B are met.

While land application capacity varies throughout the year, Powertech estimates that each land application area will be able to dispose of 310 gpm. Powertech proposes two land application areas, which will provide 620 gpm of capacity. Powertech's proposed disposal capacity is sufficient to accommodate the proposed maximum generation rate of liquid byproduct material.

15.3.3 Solid Byproduct Material during Operations, Deep Injection Well Disposal Option

Solid byproduct material generated during operations could include maintenance and housekeeping rags and trash; packing materials; replaced components; filters; protective clothing; and solids removed from process pumps, vessels, and ponds. As discussed in SEIS Section 2.1.1.1.6.3, Powertech estimates, during ISR operations and combined operations and aquifer restoration, using barium to settle out radium during treatment of the deep well injectate is expected to will produce 29 cubic yards of solid byproduct material from radium settling ponds annually. Powertech will store solid byproduct material onsite within a restricted area until sufficient volume is generated for disposal.

15.3.4 Solid Byproduct Material during Operations, Land Application Disposal Option

Solid byproduct material generated during operations could include maintenance and housekeeping rags and trash; packing materials; replaced components; filters; protective clothing; and solids removed from process pumps, vessels, and ponds. As discussed in SEIS Section 2.1.1.1.6.3, Powertech estimates, during the operational period and assuming combined operations and aquifer restoration, the proposed Dewey-Burdock facility will produce **66** cubic yards of solid byproduct material from the land application option. Powertech will store solid byproduct material onsite within a restricted area until sufficient volume is generated for disposal.

15.3.5 Nonhazardous Solid Wastes during Operations

Nonhazardous solid wastes generated during operations would be the same for both the deep injection well disposal option and the land application disposal option. Nonhazardous solid wastes generated during operations would include facility trash, septic solids, and other uncontaminated solid wastes (e.g., piping, valves, instrumentation, and equipment). As stated in SEIS Section 2.1.1.1.6.3, the proposed generation rate of nonhazardous solid waste will be a small percentage of the landfill capacity discussed in SEIS Section 3.13.2.

15.3.6 Hazardous Solid Wastes during Operations

Powertech expects solid hazardous wastes from the Dewey-Burdock Project site to be comprised of used batteries and light bulbs. Powertech expects the liquid hazardous waste that will be generated to be waste oil, cleaning solvents. Powertech estimates the proposed Dewey-Burdock ISR Project will generate less than 220 lb per month of all forms of hazardous waste, a quantity that will allow the Dewey-Burdock Project to be classified as a Conditionally Exempt Small Quantity Generator under RCRA and South Dakota regulations. The amount of hazardous wastes generated during operations would be the same for both the deep injection well disposal option and the land application disposal option. Powertech will transport the hazardous waste generated by ISR operation to a permitted hazardous waste facility for disposal.

15.4 Waste Disposal during Aquifer Restoration

15.4.1 Liquid Byproduct Material during Aquifer Restoration, Deep Injection Well Disposal Option

For the proposed Dewey-Burdock Project, Powertech will use the same waste management systems for aquifer restoration as used during ISR operations. Liquid byproduct material generated during aquifer restoration is composed of reverse osmosis brine as discussed in SEIS Section 2.1.1.1.6.2. Powertech proposes to manage aquifer restoration wastewater (i.e., liquid byproduct material) by treating the wastewater by reverse osmosis and reinjecting the treated water (i.e., permeate) back into the aquifer production zone undergoing restoration as described in SEIS Section 2.1.1.1.4.1. Powertech will combine the contaminants removed from water with operational wastewater and transfer the combined wastewater to the radium settling ponds for further treatment prior to disposal in the deep injection wells. As stated previously, Powertech will have to meet applicable EPA and NRC requirements before injection into a deep disposal well will be authorized. Both the NRC and the EPA will require liquid byproduct material to be treated prior to injection and treatment systems be approved, constructed, operated, and monitored to ensure release standards in 10 CFR Part 20, Subparts D and K and Appendix B are met.

