5.3.9.3 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 (USA) 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 (USA) also will limit the sediment mobility by reseeding disturbed areas as soon as possible. Sediment control structures will be most critical while the well field is being constructed and immediately after redistributing topsoil.

Plates 5.3-6 through 5.3-8 show the sediment control measures that will be implemented in the permit area. These include sediment ponds, traps, and other Alternative Sediment Control Measures (ASCMs). Areas that will use silt fence have not been shown on the sediment control maps. Silt fence 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. Sediment pond designs for the first two well fields are provided on Plates 5.3-12 and 5.3-13. Other sediment pond designs will be completed following delineation of future well fields and will be provided to DENR for review and verification prior to construction.

To select the type of sediment control structure, a breakdown of drainage basin acreage was developed to provide general guidance. The following sediment control structures were designated for corresponding drainage basin sizes:

- Silt fence – sheet flow
- 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 well field construction is the 5-year, 24-hour precipitation event. This is justified on the basis that typical well field construction is anticipated to be approximately 2 years per well field, during which time topsoil will be redistributed and revegetated as portions of the well field are completed. The runoff volume for the precipitation event will be calculated using the NRCS triangular hydrograph method. Any number of computerized models (HEC-HMS TRIHYDRO, SEDCAD, TR-20, etc.) may be used 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., 1990). 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.

Throughout the life of the project, Powertech (USA) will 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.).

Quarterly inspections of sediment ponds will be conducted by trained personnel who are knowledgeable of pond construction and safety features. A detailed checklist will be developed and followed to document the pond structural and erosional condition. Inspections will be documented and the reports retained on site for reference and inspection by regulatory agencies.

5.4 Waste Management

This section describes the types, quantities and management of wastes associated with the Dewey-Burdock Project. Liquid and solid wastes are divided into two general categories: Atomic Energy Act (AEA)-regulated waste and non-AEA-regulated waste. AEA-regulated waste includes liquids and solids meeting the definition of "byproduct material" in 10 CFR § 40.4: "The tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content." This is also referred to as "11e.(2) byproduct material." All other waste is classified as non-AEA-regulated waste.

5.4.1 AEA-Regulated Waste

5.4.1.1 Wastewater Associated with ISR Operations

This section describes the disposal methods for wastewater associated with ISR operations from the Dewey-Burdock Project. Wastewater associated with ISR operations includes the production bleed, groundwater generated during aquifer restoration, process solutions (such as resin transfer water and brine generated from the elution and precipitation circuits), affected well development water, laboratory wastewater, laundry water, plant wash down water, and decontamination/decommissioning solutions from surface facilities.

Powertech (USA) proposes two options for the disposal of wastewater associated with ISR operations. The preferred disposal option is underground injection of treated liquid waste in non-hazardous Class V DDWs. In this disposal option, wastewater will be treated to meet EPA non-hazardous waste requirements and injected into the Minnelusa and/or Deadwood formations in four to eight DDWs permitted pursuant to the SDWA through the EPA UIC Program. It is anticipated that all wastewater will be disposed using this option if sufficient capacity is available in DDWs. Additional details about the design of the DDWs are provided below.

The alternate wastewater disposal option is land application. This option involves treatment in lined radium settling ponds followed by seasonal application of treated wastewater through center pivot sprinklers. Land application will be carried out under a GDP permitted through DENR. Depending on the availability and capacity of DDWs, Powertech (USA) may use land application in conjunction with DDWs or by itself. An overview of the land application system design and operation is provided below.

Both wastewater disposal options involve the use of lined ponds, which are described in Section 5.3.4.

5.4.1.1.1 Deep Disposal Wells

Powertech (USA) submitted a Class V UIC permit application (Appendix 3.4-A) to EPA Region 8 in March 2010 for authorization to install and operate DDWs within the permit area. DDWs will target the Pennsylvanian and Permian-age Minnelusa Formation and the Cambrian-age Deadwood Formation. The targeted injection interval in the Minnelusa Formation ranges from 1,615 to 2,540 feet below ground surface (bgs), and the targeted injection interval in the Deadwood Formation ranges from 3,095 to 3,530 feet bgs.

Powertech (USA) has requested an Area Permit authorizing the installation and operation of four to eight DDWs within the permit area. The number of wells required will depend on well capacity. Powertech (USA) has requested authorization to inject up to 300 gpm total in a maximum of eight wells. Proposed locations for the first four wells are provided in Figure 5.3-2. The initial four DDWs are proposed at two sites, one near the Satellite Facility and one near the CPP. Two disposal wells are proposed at each site with one well targeting the Minnelusa Formation and one targeting the Deadwood Formation. Based on the anticipated porosity, thickness, lateral extent, and permeability of the receiving formations, the capacity of each Class V DDW is expected to range from 50 to 75 gpm.

Prior to Class V DDW disposal, wastewater will be treated as necessary to comply with non-hazardous Class V UIC requirements. Treatment methods are described in Section 5.4.1.1.3. Surface facilities near the CPP and Satellite Facility related to wastewater disposal in the DDW option will include radium settling ponds, outlet and surge ponds, a central plant pond located at the CPP, and surface facilities required for DDW operation such as pretreatment facilities, screens/filters, and high pressure pumps for DDWs. Proposed facilities for the deep disposal option are depicted on Figure 5.3-2.

In the DDW option, RO treatment with permeate injection will be the primary method of aquifer restoration. Groundwater withdrawn during aquifer restoration will be treated using RO, and the resulting brine will be treated and disposed with other treated wastewater in DDWs. The water balance is presented in Section 5.3.3.5.3.

5.4.1.1.2 Land Application Systems

In the land application option, land application will occur at two areas, one near the Satellite Facility, and one near the CPP. Land application systems have been designed to apply water at agronomic rates that prevent runoff and limit the potential for deep percolation beneath the land application areas. Hydrologic modeling presented in the GDP demonstrates that groundwater is not expected to be impacted by the proposed land application systems. Nevertheless, Powertech (USA) will establish perimeter of operational pollution (POP) zones in the alluvial groundwater systems with alluvial compliance monitor wells to ensure protection of waters of the State of South Dakota. The proposed land application systems are separated from bedrock aquifers by some 25 to 500 feet of Graneros Group shales, which will eliminate any potential to impact bedrock aquifers.

Each land application system will consist of irrigation center pivots, associated pumps and piping, and catchment areas. Catchment areas will be designed to capture precipitation and runoff from land application areas up to the 100-year, 24-hour precipitation event. Associated facilities include radium settling ponds and storage ponds. Wastewater will be treated to remove radionuclides in lined radium settling ponds. Treated water will be stored temporarily in lined storage ponds and then seasonally applied to the land application areas through center pivots. Powertech (USA) anticipates that land application will typically occur during late March through October, but it could occur during other times of the year weather permitting. Adequate capacity in the storage ponds will provide storage during the months when land application will not be used (typically November through early March). Additional design information for the land application systems is presented in the GDP. Figure 5.3-1 depicts the proposed facilities in the land application option.

Each of the two land application systems will have up to 315 acres of irrigated area and an additional 65 acres of center pivots on standby. Each of the two land application systems is designed for an average annual application rate of 310 gpm and an instantaneous application rate of 297 to 653 gpm.

In the land application option, groundwater withdrawn during aquifer restoration will not be treated with RO. Instead, the aquifer restoration water will be disposed directly in land application systems following treatment to remove uranium and radium. The water balance for the land application option is presented in Section 5.3.3.5.3.

Following is a summary of how the proposed land application systems satisfy specific site evaluation and compatibility criteria in ARSD 74:29:05:16.

Potential Impacts to Wildlife Grazing in Land Application Areas (ARSD 74:29:05:16(1))

Potential impacts to wildlife grazing in the land application areas will be minimized through treating the land application effluent prior to application, monitoring vegetation within land application areas, and evaluating the monitoring results annually to detect potential increasing trends in constituent concentrations. As a condition of the GDP, the land application water quality will be required to meet effluent limits established by DENR that are protective of groundwater quality. Section 5.4.1.1.4.1 describes the anticipated land application water quality. Trace metal concentrations are anticipated to be at or below ARSD 74:54:01:04 human health standards. Radionuclide concentrations will be below 10 CFR Part 20, Appendix B, Table 2, Column 2 effluent limits for release of radionuclides to the environment. The suitability of land application vegetation to wildlife grazing will be verified through annual vegetation monitoring in the land application areas. Section 5.5.6.2 describe how vegetation in the land application areas will be sampled each year. Section 5.5.6.2 describes how this information will be evaluated annually and the results reported to DENR to determine whether there is any risk to wildlife.

Compatibility with Site Geology ((ARSD 74:29:05:16(2))

The site geology is well suited to land application. The depth to alluvial groundwater, where encountered, is greater than the maximum anticipated infiltration depth of the land application water. The Graneros Group shales will prevent the land application water from reaching bedrock aquifers. The thickness of the Graneros Group is approximately 500 to 550 feet beneath the proposed Dewey land application area and approximately 25 to 250 feet beneath the proposed Burdock land application area. Refer to Cross Sections 3.2-23 through 3.2-27, which depict the thickness of the Graneros within the proposed land application areas.

Compatibility of Slopes with Land Application Systems (ARSD 74:29:05:16(5))

In the proposed Dewey land application area, the average slope is approximately 3.5 percent. The maximum slope is between 15 and 25 percent in a small area (approximately 5 acres) at the northern edge of one proposed land application area (refer to page 5.3-B-42 in Appendix 5.3-B). In the proposed Burdock land application area, the average slope is approximately 2 percent. Only about 2 acres of the proposed Burdock land application area has a slope greater than 15 percent (refer to page 5.3-B-43 in Appendix B). These slopes will be compatible with center pivot irrigation.

During final design of the land application systems and catchment areas, Powertech (USA) will evaluate any areas with slopes greater than 15 percent to determine whether they can be avoided or whether they require mitigation. The evaluation will consider the maximum manufacturer-recommended slope based on the center pivot climbing capability and ground clearance requirements. It also will consider whether regrading will be necessary to reduce the potential for runoff and erosion. It is currently anticipated that approximately 5 acres in the proposed Dewey land application area and 2 acres in the proposed Burdock land application area will be regraded to a maximum slope of 15 percent unless these areas are avoided during final design.

Potential for Erosion (ARSD 74:29:05:16(6))

The potential for erosion within the land application areas will be minimized through siting land application areas in relatively flat terrain, maintaining vegetation, optimizing the irrigation rate to avoid runoff, using low-impact sprinkler heads, and capturing any runoff in catchment areas. The average slopes in the proposed land application areas are 2 to 3.5 percent. Small areas with slopes greater than 15 percent are anticipated to be regraded to minimize the potential for erosion and to meet the maximum manufacturer-recommended slopes for the center pivots. Relatively flat slopes along with maintenance of the land application areas in a vegetated state will limit the potential for erosion. The land application water will be applied at an agronomic rate to prevent runoff into the catchment areas. Should runoff from precipitation or snowmelt occur, the runoff and sediment will be captured in the catchment areas and will not reach perennial or ephemeral stream channels.

Daily inspections of the land application areas and catchment berms during operation of the land application systems will determine whether there are any unplanned effects such as erosion.

Distance to Flowing Streams (ARSD 74:29:05:16(7))

Beaver Creek is the only flowing stream within the proposed permit area. The minimum distance from a proposed Dewey land application area to Beaver Creek is approximately 280 feet. The minimum distance from a proposed Burdock land application area to Beaver Creek is approximately 1.1 miles.

Potential Impacts to Adjacent Land Uses (ARSD 74:29:05:16(8))

Land uses adjacent to the proposed land application areas includes livestock grazing on rangeland and recreational use (primarily hunting) on private lands. No effects from land application on adjacent land uses are anticipated due to the operation of land application systems to minimize overspray and due to Powertech (USA)'s commitment to limit hunting within the proposed permit area. Section 3.1.2 describes how Powertech (USA) will work with BLM, SDGF&P and private landowners to limit hunting within the proposed permit area to the extent practicable.

Consideration of Weather Conditions (ARSD 74:29:05:16(9))

Prior to operation of the land application systems, Powertech (USA) will develop a standard operating procedure (SOP) for land application system operation that will include provisions to minimize overspray outside of the center pivot areas. The SOP will include using the results of meteorological monitoring (wind speed, wind direction and temperature) to modify operating parameters. It will include maximum wind speed/wind direction combinations for land application system operation. The SOP also will address precipitation thresholds to avoid land application during heavy or prolonged precipitation events. Temperature thresholds also will be included to avoid land application when water cannot infiltrate due to frozen ground.