15.4.2 Liquid Byproduct Material during Aquifer Restoration, Land Application Disposal Option

For the proposed Dewey-Burdock ISR Project, Powertech will use the same waste management systems for aquifer restoration as used during ISR operations discussed in SEIS Section 2.1.1.1.6. Liquid byproduct material generated during aquifer restoration is composed of produced water from the ore zone aquifer. Powertech estimates the maximum production of liquid byproduct material at any time, considering concurrent uranium recovery operations and aquifer restoration activities, **547 gpm** for the land application option. Powertech proposes to manage aquifer restoration wastewater (i.e., liquid byproduct material) by treating the wastewater onsite by ion exchange and radium settling prior to land application as discussed in SEIS Section 2.1.1.1.6.2. As stated in Section 2.1.1.1.6.2, Powertech will conduct land application under a Groundwater Discharge Permit that is currently proposed by the DENR. In accordance with the proposed Groundwater Discharge Permit requirements, Powertech's land application operations will have to meet applicable state groundwater quality standards. The NRC, the DENR and the EPA will require liquid byproduct material be treated prior to injection and treatment systems be approved, constructed, operated, and monitored to ensure release standards in 10 CFR Part 20, Subparts D and K and Appendix B are met. While land application capacity will vary seasonally throughout the year, Powertech estimates that each land application area will be able to dispose of 310 gpm. Powertech proposes two land application areas, which will provide **620 gpm** of capacity. Powertech's proposed disposal capacity should be sufficient to accommodate the proposed maximum generation rate of liquid byproduct material.

15.4.3 Solid Byproduct Material during Aquifer Restoration, Deep Injection Well Disposal Option

Solid byproduct material generated during aquifer restoration would include maintenance and housekeeping rags and trash; packing materials; replaced components; filters; protective clothing; and solids removed from process pumps, vessels, and ponds. As stated previously, Powertech estimates, during the operational period and assuming combined operations and aquifer restoration, the proposed Dewey-Burdock facility will produce **29 cubic yards** of solid byproduct material annually from the radium settling ponds treating the deep injection well injectate. Solid byproduct material will be stored onsite within a restricted area until sufficient volume is generated for disposal

15.4.4 Solid Byproduct Material during Aquifer Restoration, Land Application Disposal Option

Solid byproduct material generated during aquifer restoration could include maintenance and housekeeping rags and trash; packing materials; replaced components; filters; protective clothing; and solids removed from process pumps, vessels, and ponds. As discussed in SEIS Section 2.1.1.1.6.3, Powertech estimates, during the operational period and assuming combined operations and aquifer restoration, the proposed Dewey-Burdock facility will produce **66 cubic yards** of solid byproduct material from the land application option. Solid byproduct material will be stored onsite within a restricted area until sufficient volume is generated for disposal.

15.4.5 Nonhazardous Solid Wastes during Aquifer Restoration

Nonhazardous solid wastes generated during aquifer restoration would be the same for both the deep injection well disposal option and the land application disposal option. Nonhazardous solid wastes generated during aquifer restoration would include facility trash, septic solids, and other uncontaminated solid wastes (e.g., piping, valves, instrumentation, and equipment). The proposed generation rate of nonhazardous solid waste during aquifer restoration will be a small percentage of the landfill capacity discussed in SEIS Section 3.13.2.

15.4.6 Hazardous Solid Wastes during Aquifer Restoration

The amount of hazardous wastes generated during aquifer restoration is expected to be the same as for operations and would be the same for both the deep injection well disposal option and the land application disposal option.

15.5 Waste Disposal during Decommissioning

Powertech proposed to conduct radiological surveys of decommissioned facilities and equipment and classify materials in accordance with the applicable disposition of the materials, including decontamination, recycling and reuse, disposal as byproduct material at a licensed facility, or disposal as nonhazardous solid waste at a municipal solid waste landfill. At the point of decommissioning, a wellfield has been restored and the post-restoration monitoring for that wellfield has been completed. As shown in Figure 29, Powertech expects to begin decommissioning the first wellfields in approximately 6.5 years after project startup. Powertech expects to spend 6 years decommissioning wellfields. Once the last wellfield has completed post-restoration monitoring, there should be no generation of liquid by-product waste. The last two years of decommissioning will include plant facilities.

15.5.1 Byproduct Waste from Decommissioning

As shown in Figure 29, Powertech expects six years of decommissioning ISR wellfields as each wellfield is restored, then decommissioned in sequence. Powertech expects to install approximately 4,000 injection and production wells. A number of monitoring wells will also be installed in the perimeter monitoring well ring and in aquifers above and below the injection zones. The plugging and abandonment plan in the Class III Draft Area Permit require Powertech remove the tubing and packer from each injection well and the tubing, packer and pump from each production well. The pumps may be able to be decontaminated and decommissioned, but if not, the pumps must be disposed of as byproduct waste. The Class III Draft Area Permit gives Powertech the option of removing the well casing from the ground or cutting the casing off below the ground surface and plugging the well with the casing in place. Remove the casing from the ground will add to the volume of waste that Powertech must manage.

As discussed in SEIS Section 2.1.1.1.6.3, Powertech estimates the volume of byproduct material that will be generated from decommissioning the plant facilities and all wellfields (over a planned 6-year period for wellfields and a 2-year period for plant facilities) is **1,856** cubic yards for the deep Class V injection well disposal option. Powertech estimates the volume of byproduct material that will be generated from decommissioning the plant facilities and all wellfields over the same time period is **2,067** cubic yards for the land application option. As stated previously, Powertech intends to pursue an agreement with the White Mesa site in Blanding, Utah, for disposal of solid byproduct material. The NRC license requires this agreement to be in place before ISR operations can begin.