5.4.1.1.3 Wastewater Treatment

Prior to discharge to the storage ponds, Powertech (USA) will treat all wastewater associated with ISR operations to meet the requirements of 10 CFR 20, Appendix B, Table 2, Column 2, which are the established limits for discharge of radionuclides to the environment and include limits for natural uranium, radium-226, lead-210 and thorium-230 (see Table 5.4-1). Powertech (USA) anticipates that the GDP will include effluent limits established according to ARSD 74:54:01:04 groundwater standards and ambient alluvial water quality. Treatment will be accomplished by ion exchange for uranium removal followed by radium removal through co-precipitation with barium sulfate in radium settling ponds. It is not anticipated that thorium-230, lead-210 or other radionuclides will be present at concentrations above the limits. If concentrations in the storage ponds are above the release limits, the effluent will be treated as necessary to satisfy the GDP limits.

5.4.1.1.4 Treated Wastewater Quality

The types of wastewater that will be disposed in the DDWs or land application systems include production bleed, groundwater generated during aquifer restoration, affected groundwater generated during well development, and liquid process waste such as resin transfer water and the brine generated during uranium processing. Of these, the largest contributors will be the production bleed and groundwater generated during aquifer restoration.

Table 5.4-2 presents the estimated end-of-production water quality in the ISR well fields. This represents the untreated water quality extracted from the ore zone at the end of uranium recovery and at the beginning of aquifer restoration. This table represents the worst-case water quality

Table 5.4-1: Anticipated NRC Effluent Limits for DDWs or Land Application

Radionuclide	Anticipated Effluent Limits		Analytical Method
	μCi/ml	pCi/L	
Lead-210	1E-8	10	E903.0
Radium-226	6E-8	60	E908.0
Uranium-natural	3E-7	300	E907.0
Thorium-230	1E-7	100	E905.0

Source: 10 CFR 20, Appendix B, Table 2, Column 2

Table 5.4-2: SAR, ESP and RSC Calculations for Dewey and Burdock End-of-Production Groundwater Quality

Constituent	Dewey					Burdock				
	(mg/L)	(meq/L)	ESP	RSC	SAR	(mg/L)	(meq/L)	ESP	RSC	SAR
CO_3	0.5	0.02				0.50	0.02			
HCO_3	25	0.41				25.00	0.41			
Cl	1,300	36.67				1,300	36.67			
SO_4	1,000	20.82				1,800	37.48			
Na	270	11.74				190	8.26			
Ca	730	36.43				970	48.40			
Mg	120	9.87	2.29	-45.87	2.44	220	18.09	0.85	-66.07	1.43
K	20	0.51				10	0.26			
Total Ion Bal.		0.54					0.29			
SAR (measured)	4.9					2.8				
pH (s.u.)	6.5-7.5					6.5-7.5				
TDS (mg/L)	4,500					4,500				
Spec. Cond. (µS/cm)	5,000					5,000				
As	0.01					0.01				
V	<10					6				

Notes: SAR = sodium adsorption ratio
ESP = exchangeable sodium percentage
RSC = residual sodium carbonate

encountered in the well fields, and it was used to estimate the range of concentrations of the treated effluent proposed for land application after accounting for treatment and blending.

5.4.1.1.4.1 Land Application Water Quality

The typical water quality during land application will be better than that shown in Table 5.4-2, since the water quality will be continually improving during aquifer restoration. Table 5.4-3 presents the anticipated land application water quality. The upper values shown in this table represent the estimated worst-case water quality to be land applied. The typical land application water quality will be better than the upper values, since multiple well fields typically will be in various stages of production and aquifer restoration at one time, with water quality gradually degrading toward the worst case during production and gradually improving to approximately baseline water quality during restoration. In addition, Madison water may be used at any time to improve the land application water quality.

It is anticipated that trace metal concentrations will be at or below ARSD 74:54:01:04 human health standards. In addition, the effluent concentration limits will be met for the release of radionuclides to the environment as defined in 10 CFR Part 20, Appendix B, Table 2, Column 2. This will be accomplished through treating the water as described previously.

The values shown in Tables 5.4-2 and 5.4-3 were estimated by Powertech (USA) based on results of laboratory-scale leach tests conducted on ore samples from the project sandstones, as well as from historical end-of-production water quality data from other ISR facilities in Wyoming and Nebraska, with adjustments as necessary to account for planned post-production water treatment(s).

The primary source of land application water, production and restoration bleed, will result from multiple well fields undergoing differing phases of production and restoration. During production, the concentrations of dissolved constituents in each well field will gradually increase from the baseline quality to the post-production quality estimated in Table 5.4-2. During restoration, the water quality will be returned to approximately baseline water quality. The water from multiple well fields will be combined in the storage ponds, where increasing concentrations from producing well fields will be offset by decreasing concentrations from well fields undergoing restoration. This, combined with adequate pond capacity, will ensure that the land application water has relatively consistent water quality throughout the project duration. Additional information is found in the GDP.

Table 5.4-3: Estimated Land Application Water Quality

Analyte	Units	Land Application Water Estimate
Physical Properties		
pH	s.u.	6.5 - 7.5
Total dissolved solids (TDS)	mg/L	1,000 - 5,000
Electrical conductivity	umhos/cm	1,500 - 6,000
Common Elements and Ions		
Bicarbonate	mg/L	50 - 300
Calcium	mg/L	200 - 1,000
Carbonate	mg/L	<1
Chloride	mg/L	300 - 1300
Magnesium	mg/L	50 - 300
Potassium	mg/L	10
Sodium	mg/L	100 - 500
Sulfate	mg/L	500 - 2,000
Sodium adsorption ratio (SAR)	unitless	2 - 6
Minor Ions and Trace Elements		
Arsenic	mg/L	0.01
Barium	mg/L	0.4
Cadmium	mg/L	0.3
Chromium	mg/L	0.4
Copper	mg/L	0.3
Iron	mg/L	0.2
Molybdenum	mg/L	<0.1
Nickel	mg/L	0.3
Selenium	mg/L	<0.2
Vanadium	mg/L	<10
Radiological Parameters		
Lead-210	pCi/L	<10
Radium-226	pCi/L	<60
Thorium-230	pCi/L	<100
U-natural	pCi/L	<300

Note: Estimates of land application water quality were based on the results of laboratory scale leach tests conducted on ore samples from the Dewey (Fall River) and Burdock (Chilson) sites, as well as from historical end-of-production water quality data from other ISR sites in Wyoming and Nebraska, with adjustments as necessary to account for planned post-production water treatments.

5.4.1.1.4.2 Deep Disposal Well Water Quality

Table 5.4-4 shows the estimated water quality of various liquid waste streams for the Highland ISR Facility. The wastewater from the Dewey-Burdock Project is expected to fall within the broad ranges of concentrations shown in the table because both the Dewey-Burdock Project and Highland ISR Facility will use virtually identical processes and chemistry during ISR operations. The column labeled "Restoration Wastes" is expected to be representative of the quality of the production bleed and the restoration composite streams at the Dewey- Burdock Project prior to treatment. For the DDW liquid waste disposal option, the restoration composite will be treated with RO and the resulting brine will be combined with other liquid waste (e.g., production bleed, process solutions, etc.) in the lined ponds prior to disposal in the DDWs. In the DDW liquid waste disposal option, the water quality of the composite liquid waste stream will resemble the first four columns in Table 5.4-4 depending on the specific contribution from each of the liquid waste sources, except that the liquid waste will be treated to remove uranium, radium-226 and gross alpha.

5.4.1.2 Solid 11.e(2) Byproduct Material

Solid 11e.(2) byproduct material will include spent resins and process sludges, including pond sludges; spent sand, disposable filters, or other process media; solid waste such as spent resin from shaker screens; contaminated personal protective equipment; rags or other wastes from cleanup of spills or other housekeeping activities; and, potentially, small amounts of contaminated soil from leaks and/or spills. Additional solid 11e.(2) byproduct material will include contaminated piping and equipment as result of use and/or contact with process streams. Contaminated equipment will be generated primarily during decommissioning. Some contaminated equipment will be decontaminated and released as non-11e.(2) byproduct material in accordance with NRC license conditions.

Solid 11e.(2) byproduct material will be accumulated temporarily at designated on-site locations pending further evaluation and/or shipment offsite. Pond sludge will be accumulated temporarily in the lined ponds until it is removed during decommissioning. Other solid 11e.(2) byproduct material will be accumulated temporarily in byproduct storage buildings as described in Section 5.3.1.2.9. 11e.(2) byproduct material storage areas will be in designated restricted access areas to minimize any potential exposure or contamination.

Table 5.4-4: Estimated Process Wastewater Quality

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

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

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

Source: NUREG-1910, Table 2.7-3 (NRC 2009)

5.4.2 Non-AEA-Regulated Waste

The Dewey-Burdock Project will generate small quantities of non-radioactive, solid and liquid waste as described below. These wastes will be managed in compliance with EPA, DENR, and county regulations addressing solid waste, hazardous waste, used oil, and non-AEA-regulated liquid waste such as domestic waste and stormwater runoff. These wastes also will be managed in accordance with NRC license requirements.

5.4.2.1 Solid Waste

Solid waste will include construction debris, office trash, uncontaminated equipment and parts, and decontaminated material and equipment. It will be accumulated in dumpsters and transported to an appropriately permitted solid waste disposal or recycling facility permitted by South Dakota or another state.

5.4.2.2 Hazardous Waste and Used Oil

The potential exists for any industrial facility to generate hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Hazardous waste may include hydraulic fluid, cleaners, solvents, degreasers, and used batteries. On the basis of the processes and materials to be used on the project, it is likely that this project will be classified as a Conditionally Exempt Small Quantity Generator (CESQG), defined as a generator that generates less than 100 kg of hazardous waste in a calendar month and that complies with all applicable hazardous waste program requirements. In the event that Powertech (USA) is not classified as a CESQG, Powertech (USA) will obtain the appropriate approvals or permits. Hazardous waste and used oil (including used oil filters and oily rags) will be accumulated in designated hazardous waste and used oil storage areas and transported and disposed in an appropriately permitted disposal or recycling facility permitted by South Dakota or another state.

5.4.2.3 Liquid Waste

Liquid waste not classified as AEA-regulated waste will include domestic (septic) waste and stormwater runoff. Management of each of these liquid waste streams is described below.

5.4.2.3.1 Domestic (Septic) Waste

Domestic waste will be disposed in on-site wastewater disposal systems constructed at the CPP and Satellite Facility. Domestic wastewater disposal systems will be designed to meet applicable DENR and Fall River County or Custer County regulations and will be permitted through DENR and/or Fall River or Custer County.

5.4.2.3.2 Stormwater Runoff

Stormwater runoff will be managed through construction and industrial NPDES permits obtained through DENR. Facility drainage will be designed to route stormwater runoff either away from or around the plants, ancillary buildings, parking areas, and chemical storage areas. The design of the project facilities, combined with engineering and procedural controls contained in a Stormwater Pollution Prevention Plan (SWPPP), will ensure that stormwater runoff is not a potential source of pollution. Section 5.3.9 provides more detail regarding the stormwater management plan.

5.4.3 Waste Minimization

Waste will be minimized during all project phases to minimize potential exposure to hazardous and radiological emissions from waste, minimize disposal costs, and minimize potential impacts from waste management activities such as from transporting waste to appropriately permitted disposal facilities. Waste minimization measures may include but will not be limited to:

- Limit production and restoration bleed to the minimum amount needed to ensure hydraulic well field control;
- Recycle wastewater to reduce the amount of water needed for facilities and the amount of wastewater that requires disposal;
- Use decontamination techniques that reduce waste generation;
- Institute preventative maintenance and inventory management programs to minimize waste from breakdowns and overstocking;
- Recycle materials where appropriate;
- Encourage the reuse of materials and the use of recycled materials;
- Avoid using hazardous materials when possible; and
- Salvage extra materials and use them for other construction activities or for regrading activities.

5.5 Monitoring

This section describes the monitoring programs associated with the Dewey-Burdock Project. Extensive monitoring programs will be implemented to detect any potential impacts to human health or the environment in accordance with the requirements of the NRC license, LSM permit, GDP, EPA Class III and V UIC permits, and other relevant permits. These include well field, groundwater, surface water, land application effluent, flow/pressure, soil, vegetation, livestock/fish, air, and meteorological monitoring programs.

5.5.1 *Well Field Monitoring*

Following is a description of the ISR well field monitoring that will be conducted in accordance with NRC license and EPA Class III UIC permit requirements. This includes baseline groundwater monitoring to establish the ambient water quality and target restoration goals for each well field, excursion monitoring to detect any potential migration of ISR solutions away from the production zone, groundwater restoration monitoring, injection fluid monitoring, and well field leak detection monitoring.

5.5.1.1 *Well Field Production Zone Baseline Groundwater Monitoring*

Production zone baseline water quality and target restoration goals (TRGs) will be established according to NRC license requirements. Prior to uranium ISR, a subset of wells within each well field to be utilized as production wells will be identified for baseline water quality sampling. The sample density is anticipated to be one well per 4 acres of well field pattern area or six wells, whichever is greater, except that fewer than six wells may be used for well fields smaller than 6 acres. The expected sample frequency is four sample events spaced at least 14 days apart, with samples analyzed for the constituents listed in Table 6.2-1. Baseline water quality and TRGs will be established according to statistical methods approved by NRC.

5.5.1.2 *Excursion Monitoring Program*

The excursion monitoring program will be conducted in accordance with NRC license requirements to detect the potential horizontal or vertical movement of ISR solutions away from the production zone. The monitor well design is described in Section 5.3.3.1.2 and includes perimeter monitor wells completed in the production zone around the perimeter of each well field and non-production zone monitor wells completed in the overlying and underlying hydrogeologic units. The following sections describe how Powertech (USA) will establish baseline water quality and upper control limits (UCLs) for each monitoring zone and perform the excursion monitoring program throughout uranium extraction and aquifer restoration. Corrective actions to control and correct excursions are described in Section 5.6.3.2.

5.5.1.2.1 Establishing UCLs

Powertech (USA) will establish baseline water quality in the perimeter wells and non-production zone monitor wells according to NRC license requirements. Baseline water quality will be calculated based on the analysis of multiple samples from each monitor well. Baseline water quality will be used to establish UCLs as a function of the average baseline water quality and the variability in each parameter according to statistical methods approved by NRC.

UCLs will be established for constituents that provide early indication of a potential excursion. The anticipated excursion indicators include chloride, conductivity and total alkalinity. These are commonly used excursion indicators that are highly mobile in groundwater and not influenced significantly by pH changes or oxidation-reduction reactions.

5.5.1.2.2 Excursion Sampling

Excursion sampling will occur in accordance with NRC license requirements. The sampling frequency will be twice monthly during uranium recovery operations and once every 60 days during aquifer restoration. As previously described, the anticipated excursion indicators include chloride, conductivity and total alkalinity. Water levels will be recorded during excursion sampling events.

Water levels will be measured using downhole pressure transducers or manual electronic meters. These measurements will alert operators to any significant change in the water levels within the monitor wells to provide an early warning of a potential excursion. Operators may then follow standard operating procedures to make adjustments to well field production and/or injection flow rates to avoid an excursion due to any unbalanced flow condition in a well field. Water level readings will be recorded at a minimum frequency of twice monthly from production zone monitor wells and monitor wells installed in the overlying and underlying hydrogeologic units.

5.5.1.2.3 Excursion Confirmation

An excursion will be deemed to have occurred if two or more excursion indicators in any monitor well exceed their UCLs. A verification sample will be taken within 48 hours after results of the first analyses are received. If the results of the verification sampling are not complete within 30 days of the initial sampling event, then the excursion will be considered confirmed for the purpose of meeting the reporting requirements described below. If the excursion is not confirmed by the verification sample, a third sample will be taken within 48 hours after the second set of sampling data are received. If neither the second nor the third sample confirms the excursion by two indicators exceeding their UCLs, the first sample will be considered to have been in error, and the well will be removed from excursion status. If either the second or third sample exhibits two or more indicators above their UCLs, an excursion will be confirmed, the well will be placed on confirmed excursion status, and corrective action will be initiated. Corrective actions are described in the Section 5.6.3.2.

5.5.1.3 Groundwater Restoration Monitoring

During all phases of groundwater restoration, including active restoration and stability monitoring, excursion monitoring will continue in accordance with NRC license conditions. The following additional monitoring associated with groundwater restoration will be conducted in accordance with NRC license requirements.

5.5.1.3.1 Monitoring during Active Restoration

Powertech (USA) will monitor the progress of aquifer restoration by sampling ore zone monitor wells in each well field at a frequency sufficient to determine the success of aquifer restoration, optimize the efficiency of aquifer restoration, and determine if any areas need additional attention. The results of active restoration monitoring will be used to evaluate potential areas of flare or hot spots. If potential flare or hot spots are identified, appropriate corrective measures will be taken such as adjusting the flow in the area, changing wells from injection to production, or adjusting the restoration bleed in a specific area.

5.5.1.3.2 Restoration Stability Monitoring

A groundwater stability monitoring period will be implemented to show that the restoration goal has been adequately maintained. The stability monitoring period proposed in the NRC license application includes 12 months with quarterly sampling (at least 5 sample events, including 1 at the beginning of the stability monitoring period and following each of the following 4 quarters). The sample results will be analyzed using statistical methods approved by the NRC to evaluate stability.

If a constituent does not meet the stability criteria, Powertech (USA) will take appropriate action considering the constituent and the status of the restored groundwater system. Potential actions may include extending the stability period or returning the well field to a previous phase of active restoration to resolve the issue.

If the analytical results from the stability period continue to meet the TRGs and meet the stability criteria, then Powertech (USA) will submit supporting documentation to the NRC showing that the restoration parameters have remained at or below the restoration standards and requesting that the well field be declared restored.

5.5.1.4 ISR Solution Monitoring

Powertech (USA) will install automated control and data recording systems at the Satellite Facility and the CPP that will provide centralized monitoring and control of the process variables including the flow rate and pressure of the injection and production stream in each header house. In addition, the flow rate of each injection and production well will be measured automatically. Pressure gauges installed at each injection wellhead or in the injection manifold also will be manually recorded at least daily.

The volumetric flow rate of oxygen and carbon dioxide will be measured at the point of injection into the barren lixiviant using calibrated gas flow meters. The flow meters will be routinely calibrated according to manufacturer recommendations.

The injection fluid in each operating well field will be sampled in accordance with EPA Class III permit requirements. Samples will be collected from the injection manifold, individual injection flow lines, or the injection well heads following the appropriate quality assurance/quality control (QA/QC) procedures. The anticipated sampling frequency is monthly. Samples will be submitted to an EPA-certified laboratory and analyzed for parameters required by the Class III UIC permit. These are anticipated to include pH, TDS, specific conductance, total alkalinity, chloride, sulfate, and select dissolved metals and radionuclides.

5.5.1.5 Well Field Leak Detection Monitoring

Leak detection will be performed by daily visual inspection of all aboveground pipe, connections, and fittings by field personnel during their daily site visits.

5.5.2 Operational Groundwater Monitoring Program

The operational groundwater monitoring program will be conducted in accordance with NRC license requirements and will be used to detect potential changes in groundwater quality in and around the permit area as a result of the Dewey-Burdock Project. The operational monitoring program is designed to provide a comprehensive evaluation of water supply wells in and around the permit area. Wells to be included in the operational monitoring program include domestic wells, stock wells, irrigation wells, and additional monitor wells in the alluvium, Fall River, Chilson and Unkpapa.

Prior to operations all domestic, stock, and irrigation wells within 2 km of the potential perimeter monitor well rings will be sampled to establish baseline water quality. These will be monitored quarterly for one year prior to operation (including monitoring already completed). All samples will be analyzed for constituents listed in Table 6.2-1.

5.5.2.1 Domestic Wells

Prior to operations, all domestic wells within the permit area will be removed from private use, or, at a minimum, from drinking water use. Depending on the well construction, location and screen interval, Powertech (USA) may continue to use the well for monitoring or plug and abandon the well. From the onset of ISR operations until groundwater restoration is approved by NRC, Powertech (USA) will monitor all domestic wells within 2 km of the perimeter monitor well rings. Samples will be collected annually and analyzed for the constituents listed in Table 6.2-1.

5.5.2.2 Irrigation Wells

From the onset of ISR operations until groundwater restoration is approved by NRC, Powertech (USA) will monitor all irrigation wells within 2 km of the perimeter monitor well rings. Samples will be collected annually and analyzed for the parameters in Table 6.2-1.

5.5.2.3 Stock Wells

During the design of each well field, all nearby stock wells will be evaluated for the potential to be adversely affected by ISR operations or to adversely affect ISR operations. At a minimum, all stock wells within ¼ mile of well fields will be removed from private use prior to operation of nearby well fields. Depending on the well construction, location and screen interval, Powertech (USA) may continue to use the well for monitoring or plug and abandon the well. During operation, Powertech (USA) will monitor all stock wells within the permit area. Samples will be collected quarterly and analyzed for water level and the three excursion indicators of chloride, total alkalinity, and conductivity.