15.5.2 Nonhazardous Solid Waste from Decommissioning

For the deep injection well disposal option, Powertech's estimate of the total volume of nonhazardous solid waste that will be generated from decommissioning is **13,638** cubic yards. From this estimate, the NRC staff derived an annual nonhazardous solid waste generation of 6,819 yd^3 from decommissioning by dividing Powertech's total estimate by two (the number of years Powertech expects it will take to decommission plant facilities and the final wellfields) to arrive at an annual rate of solid waste generation.

For the land application option, Powertech's estimate of the total volume of nonhazardous solid waste that will be generated from decommissioning is **16,344** cubic yards. From this estimate, the NRC staff derived an annual nonhazardous solid waste generation of 8,172 yd^3 from decommissioning by dividing Powertech's total estimate by two, as described above, to arrive at an annual rate of solid waste generation.

The NRC evaluated the estimated landfill capacities and local community demands for solid waste disposal for the projected time of project decommissioning. The NRC evaluated the permitted landfill disposal capacities of the landfills located closest to the project site: the Custer-Fall River Waste Management District landfill and the Newcastle landfill**,** as discussed in SEIS Section 3.13.2. Because the project has not yet begun, a new timeframe must now be considered for these landfills. The City of Newcastle is proposing a landfill expansion that is projected to add 5 years to the life of the landfill. However, this estimate is based only on the projected regional disposal demand. This projection does not indicate that the Newcastle landfill will still be available when the Dewey-Burdock site is decommissioned, unless additional expansion occurs. The EPA investigated the current status of both landfills and found that both landfills have plans to expand. The NRC will update this evaluation as part of the pre-operational analysis for the Dewey-Burdock Project Site, and certify that binding contractual arrangements and commitments for providing capacity for the proposed Dewey-Burdock ISR Project have been made with one or both of these landfill options prior to beginning construction.

15.5.3 Hazardous Waste from Decommissioning

Powertech estimates the volume of hazardous waste generated from decommissioning activities for both the deep injection well and the land application disposal options will be less than 200 lb. The hazardous waste streams from decommissioning will be similar to the waste streams generated during the ISR construction phase and could include used oil, batteries, and cleaning solvents. The NRC licensed requires that Powertech must have in place a hazardous material program that complies with applicable EPA and SDDENR requirements for its handling, storage, and disposal at approved facilities prior to construction and operation.

15.5.4 Disposal Via Combination of Class V Injection and Land Application

If a permit for Class V injection wells is obtained from EPA but the capacity of the wells is insufficient to dispose of all liquid wastes generated at the proposed Dewey-Burdock ISR Project, Powertech has proposed to dispose of liquid waste by a combination of deep well disposal using Class V injection wells and land application as described in SEIS Section 2.1.1.1.2.4.3.

For the combined deep Class V injection well and land application disposal option, land application facilities and infrastructure will be constructed, operated, restored, and decommissioned on an as-needed basis depending on the deep injection well disposal capacity. The land application option will require the construction and operation of irrigation areas and increased pond capacity for storage of liquid wastes during nonirrigation periods as discussed in SEIS Section 2.1.1.1.2.4.2, whereas the deep injection well disposal option will require the construction and operation of probably three deep disposal wells completed in the Minnelusa Formation, as discussed in Section 14.3.1 of this document.

The relative volumes of byproduct material generated by the two disposal options differ during operations, aquifer restoration, and decommissioning phases with the land application option generating the larger amount of material for offsite disposal in each phase. The relative volumes of nonhazardous solid waste generated by the two disposal options differ during the decommissioning phase. The significance of these differences with regard to environmental impacts is low and does not change the impact conclusions for each disposal option. Therefore, the environmental impacts on waste management resources associated with the land application option will be the same for the deep Class V injection well disposal option for all phases of the ISR process. Furthermore, only a portion of land application facilities and infrastructure (e.g., irrigation areas and storage ponds) will be constructed, operated, and decommissioned for the combined disposal option. Therefore, the significance of environmental impacts on waste management resources for the combined disposal option will be less than for the land application option alone. Based on this reasoning, the NRC staff concluded that the environmental impacts on waste management of the combined deep Class V injection well and land application disposal option for each phase of the proposed Dewey-Burdock ISR Project will fall between the impacts of the deep Class V injection well disposal option and impacts of the land application disposal option.