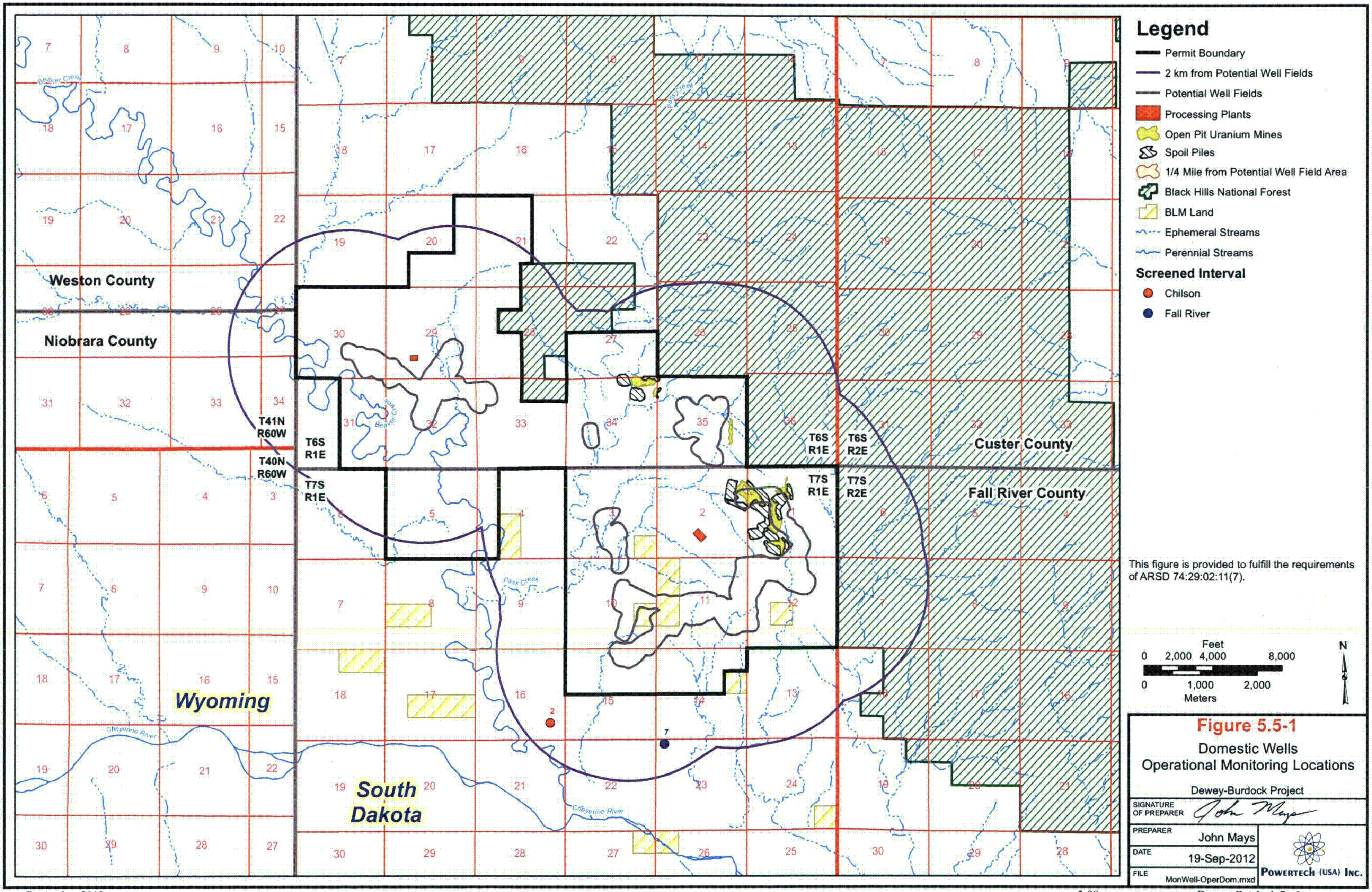
5.5.2.4 Monitor Wells

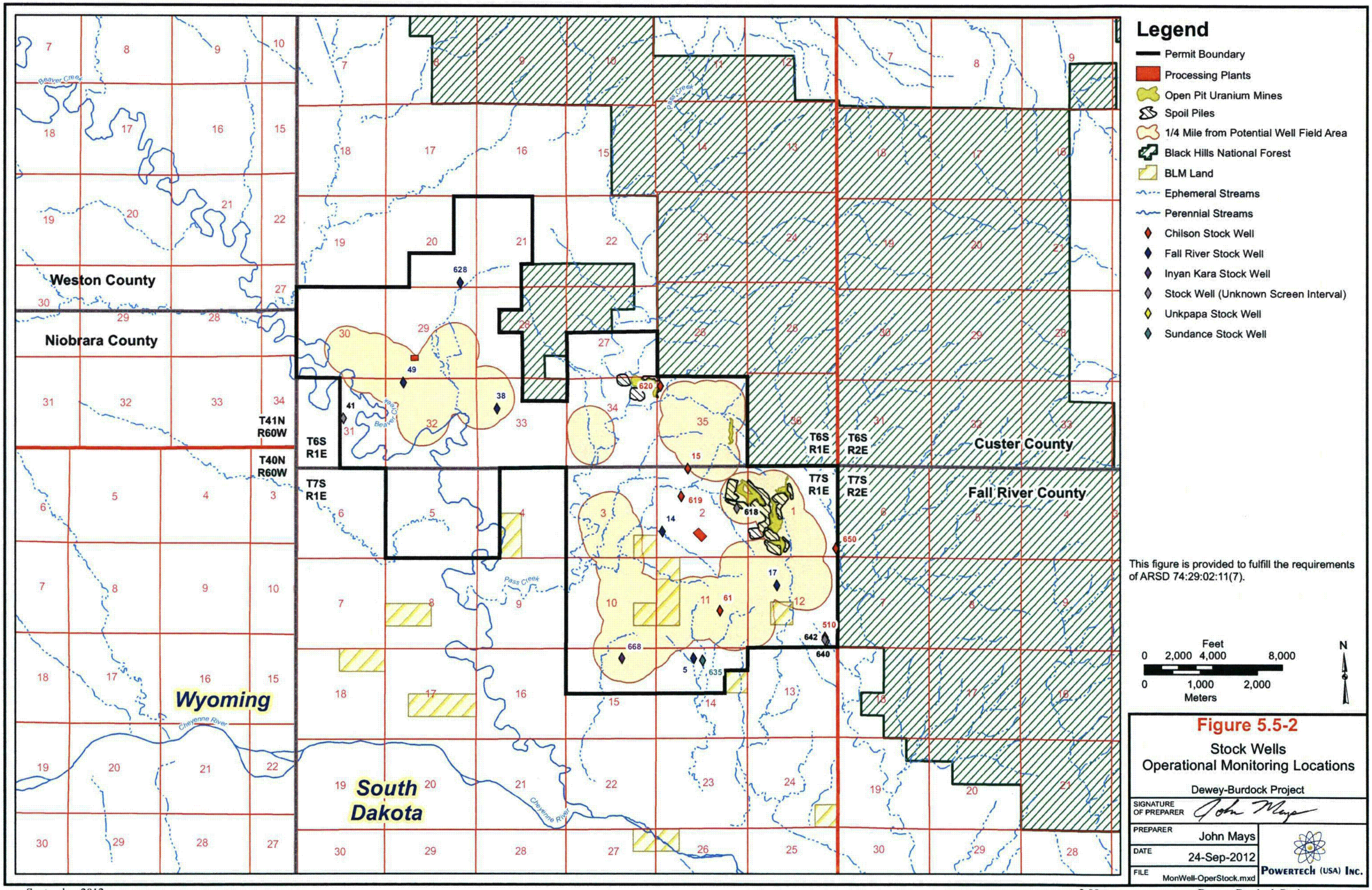
Per NRC license requirements, Powertech (USA) will monitor wells located hydrologically upgradient and downgradient of ISR operations as part of the operational groundwater monitoring program. A list of the monitor wells included in the operational monitoring program is provided in Table 5.5-1. Monitor wells included in the operational monitoring program are depicted on Figures 5.5-1 through 5.5-6 and include domestic wells, stock wells, and wells completed in the alluvium, Fall River, Chilson, and Unkpapa. Currently there are no irrigation wells within 2 km of the potential perimeter monitor well rings. The monitor wells will be monitored quarterly from the onset of ISR operations through NRC approval of groundwater restoration and analyzed for constituents listed in Table 6.2-1.

Table 5.5-1: Monitor Wells Included in Operational Monitoring Program

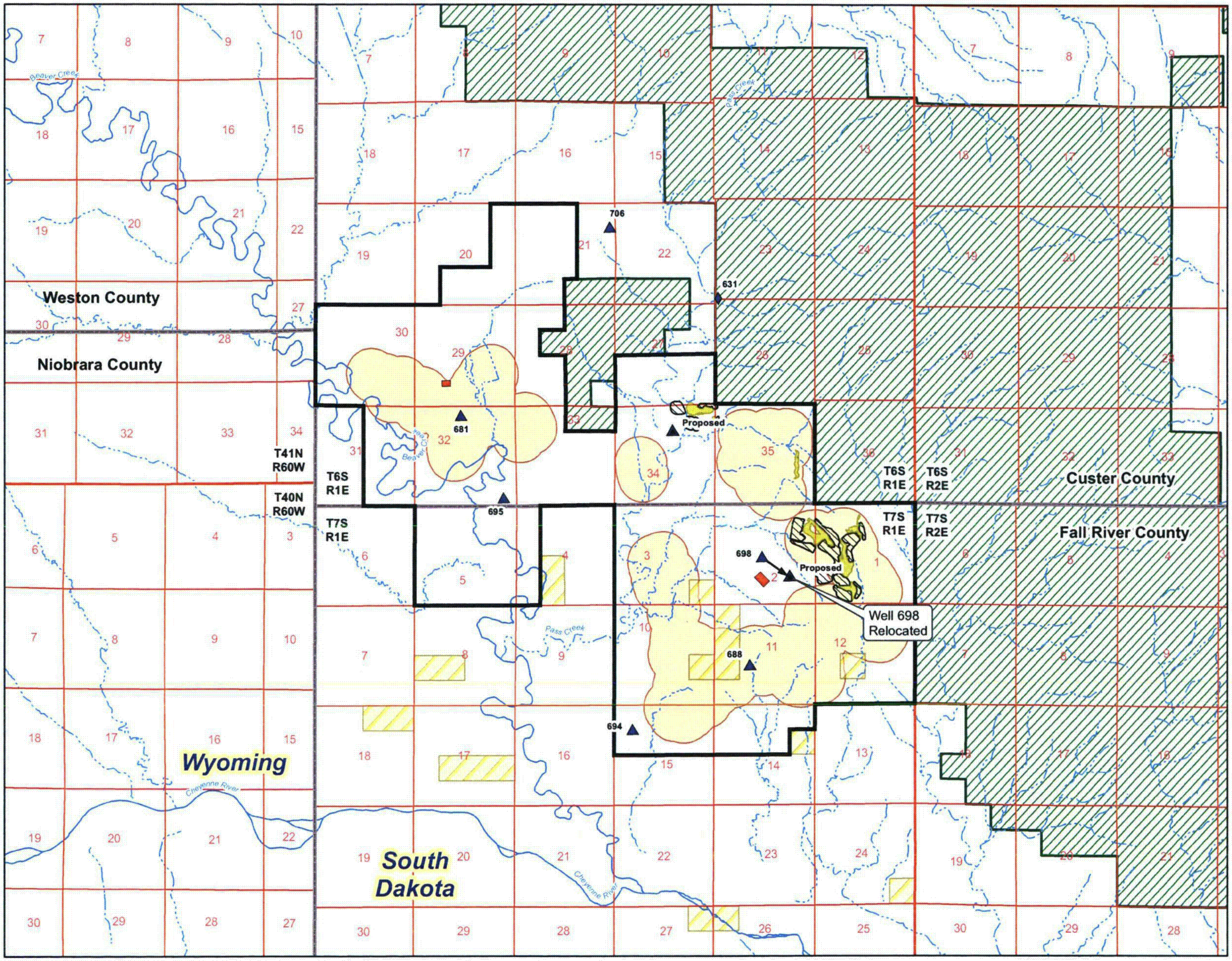
Well ID	Qtr-Qtr	Section	Township	Range	Relative Position
Alluvium					
676	SESW	34	6S	1E	Downgradient of land application
677	SWSW	27	6S	1E	Downgradient
678	SWNE	4	7S	1E	Downgradient
679	NESW	9	7S	1E	Upgradient
707	SWNE	34	6S	1E	Downgradient of Triangle Pit
708	SESW	3	7S	1E	Downgradient of land application
709	SENW	15	7S	1E	Downgradient of well field
TBD	NWNW	20	6S	1E	Upgradient
TBD	NENE	31	6S	1E	Downgradient of well field
TBD	NWSE	32	6S	1E	Downgradient of well field
TBD	NWNW	20	6S	1E	Downgradient of land application
Fall River					
631	SWSW	23	6S	1E	Upgradient
681	NWNE	32	6S	1E	Production zone
688	NESW	11	7S	1E	Overlying production zone
694	NWNW	15	7S	1E	Upgradient
695	SESE	32	6S	1E	Downgradient
698	SENW	2	7S	1E	Downgradient
706	NENE	21	6S	1E	Upgradient
TBD	SWNE	34	6S	1E	Downgradient of Triangle Pit
TBD	NWSE	2	7S	1E	Downgradient of Darrow Pit
Chilson					
43	SWSE	34	6S	1E	Downgradient of Triangle Pit
680	NESW	11	7S	1E	Production zone
689	NENW	32	6S	1E	Production zone
696	NWNW	15	7S	1E	Downgradient
697	SESE	32	6S	1E	Downgradient
705	NENE	21	6S	1E	Upgradient
3026	SESE	12	7S	1E	Upgradient
TBD	SWSE	2	7S	1E	Downgradient of Darrow Pit
Unkpapa					
690	NESW	11	7S	1E	
693	NENW	32	6S	1E	
703	SWSE	1	7S	1E	

TBD – To be determined; well not yet installed.


Legend
Permit Boundary
2 km from Potential Well Fields
Potential Well Fields
Processing Plants
Open Pit Uranium Mines
Spoil Piles
1/4 Mile from Potential Well Field Area
Black Hills National Forest
BLM Land
Ephemeral Streams
Perennial Streams
Screened Interval
Chilson
Fall River
Weston County
Niobrara County
Custer County
Fall River County
Wyoming
South Dakota
T41N R60W
T40N R60W
T6S R1E
T7S R1E
T6S R2E
T7S R2E
Beaver Creek
Pass Creek
Cheyenne River
This figure is provided to fulfill the requirements of ARSD 74:29:02:11(7).
Feet
0 2,000 4,000 8,000
0 1,000 2,000
Meters
N
Figure 5.5-1
Domestic Wells
Operational Monitoring Locations
Dewey-Burdock Project
SIGNATURE OF PREPARER
PREPARER John Mays
DATE 19-Sep-2012
FILE MonWell-OperDom.mxd
POWERTECH (USA) INC.



Legend
Permit Boundary
Processing Plants
Open Pit Uranium Mines
Spoil Piles
1/4 Mile from Potential Well Field Area
Black Hills National Forest
BLM Land
Ephemeral Streams
Perennial Streams
Chilson Stock Well
Fall River Stock Well
Inyan Kara Stock Well
Stock Well (Unknown Screen Interval)
Unkpapa Stock Well
Sundance Stock Well
This figure is provided to fulfill the requirements of ARSD 74:29:02:11(7).
Feet
0 2,000 4,000 8,000
0 1,000 2,000
Meters
N
Weston County
Niobrara County
Custer County
Fall River County
Wyoming
South Dakota
T41N R60W
T40N R60W
T6S R1E
T7S R1E
T6S R2E
T7S R2E
Beaver Creek
Pass Creek
Cheyenne River
Figure 5.5-2
Stock Wells
Operational Monitoring Locations
Dewey-Burdock Project
SIGNATURE OF PREPARER
PREPARER
John Mays
DATE
24-Sep-2012
FILE
MonWell-OperStock.mxd
POWERTECH (USA) INC.



Legend

- Permit Boundary
- Processing Plants
- Open Pit Uranium Mines
- Spoil Piles
- 1/4 Mile from Potential Well Field Area
- Black Hills National Forest
- BLM Land
- Ephemeral Streams
- Perennial Streams
- Baseline Monitor Wells
- Proposed Monitor Wells
- Stock Well

This figure is provided to fulfill the requirements of ARSD 74:29:02:11(7).

Feet: 0, 2,000, 4,000, 8,000
Meters: 0, 1,000, 2,000
N

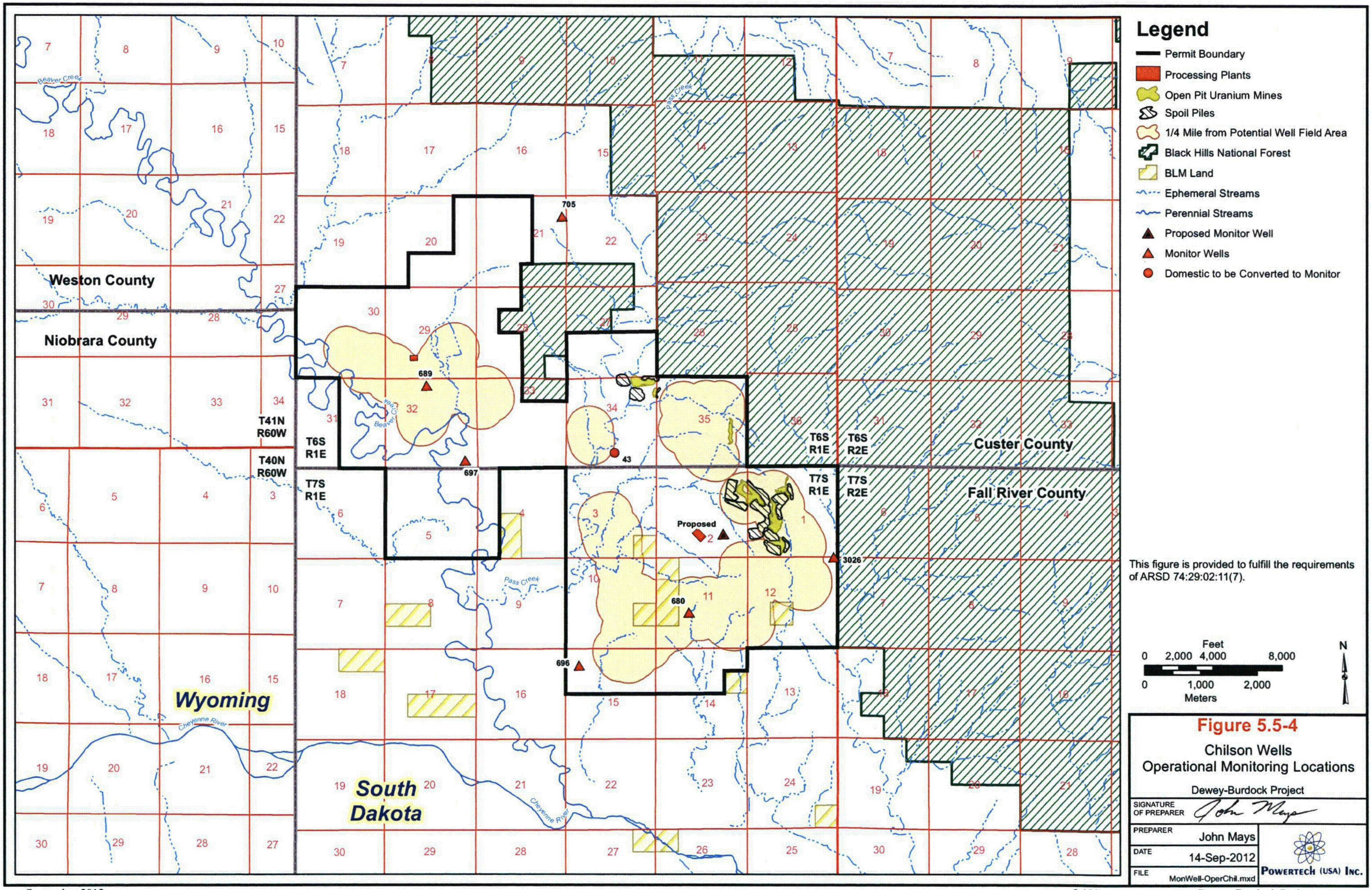
Figure 5.5-3

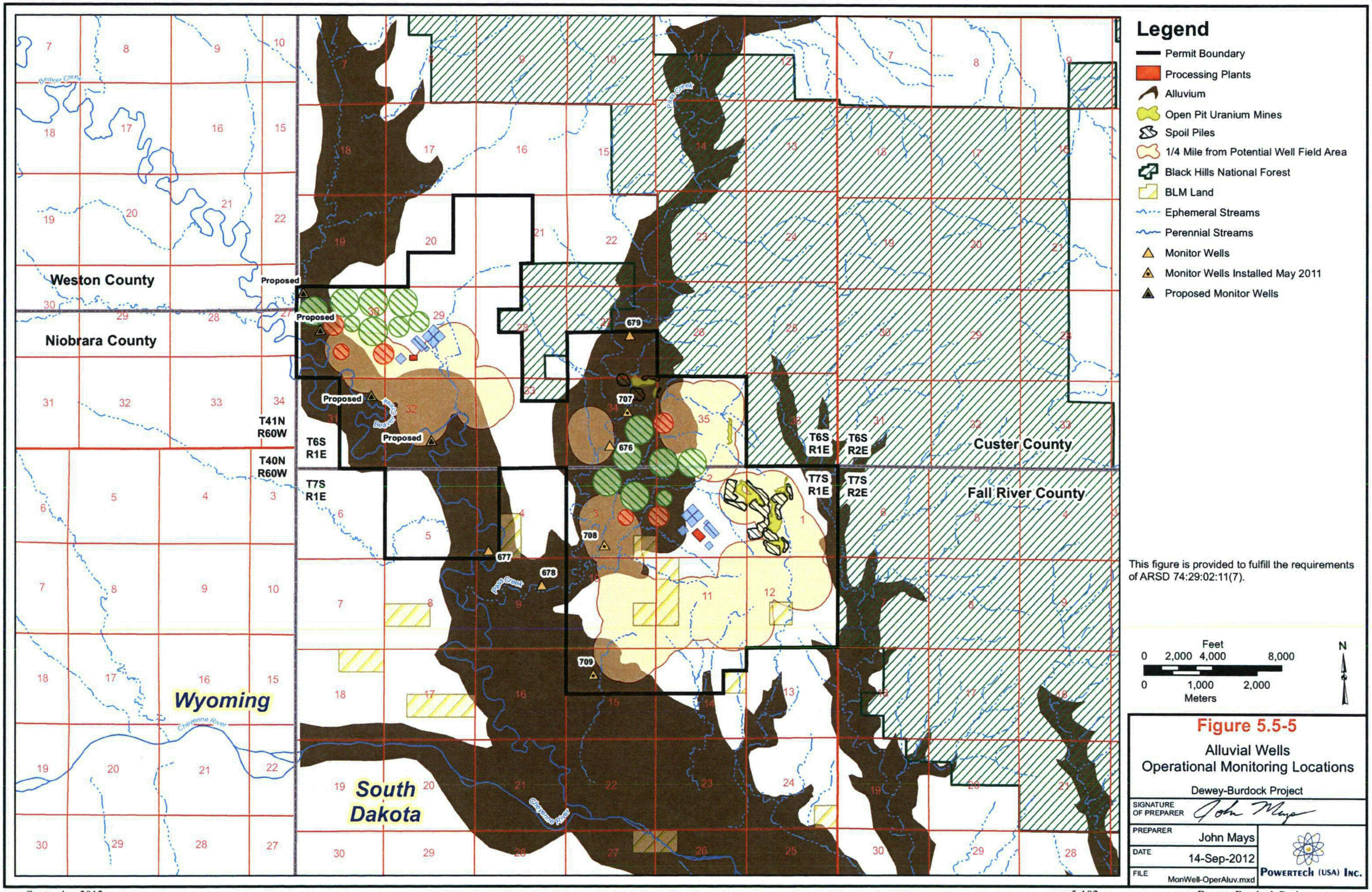
Fall River Wells
Operational Monitoring Locations

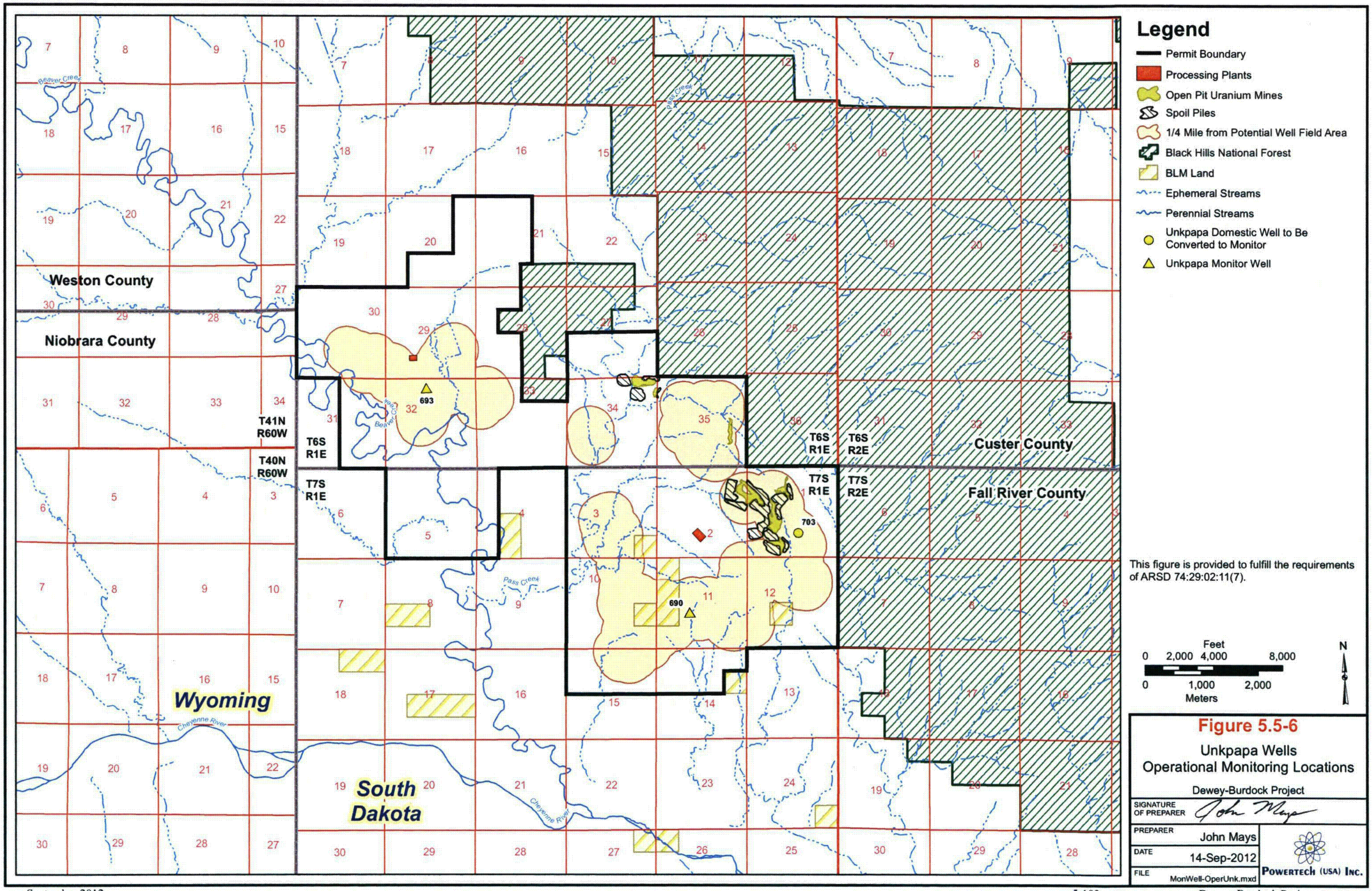
Dewey-Burdock Project

SIGNATURE OF PREPARER	John Mays
PREPARER	John Mays
DATE	14-Sep-2012
FILE	MonWell-OperFallRvr.mxd

POWERTECH (USA) INC.