15.6 Conclusions on Waste Management Impact Analysis

Although there is a degree of uncertainty in the ultimate destination of the non-byproduct solid waste that will be generated at the Dewey-Burdock Site, the waste management impact analysis presented in the NRC SEIS is detailed enough to provide an accurate estimate of the future waste disposal needs. Before the NRC will authorize commencement of ISR operations, Powertech will be required to have an agreement in place with White Mesa Mill for the disposal of solid by-product waste.

The NRC provided this information about the White Mesa Mill the response to public comment section of the final SEIS:

> *The White Mesa site in Blanding, Utah is an existing conventional mill site that has a tailings disposal area licensed by the State of Utah to accept 11e.(2) byproduct wastes. The amount of solid byproduct material generated by an ISR facility, such as the proposed Dewey-Burdock ISR Project, is only a small fraction of the tailings generated and disposed of at a conventional mill site. In addition, the proposed Dewey-Burdock ISR project would be only one of many ISR projects disposing of solid byproduct material at the White Mesa site. Therefore, the addition of ISR*

byproduct material from the proposed Dewey-Burdock ISR Project to the White Mesa disposal site is not considered significant.

As a matter of sound business practice, Powertech will set up an agreement with a solid waste disposal facility before construction operations begin at the site. The volume of waste generated during construction, operation and aquifer restoration will be small enough that it is not expected to place an undue burden on the landfills currently in operation. The Newcastle is currently planning an expansion and Custer Fall River Landfill recently completed an expansion. Although neither of these expansions will provide the solid waste disposal capacity that Powertech will need during the decommissioning phase, there will be sufficient time before decommissioning begins that these landfills can plan additional expansion if these communities decide to handle the decommissioning waste from the Dewey-Burdock Project Site.

Powertech's license includes two conditions related to waste disposal: License Condition 12.6 requires Powertech to submit to the NRC a disposal agreement with a licensed disposal site before beginning operations.76 License Condition 9.9 requires Powertech to maintain such a disposal agreement; if the agreement expires or otherwise terminates, Powertech must halt operations. License Condition 12.6 expressly prevents Powertech from beginning operations—and therefore producing byproduct material—before it has in place an agreement with a licensed waste disposal site. License Condition 9.9 prevents Powertech from continuing to operate if the waste disposal agreement expires or is otherwise terminated. Based on the review of NRC's analysis of waste management impacts and requirements the License, the EPA is able to conclude that the environmental concerns related to waste management impacts resulting from the drilling and operation of the injection wells proposed under the UIC area permits are acceptable.

16.0 CONCLUSIONS

UIC regulation 40 CFR § 144.33(c)(3) states that a UIC area permit may authorize the Permittee to construct and operate, convert, or plug and abandon wells within the permit area provided the cumulative effects of drilling and operation of additional injection wells are considered by the Director during evaluation of the area permit application and are acceptable to the Director. This document discusses the EPA's evaluation of the cumulative effects of all injection wells proposed for drilling and operation at the Dewey-Burdock Project Site under the Class III and Class V Area Permits. The EPA evaluated the cumulative effects from injection wells in the areas listed in Table 32. The EPA analysis of cumulative effects includes review of information in: 1) the NRC SEIS, 2) the NRC Safety Evaluation Report, 3) the proposed DENR Large Scale Mine Permit, 4) the Powertech water rights permit applications and associated DENR Water Rights Program reports, 5) the DENR Air Program Statement of Basis and 6) additional references included in this document.

The EPA finds the level of environmental concern resulting from the cumulative effects of the drilling and operations of the injection wells proposed under the UIC area permits is acceptable. This finding is based on the protective UIC permit requirements and based on the analyses described in each section of this document, including the proposed and required prevention, mitigation, remediation, reclamation or restoration procedures identified for each type of impact discussed. The EPA bases this finding on the commitments and requirements Powertech has agreed to implement in the various permitting and licensing application documents developed for the proposed Dewey-Burdock Project Site. If Powertech does not implement the applicable proposed prevention, mitigation, remediation, reclamation or restoration procedures identified for each type of impact discussed and the result is that environmental concerns resulting from the impact are no longer acceptable, the UIC Director may decide to modify the Class III and/or V Area Permits according to 40 CFR § 144.39 and § 124.5.

Table 39. Areas where the EPA Evaluated Impacts Potentially Resulting from the Drilling and Operation of Injection Wells Authorized under UIC Area Permit.

Impact Area	Document Section
Impacts to USDWs	3.0
Impacts to surface water and wetlands	4.0
Impacts from spills and leaks	5.0
Impacts to land use	6.0
Impacts to soils	7.0
Impacts to geology	8.0
Potential radiological impacts and effluent control systems	9.0
Impacts to Air Quality	10.0
Climate change impacts	11.0
Transportation Impacts	12.0
Impacts from Potential Accidents	13.0
Impacts to Ecological Resources	14.0
Impacts from Waste Management	15.0