Legend
Permit Boundary
Processing Plants
Open Pit Uranium Mines
Spoil Piles
1/4 Mile from Potential Well Field Area
Black Hills National Forest
BLM Land
Ephemeral Streams
Perennial Streams
Proposed Monitor Well
Monitor Wells
Domestic to be Converted to Monitor
This figure is provided to fulfill the requirements of ARSD 74:29:02:11(7).
Feet
0 2,000 4,000 8,000
0 1,000 2,000
Meters
N
Weston County
Niobrara County
Custer County
Fall River County
Wyoming
South Dakota
T41N R60W
T40N R60W
T6S R1E
T7S R1E
T6S R2E
T7S R2E
Beaver Creek
Pass Creek
Cheyenne River
Proposed
705
689
697
43
680
696
3026
Figure 5.5-4
Chilson Wells
Operational Monitoring Locations
Dewey-Burdock Project
SIGNATURE OF PREPARER
PREPARER John Mays
DATE 14-Sep-2012
FILE MonWell-OperChil.mxd
POWERTECH (USA) INC.


Legend
Permit Boundary
Processing Plants
Alluvium
Open Pit Uranium Mines
Spoil Piles
1/4 Mile from Potential Well Field Area
Black Hills National Forest
BLM Land
Ephemeral Streams
Perennial Streams
Monitor Wells
Monitor Wells Installed May 2011
Proposed Monitor Wells
This figure is provided to fulfill the requirements of ARSD 74:29:02:11(7).
Feet
0 2,000 4,000 8,000
0 1,000 2,000
Meters
N
Weston County
Niobrara County
Custer County
Fall River County
Wyoming
South Dakota
T41N R60W
T40N R60W
T6S R1E
T7S R1E
T6S R2E
T7S R2E
Proposed
679
707
676
708
677
678
709
Beaver Creek
Pass Creek
Cheyenne River
Figure 5.5-5
Alluvial Wells
Operational Monitoring Locations
Dewey-Burdock Project
SIGNATURE OF PREPARER
PREPARER
John Mays
DATE
14-Sep-2012
FILE
MonWell-OperAluv.mxd
POWERTECH (USA) INC.



Legend
Permit Boundary
Processing Plants
Open Pit Uranium Mines
Spoil Piles
1/4 Mile from Potential Well Field Area
Black Hills National Forest
BLM Land
Ephemeral Streams
Perennial Streams
Unkpapa Domestic Well to Be Converted to Monitor
Unkpapa Monitor Well
Weston County
Niobrara County
Custer County
Fall River County
Wyoming
South Dakota
T41N R60W
T40N R60W
T6S R1E
T7S R1E
T6S R2E
T7S R2E
693
703
690
Beaver Creek
Pass Creek
Cheyenne River
This figure is provided to fulfill the requirements of ARSD 74:29:02:11(7).
Feet
0 2,000 4,000 8,000
0 1,000 2,000
Meters
N
Figure 5.5-6
Unkpapa Wells
Operational Monitoring Locations
Dewey-Burdock Project
SIGNATURE OF PREPARER
PREPARER John Mays
DATE 14-Sep-2012
FILE MonWell-OperUnk.mxd
POWERTECH (USA) INC.

In addition, Powertech (USA) will monitor additional alluvial monitor wells within and downgradient of the land application systems if land application is used. These wells will be monitored as required by the GDP, and the well locations are provided in the GDP.

Monitoring conducted as part of the operational monitoring program will be conditional upon landowner access and suitable conditions allowing proper collection of a sample. If access is not available during the time of monitoring, a second attempt will be made to collect a sample during the monitoring period. If a well cannot be accessed continually, Powertech (USA) will establish an alternate monitoring location or remove the well from the operational groundwater monitoring program.

5.5.2.5 Sampling Methods

Groundwater sampling methods will be the same as the methods utilized for baseline characterization. Static water level will be measured before sample collection when access is available. Measurement techniques will include pressure transducers, a portable electronic water level meter, or an ultrasonic water level sensor. For flowing artesian wells, the shut-in pressure will be measured, where access is available, using a 15 or 30 psi NIST pressure gauge. Prior to measuring the pressure, the well will be shut in and the pressure allowed to stabilize before recording the hydrostatic pressure.

Three casing volumes will be purged prior to sample collection where possible, except that flowing artesian wells will be assumed to contain representative formation water without purging. In all cases, field parameters will be measured and recorded and samples will not be collected until field pH, conductivity and temperature have stabilized. The criterion used to assess stability will be three consecutive measurements of each of the field parameters with values for each parameter within 10%.

All groundwater samples will be collected in clean sample containers and field preserved, where required. The sample containers will be kept cool (less than 4°C) until delivery to the contract laboratory.

5.5.2.6 Reporting

Powertech (USA) will provide DENR with the results of all operational groundwater monitoring, including domestic wells, stock wells, irrigation wells, and monitor wells. These will be provided in the annual environmental monitoring report described in Section 5.7.2.6.

5.5.3 Operational Surface Water Monitoring Program

During ISR operations, 24 impoundments and 10 stream sampling sites, depicted on Plate 5.5-1, will be monitored as part of the operational monitoring program. Impoundments within and surrounding the permit area were evaluated based on location in relation to ISR operations (i.e., downgradient of proposed well fields, CPP, etc.). Table 5.5-2 lists all of the impoundments identified during the baseline surveys. The table lists all of the impoundments and identifies which impoundments are located downgradient (i.e., potentially subject to surface runoff) from ISR operations. The table also denotes the 24 impoundments included in the operational monitoring program and provides justification for impoundments not included. All 24 impoundments identified for operational monitoring will be visited on a quarterly basis throughout construction and operation. In addition, Powertech (USA) will visit all 24 of the impoundments included in the operational monitoring program four times (including pre-operational samples already collected) prior to operations to satisfy NRC pre-operational monitoring requirements. Water samples will be collected, when available, and analyzed for constituents listed in Table 6.2-1.

The previous stream sampling sites described in Section 3.5.3.1 were evaluated against NRC regulatory guidance (NRC, 1980a) to establish an operational monitoring program. Four sites (BVC01, BVC04, PSC01, and PSC02) used for baseline monitoring will be replaced with operational monitoring sites that better meet NRC guidance as follows:

- BVC11 will be located where Beaver Creek exits the permit area. This monitoring location will replace BVC01, which was approximately 2 stream miles farther downstream, below the confluence with Pass Creek.

- BVC14 will be located where Beaver Creek enters the permit area. This monitoring location will replace BVC04, which was approximately 12 stream miles upstream from the permit area.

- PSC11 will be located where Pass Creek exits the permit area. This monitoring location will replace PSC01, which was approximately 2 stream miles upstream from the PSC11 location, within the permit area.

- PSC12 will be located where Pass Creek enters the permit area. This monitoring location will replace PSC02, which was about 2 stream miles upstream from the permit area

A total of 10 stream sampling sites will be included in the operational monitoring program. In addition to the four new sites described above, Powertech (USA) will establish two additional

Table 5.5-2: Impoundments Included in the Operational Monitoring Program

Site	Type/Name	Down-Gradient of ISR Operations*	Included in Operational Monitoring Program	Justification for Not Including in Operational Monitoring Program
Sub01	Stock Pond	No		Not downgradient and outside of permit area
Sub02	Triangle Mine Pit	No	**Yes**	
Sub03	Mine Dam	Yes	**Yes**	
Sub04	Stock Pond	Yes	**Yes**	
Sub05	Mine Dam	Yes	**Yes**	
Sub06	Darrow Mine Pit Northwest	Yes	**Yes**	
Sub07	Stock Dam	Yes	**Yes**	
Sub08	Stock Pond	Yes	**Yes**	
Sub09	Stock Pond	Yes	**Yes**	
Sub10	Stock Pond	Yes	**Yes**	
Sub11	Stock Pond	Yes	**Yes**	
Sub20	Stock Pond	Yes	**Yes**	
Sub21	Stock Pond	Yes	**Yes**	
Sub22	Stock Pond	Yes	**Yes**	
Sub23	Stock Pond	No		Not an impoundment, but an infrequent, small pool of water due to inadequate stormwater control at county road crossing
Sub24	Stock Pond	No		Outside of permit area; not located in a permit area drainage
Sub25	Stock Pond	No		Outside of permit area; not downgradient
Sub26	Stock Pond	No		Outside of permit area; not downgradient
Sub27	Stock Pond	Yes		Outside of permit area; downstream of Sub28
Sub28	Stock Pond	Yes		Outside of permit area; downstream of Sub08 and Sub09 with no proposed ISR operations between Sub08 or Sub09 and Sub28
Sub29	Stock Pond	Yes	**Yes**	
Sub30	Stock Pond	Yes	**Yes**	
Sub31	Stock Pond	Yes	**Yes**	
Sub32	Stock Pond	Yes	**Yes**	
Sub33	Stock Pond	Yes	**Yes**	
Sub34	Stock Pond	Yes	**Yes**	
Sub35	Stock Pond	Yes	**Yes**	
Sub36	Stock Pond	Yes	**Yes**	

Table 5.5-2: Impoundments Included in the Operational Monitoring Program (Cont'd)

Site	Type/Name	Down-Gradient of ISR Operations*	Included in Operational Monitoring Program	Justification for Not Including in the Operational Monitoring Program
Sub37	Stock Pond	Yes		Downstream of Sub36
Sub38	Stock Pond	No		Outside of permit area; not downgradient
Sub39	Stock Pond	No		Not downgradient
Sub40	Darrow Mine Pit Southeast	Yes	**Yes**	
Sub41	Stock Pond	Yes		Only downgradient of potential perimeter monitor wells
Sub42	Stock Pond	No		Not downgradient
Sub43	Stock Pond	No		Not downgradient
Sub44	Stock Pond	No		
Sub45	Stock Pond	No		Outside of permit area; not downgradient
Sub46	Stock Pond	No		Outside of permit area; not downgradient
Sub47	Stock Pond	No		Outside of permit area; not downgradient
Sub48	Stock Pond	No		Outside of permit area; not downgradient
Sub49	Darrow Mine Pit	Yes	**Yes**	
Sub50	Darrow Mine Pit	Yes	**Yes**	
Sub51	Stock Pond	No		Outside of permit area; not downgradient
Sub52	Stock Pond	No		Outside of permit area; not downgradient
Sub53	Stock Pond	No		Outside of permit area; not downgradient
Sub54	Stock Pond	No		Outside of permit area; not downgradient

* Potentially subject to surface runoff from Satellite Facility, CPP, ponds, potential land application areas, pipelines, or potential well field areas.

sites on unnamed tributaries in the southeast portion of the permit area. Details for each of the operational stream sampling sites are provided in Table 5.5-3.

Prior to ISR operations, Powertech (USA) will sample each site monthly (including samples already collected) for 12 consecutive months in accordance with NRC license requirements. Grab samples will be collected from sites BVC11, BVC14, CHR01, and CHR05. Passive samplers will be installed at the remaining sites to collect samples during ephemeral flow events. Water samples will be analyzed for constituents listed in Table 6.2-1.

5.5.3.1 Sampling Methods and Parameters

Impoundments will be sampled by collecting grab samples. Prior to sampling, the sampler will conduct a visual survey of the impoundment to identify an appropriate sample location. This will include an area free of ice or floating debris and with sufficient water depth to permit sample collection without disturbing sediments. If necessary, a clean, long-handled dip sampler will be used. Typically the sample location will be near the impoundment embankment where the water is deepest. Grab samples will be collected in clean sample containers provided by the contract laboratory. Water will be obtained by filling the containers from the top 10 cm (4 in) of the water column. Samples will be field-preserved where required. The sample containers will be kept cool (less than 4°C) until delivery to the contract laboratory. In the event that a sample cannot be collected from an impoundment during the quarterly visit, the reason will be stated on a field sheet.

Streams will be sampled by grab sampling or with automatic samplers. Perennial stream sampling locations include those on Beaver Creek and the Cheyenne River. These will be sampled by collecting grab samples as described above. Passive samplers (single-stage samplers) will be installed at all other stream sampling sites from April through October. These will collect samples automatically when the flow rate in the channel reaches a field-adjustable minimum depth threshold. Following the runoff event the water will be manually transferred from the temporary sample container to clean sample bottles and submitted to the contract laboratory for analysis.

Representative water of that collected in the grab samples will be analyzed in the field for pH, conductivity and temperature. Impoundment and stream samples will be analyzed for the parameters presented in Table 5.5-4, which has been prepared according to NRC regulatory guidance to monitor potential impacts to surface water from uranium ISR facilities.

Table 5.5-3: Operational Stream Sampling Locations

Site ID	Name	Sample Type	Location in NAD 27, South Dakota State Plane South (feet)	
			Northing	Easting
BVC11	Beaver Creek Downstream	Grab	433,638	1,022,546
BVC14	Beaver Creek Upstream	Grab	446,829	1,012,976
CHR01	Cheyenne River Upstream	Grab	423,009	1,016,699
CHR05	Cheyenne River Downstream	Grab	405,925	1,047,227
PSC11	Pass Creek Downstream	Passive sampler	431,452	1,028,064
PSC12	Pass Creek Upstream	Passive sampler	446,470	1,031,222
BEN01	Bennett Canyon	Passive sampler	416,196	1,047,473
UNT01	Unnamed Tributary	Passive sampler	422,482	1,039,166
UNT02	Unnamed Tributary	Passive sampler	424,478	1,035,236
UNT03	Unnamed Tributary	Passive sampler	425,438	1,029,910

Table 5.5-4: Operational Surface Water Monitoring Parameter List and Analytical Methods

Parameter	Units	Analytical Method
pH	pH units	A4500-H B
Total dissolved solids (TDS)	mg/L	A2540 C
Total suspended solids (TSS)	mg/L	A2540 D
Hardness, total as $CaCO_3$	mg/L	A2340 B
Chloride	mg/L	A4500-Cl B; E300.0
Sulfate	mg/L	A4500-SO4 E; E300.0
Arsenic, dissolved	mg/L	E200.8
Cadmium, dissolved	mg/L	E200.8
Chromium, dissolved	mg/L	E200.8
Selenium, dissolved	mg/L	E200.8, A3114 B
Uranium, dissolved	mg/L	E200.8
Uranium, suspended	mg/L	E200.8
Ra-226, dissolved	pCi/L	E903.0
Ra-226, suspended	pCi/L	E903.0
Th-230, dissolved	pCi/L	E907.0
Th-230, suspended	pCi/L	E907.0
Pb-210, dissolved	pCi/L	E909.0M
Pb-210, suspended	pCi/L	E909.0M
Po-210, dissolved	pCi/L	RMO-3008
Po-210, suspended	pCi/L	RMO-3008

5.5.3.2 Reporting

Powertech (USA) will provide DENR with the results of all operational surface water monitoring, including impoundment and stream sampling results. These will be provided in the annual environmental monitoring report described in Section 5.7.2.6.

5.5.4 Land Application Effluent Monitoring

The following describes the effluent water quality monitoring program that will be implemented if land application is used as a wastewater disposal option. Land application system reporting also is described.

5.5.4.1 Monitoring Frequency and Parameters

Powertech (USA) will collect and analyze effluent water quality samples using a progressive sampling schedule that includes volume-based grab samples in accordance with ARSD 74:29:05:15 and time-based grab samples designed to detect any changes in the land application water quality. ARSD 74:29:05:15 specifies the following sampling requirements: "Sampling of solution to be applied to the land shall consist of not less than one grab sample per 100,000 gallons of solution. If less than 100,000 gallons is to be applied to land, at least one grab sample must be taken and analyzed for the required parameters. Each grab sample must be of sufficient volume so the sample can be split. Each split of the sample must be of a volume sufficient to allow for analysis for all operational monitoring parameters. At every fifth sampling, one split sample of each five consecutive grab samples shall be preserved and analyzed for the required monitoring parameters." To meet these requirements, Powertech (USA) proposes to collect a grab sample of the water pumped from the storage ponds to the land application systems at a frequency of at least one sample per 100,000 gallons. This will be accomplished by manually filling the sample containers or installing an automated grab sampler. At every fifth sampling, five consecutive grab samples will be composited and analyzed for the parameters shown in Table 5.5-5.

Justification for a relatively small list of sample parameters for the volume-based grab sampling is based on the large storage capacity available in the storage ponds at each land application site. Based on an anticipated land application rate of 297 to 653 gpm, grab samples representing each 100,000 gallons of effluent will be collected every 2.6 to 5.6 hours, and composite samples representing each 500,000 gallons of effluent will be collected every 12.8 to 28.1 hours. By comparison, the available storage capacity at each site will be 247.2 ac-ft, which is equal to 86 to 188 days of water storage at the typical pumping rates of 297 to 653 gpm, respectively. Changes

Table 5.5-5: Volume-Based Effluent Water Quality Sampling Parameter List

Constituent	Units	Analytical Method
Field pH	s.u.	Field
Laboratory pH	s.u.	A4500-H B
Field conductivity	umhos/cm	Field
Conductivity @ 25°C	umhos/cm	A2510 B

in water quality in the storage ponds will occur very slowly, since the storage capacity far exceeds the pumping rate and since changes in well field water quality will occur slowly. The primary source of land application water, production and restoration bleed, will result from multiple well fields undergoing differing phases of uranium recovery and aquifer restoration. This water will be combined in the storage ponds, where increasing concentrations in water quality constituents from well fields undergoing production will tend to be offset by decreasing concentrations in water quality constituents from well fields undergoing aquifer restoration.

In addition to the volume-based effluent sampling, Powertech (USA) will collect grab samples monthly during operation of each land application system and have them analyzed for the parameters listed in Table 6.2-1. In addition to the parameters in Table 6.2-1, monthly effluent samples will be analyzed for compliance with the anticipated NRC effluent limits listed in Table 5.4-1. These anticipated NRC effluent limits are the 10 CFR Part 20, Appendix B, Table 2, Column 2 established limits for discharge of radionuclides to the environment.

Prior to operation of the land application systems each year, Powertech (USA) will sample the storage ponds and have the samples analyzed for the parameters in Table 6.2-1.

5.5.4.2 Land Application System Reporting

Powertech (USA) will establish and maintain records and prepare and submit reports for land application system operation in accordance with the requirements of ARSD 74:29:05. Refer to Section 5.7.2.6 for a description of land application system reporting, including written notice to implement land application and a written report following each land application cycle, which is defined as the last land application operational period during each calendar year. Additional reporting will be done in accordance with DENR requirements in the approved GDP.

5.5.5 Pond Monitoring

Section 5.3.4.5 describes the monitoring and inspection program that will be implemented to document pond conditions, including inspections of liners, liner slopes and other earthwork features; measurement of pond freeboard to ensure that adequate containment capacity is available; monitoring for water accumulation in leak detection systems; and routine inspections of leak detection system functionality, embankment settlement, and slope stability.

5.5.6 Soil Sampling

5.5.6.1 Land Application Systems

If land application is used to dispose treated wastewater, soil sampling will occur as described in the GDP. Baseline soil samples will be collected prior to operation of each land application system. During operation, soil samples will be collected each year from each land application pivot that was active during that year. Soil samples also will be collected from each catchment area each year.

Potential impacts will be mitigated by monitoring soil concentrations during operations and implementing a contingency plan if concentrations approach trigger values. The proposed trigger values for arsenic and selenium are the average baseline concentrations plus 2 standard deviations. In addition, Powertech (USA) will monitor additional constituents listed in Table 6.4-1 of the GDP. Powertech (USA) will analyze the annual monitoring results and propose additional trigger values if increasing trends are observed. This analysis will be completed annually and provided in the written report submitted to DENR each year that is described in Section 5.7.2.6.

5.5.6.2 General Permit Area Soil Sampling

During operation, Powertech (USA) will collect and analyze soil samples from the air particulate monitoring locations as required by the NRC license. The anticipated sample requirements include sampling surface soils (0-5 cm) annually from each air particulate monitoring location once per year and having the samples analyzed for natural uranium, radium-226, and lead-210. This sampling will provide detection of potential aerial deposition of radionuclides from the Dewey-Burdock Project.

In addition, as described in Section 6, Powertech (USA) will conduct radiological surveys during decommissioning to identify areas for cleanup operations. A pre-reclamation survey will be used to identify cleanup areas, and a post-reclamation survey will be used to ensure that radium and other radionuclides do not exceed NRC standards. The radiological surveys will use gamma-ray detectors that are calibrated to soil radium-226 concentrations.

5.5.6.3 Vegetable Garden Soil Sampling

In accordance with NRC license conditions, Powertech (USA) will sample vegetable garden soil within 2 miles (3.3 km) of the permit area prior to operations. Plant-to-soil concentration factors will be then be used to estimate the levels of radionuclide concentrations in locally grown vegetables. Powertech (USA) anticipates modifying the NRC monitoring program to exclude vegetable garden soil sampling if the pre-operational sample results along with modeling potential radiological impacts demonstrate no significant exposure pathway from vegetable gardens to potential human receptors.

5.5.7 Vegetation Sampling

5.5.7.1 Land Application Systems

If land application is used to dispose treated wastewater, vegetation sampling will occur as described in the GDP. Vegetation samples will be collected annually from the land application areas. Vegetation samples also will be collected from each catchment area each year. Powertech (USA) will monitor for the potential buildup of metals, metalloids, and radionuclides in irrigated vegetation. The vegetation sampling parameters are listed in Table 6.5-1 of the GDP application. Metals and metalloids to be monitored include natural uranium, selenium and arsenic. Prior to operation, Powertech (USA) will develop trigger values for arsenic and selenium based on the preoperational concentrations and the variability in each parameter. Should routine operational monitoring indicate an increasing trend in constituent concentrations with potential to approach trigger values, a contingency plan will be implemented as described in Section 8.4 of the GDP application. The proposed trigger values will be provided to DENR for review and approval prior to initiating land application. The results of annual monitoring and evaluation of potential increasing trends will be provided in the written report submitted to DENR each year that is described in Section 5.7.2.6.

5.5.7.2 General Permit Area Vegetation Sampling

During operation, Powertech (USA) will collect and analyze vegetation samples from the air particulate monitoring locations as required by the NRC license. The anticipated sample requirements include sampling vegetation annually from each air particulate monitoring location once per year and having the samples analyzed for radium-226 and lead-210. The air particulate monitoring locations are located in areas having the highest predicted airborne radionuclide concentrations due to operation of the Dewey-Burdock Project.

In addition, Powertech (USA) will sample general grazing vegetation during the first year of operations in accordance with NRC license conditions. Powertech (USA) anticipates modifying the NRC monitoring program to exclude vegetation or forage sampling after the first year of operations if the initial monitoring results demonstrate that there is no ingestion pathway from grazing animals to potential human receptors. This will not impact vegetation sampling described in 5.5.7.1.

5.5.8 Livestock and Fish Sampling

In accordance with NRC license conditions, Powertech (USA) will collect livestock samples during the first year of operations for comparison to baseline. The anticipated sample requirements include collecting tissue samples at the time of slaughter of cattle, pigs and other livestock grazing within the permit area and analyzing samples for natural uranium, radium-226, lead-210, polonium-210 and thorium-230. Powertech (USA) anticipates modifying the NRC monitoring program to exclude livestock sampling after the first year of operations if the initial monitoring results demonstrate that there is no ingestion pathway from grazing animals to potential human receptors.

Powertech (USA) will collect samples of fish species with the potential for human consumption in accordance with NRC license conditions. The anticipated sample requirements include semiannual sampling of species with the potential for human consumption (green sunfish and channel catfish) if present in water bodies potentially affected by contamination.

5.5.9 Air Monitoring

Powertech (USA) will conduct an airborne radiation monitoring program at the Dewey-Burdock Project in accordance with NRC license conditions. The airborne radiation monitoring program will be designed to detect potential worker doses from radon and radionuclide particulates. It will include measurement of radon decay products and radionuclide particulates in the facilities and at effluent release points (e.g., vents).

Powertech (USA) also will conduct an airborne effluent and environmental monitoring program in accordance with NRC license conditions. The anticipated sampling requirements include continuously operating air monitoring stations located around the permit boundary. Filters from air particulate samplers operating continuously will be analyzed quarterly for natural uranium, thorium-230, radium-226, and lead-210. Radon gas will be measured monthly using passive track-etch detectors at each air monitoring station.

5.5.10 Meteorological Monitoring

The meteorological station at the site will continue to be operated by SDSU, or Powertech (USA) may install and operate a new meteorological station. A meteorological station within the permit area will be operated in accordance with NRC license requirements.

5.6 Potential Impacts and Mitigation

5.6.1 Land Use

5.6.1.1 Potential Land Use Impacts

Rangeland and agricultural cropland are the primary land uses within the permit area and the surrounding area. A portion of the land within the permit area will be temporarily converted from its previous use as rangeland and cropland to ISR use on a progressive, phased basis during construction and operation of ISR well fields, processing facilities, and associated infrastructure. However, most of the permit area will be undisturbed, and surface operations (e.g., wells and processing facilities) will affect only a small portion of it. Section 5.3.7 describes the total anticipated disturbance (topsoil stripping) area over the life of the project.

The land likely will experience an increase in human activity also contributing to land disturbance. The disturbance associated with drilling, pipeline installation, and facility construction will be limited and temporary as vegetation will be re-established through concurrent reclamation. The construction of access roads will be minimized to the extent possible by using and upgrading existing roads.

Operation of the project facilities will restrict the use of a portion of the land as rangeland and cropland for the duration of operations. This includes fenced well field areas, facility areas, and land application areas. This temporary change in land use will last until these areas are reclaimed and released for unrestricted use. Given the relatively small size of the impacted areas, the exclusion of grazing from well field and facility areas over the course of the project is expected to have minimal impact on local livestock production. Following reclamation, the permit area will be returned to the approved postmining land uses.

Recreational use, which is limited primarily to large game hunting, also will be temporarily impacted within the permit boundary. Hunting is currently open to the public on approximately 5,700 acres. Approximately 240 acres of federal land are managed by the BLM. SDGF&P leases around 3,000 acres annually of privately owned land and currently designates this acreage as walk-in hunting areas (refer to Section 3.1.2). Due to safety concerns, Powertech (USA) will work with BLM, SDGF&P and private landowners to limit hunting within the permit area to the extent practicable.

5.6.1.2 Mitigation of Potential Land Use Impacts

The following procedures will be used to minimize the potential impacts to land use.

- Disturbance will be limited to only what is necessary for operations; this will be done by using existing access roads as practicable and combining access road and utility corridors.
- Development of Quality Assurance/Quality Control (QA/QC) plan to monitor the effectiveness of mitigation methods.
- Restrict normal vehicular traffic to designated roads and keep required traffic in other areas of the well field to a minimum.
- Use Class V deep disposal wells to the extent practicable for disposal of liquid wastes to mitigate potential land use impacts from land application systems.
- Conduct site ISR reclamation in interim steps to minimize potential land use environmental impacts. Sequential well field development will minimize land area impacted at any one time.
- Ponds will be reclaimed and re-vegetated and the land released for postmining uses.
- After groundwater restoration is completed, each well field and associated pipelines and facilities will be decommissioned. This includes plugging and abandoning all wells in accordance with DENR 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.
- 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.
- Prior to completion of reclamation, landowners will be contacted and given the option to retain the roads for their private use or have the roads reclaimed by Powertech (USA). If the roads are deemed beneficial to others (i.e., hunters, ranchers and residents) and the

landowner agrees, the roads will not be reclaimed. Only roads related to ISR operations will be reclaimed.

5.6.2 Soils

5.6.2.1 Potential Soil Impacts

The two main drainage basins in the permit area have different soil types. The soil mapping unit descriptions are in Section 3.3. The Beaver Creek basin soils are composed of Haverson loam, with 0-2 percent 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 percent slopes. The historical mine pits also were classified as Barnum silt loam and Barnum-Winetti complex.

Potential soil impacts to disturbed areas include:

- Compaction
- Loss of productivity
- Loss of soil
- Salinity
- Soil contamination

These impacts could potentially occur via:

- Clearing vegetation
- Compaction
- Excavation
- Leveling
- Redistribution of soil
- Stockpiling

Severity of potential impacts to soil is dependent upon type of disturbance, duration of disturbance and quantity of acres disturbed. 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 within certain area, some soils have the potential for compaction. Compaction of the soil can lead to decreased infiltration, thereby increasing runoff. Soils compacted during construction and operations will be restored (i.e., disced and reseeded) as soon as possible following use.

Based on the soil mapping unit descriptions, the hazard for wind and water erosion within the permit 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.

If land application is used to dispose treated wastewater, there could be potential impacts to the soil from the buildup of salts, changes in 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 GDP and summarized in the following section.

Facility development will displace topsoil temporarily, which could adversely affect the structure and microbial activity of the soil. Loss of vegetation would expose soils and could result in a loss of organic matter in the soil. Excavation could cause mixing of soil layers and breakdown of the soil structure. Removal and stockpiling of soils for reclamation could result in mixing of soil profiles and loss of soil structure. Compaction of the soil could decrease pore space and cause a loss of soil structure as well. This could result in a reduction of natural soil productivity. Increased erosion and decreased soil productivity may cause a potential long-term declining trend in soil resources. Long-term impacts to soil productivity and stability could occur as a result of large-scale surface grading and leveling, until successful reclamation is accomplished. Reduction in soil fertility levels and reduced productivity could affect diversity of reestablished vegetative communities. Infiltration could be reduced, creating soil drought conditions. Vegetation could undergo physiological drought reactions (Lost Creek, 2007).

Overall, the potential environmental impacts to the soil within the permit area may be increased compared to areas outside the permit area but typically will not result from the ISR process itself, but rather from ancillary activities such as wastewater disposal and construction. The facility will be operated to minimize erosion and surface disturbance and then restored, leaving little impact on soils.

5.6.2.2 Mitigation of Potential Soil Impacts

The following measures will be used to minimize the potential impacts to soil resources.

- Design of facilities to minimize surface disturbance.
- Salvage and stockpile soil from disturbed areas (refer to Section 5.3.7).

- 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).
- Decrease runoff from disturbed areas by using structures to temporarily divert and/or dissipate surface runoff from undisturbed areas (refer to Section 5.3.9).
- Retain sediment within the disturbed areas by using silt fencing, sediment ponds, and other ASCMs (refer to Section 5.3.9).
- Fill pipeline and utility trenches with appropriate material and regrade and reseed surface soon after completion.
- 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.
- 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.
- Implement spill prevention and cleanup standard operating procedures to minimize soil contamination from vehicle accidents and/or well field 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 well field areas where spills or leaks are possible.
- Excavate contaminated soil as described in Section 6.3.3 and replace with uncontaminated soil as needed.
- Specific mitigation measures for potential soil impacts from land application are addressed in the GDP and summarized as follows:
    - The expected land application water quality is described in Section 5.4.1.1.4.1. With an anticipated TDS 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. Powertech (USA) will 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.
    - 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 SAR increase and pose a risk to soil infiltration, Powertech (USA) will apply amendments such as sulfur or gypsum at agronomic rates.

- Since Powertech (USA) will 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 surveys during decommissioning.
- During decommissioning, Powertech (USA) will conduct land cleanup in accordance with NRC license and DENR 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.
- 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:
    - Verify sample results and precisely delineate affected areas through additional soil sampling and analysis.
    - Modify land application system operating parameters to reduce the discharge rate in specific pivots or throughout the land application area.
    - Implement water treatment if necessary for radionuclides, metals or metalloids.
    - Implement a phytoremediation plan to control buildup of selenium in soil.
    - Excavate soil contaminated above the reclamation standards established in the NRC license and LSM permit and dispose excavated soil in an appropriately permitted disposal facility.
- Powertech (USA) may apply fertilizer to the land application areas to maximize crop production and maintain adequate soil fertility.

5.6.3 Groundwater

5.6.3.1 Potential Groundwater Impacts

Potential groundwater impacts include groundwater consumption, drawdown in nearby water supply wells, and potential groundwater quality impacts. Each of these is discussed below.

5.6.3.1.1 Potential Groundwater Consumption

Inyan Kara Aquifer

ISR circulates significant quantities of water through the ore zone, but only a small fraction of that water is a net withdrawal because most water is reinjected into the deposit. During ISR operations (including both production and restoration), a small portion of the solution extracted from the aquifer will be "bled" from the system. Bleed is defined as excess production or restoration solution withdrawn to maintain a cone of depression so native groundwater continually flows toward the center of the production zone. 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 production bleed may vary in the range of 0.5 to 3% for short durations, from days to months. If necessary, additional aquifer restoration bleed (up to 17%) will be used briefly during aquifer restoration to recover additional solutions and draw a greater influx of water into the ore zone from the surrounding Inyan Kara aquifer. This is known as groundwater sweep.

Table 5.6-1 summarizes the typical Inyan Kara water usage for the Dewey-Burdock Project. During uranium recovery (production), Powertech (USA) proposes to pump up to 8,000 gpm from the Inyan Kara aquifer. The typical production bleed rate will be 0.875%. Therefore, the net production withdrawal will typically be up to 70 gpm. During aquifer restoration, Powertech (USA) 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 aquifer restoration withdrawal will be up to 85 gpm. During concurrent production 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.

Madison Limestone

Table 5.6-2 summarizes the anticipated typical water consumption from the Madison Limestone. This includes approximately 12 gpm usage at the CPP plus aquifer restoration water. In the DDW option, the water withdrawn from the well fields will be treated with RO, and resulting permeate will be reinjected along with Madison Limestone water into the well fields. Based on an estimated permeate recovery rate of 70%, the Madison Limestone requirement will be 65 to 145 gpm at 17% and 1% aquifer restoration bleed, respectively.

Table 5.6-1: Typical Inyan Kara Water Usage

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 5.6-2: Typical Madison Water Usage

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

In the land application option, all of the water withdrawn during aquifer 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 aquifer restoration pumping rate will be up to 500 gpm, between 415 and 495 gpm from the Madison Limestone will be reinjected into well fields undergoing aquifer restoration.

5.6.3.1.2 Potential Drawdown

Inyan Kara Aquifer

Petrotek Engineering Corporation (Petrotek) prepared a numerical groundwater flow model using site-specific data to predict hydraulic responses of the Fall River and Chilson aquifers to ISR production and restoration operations at the Dewey-Burdock Project. A primary model objective was to predict drawdown on a local and regional scale.

The numerical groundwater model domain encompasses nearly 360 square miles with north-south and east-west dimensions of 100,000 ft (18.9 miles). The northern and eastern boundaries of the model domain represent the updip 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. 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 production 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 5.6-A. Figures 6-38 and 6-39 in Appendix 5.6-A depict the modeled maximum drawdown for the Fall River and Chilson, respectively, at an 8,000 gpm gross production rate with a 1% production bleed and 1% aquifer 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 production and restoration in Table 5.6-1.

Figure 6-38 in Appendix 5.6-A shows the maximum predicted drawdown in the Fall River Formation, and Figure 6-39 in Appendix 5.6-A 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. The groundwater model report in Appendix 5.6-A shows that potential drawdown impacts will be short-lived, with recovery to within 1 to 2 feet of pre-ISR levels within one year after the end of ISR operations.

The potential to unlawfully impair existing water rights or domestic wells will be addressed in Inyan Kara aquifer water appropriation permits obtained through the DENR Water Rights Program. The Inyan Kara water rights applications demonstrate that Inyan Kara water is available for the proposed use and the proposed diversions can be developed without unlawful impairment of existing rights.

Madison Limestone

Powertech (USA) has developed a conceptual groundwater flow model of the Madison Limestone in the vicinity of the permit area. The model results are provided with the water appropriation permit application for the Madison that has been submitted to the DENR Water Rights Program. The conceptual model demonstrates that Madison water is available for the proposed use and the proposed diversions can be developed without unlawful impairment of existing rights.

5.6.3.1.3 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.

5.6.3.1.3.1 Potential Impacts to Ore Zone Groundwater Quality

A potential environmental impact to groundwater as a result of ISR is the degradation of water quality in the ore zone within the well field 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. This will result from oxidation of uranium and other trace constituents and through the IX process, which will exchange dissolved uranium for chloride or bicarbonate ions.

During aquifer restoration, Powertech (USA) will restore groundwater quality consistent with NRC license conditions, the primary restoration goals being baseline water quality or an EPA-established maximum contaminant level (MCL) on a parameter-by-parameter basis. Therefore, the potential impacts to ore zone groundwater quality will be temporary and will end with NRC approval of successful aquifer restoration in each well field.

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

Horizontal excursions have the potential to contaminate groundwater horizontally outside of the ore zone. Horizontal excursions could be caused by a temporary well field imbalance, in which the inward hydraulic gradient normally maintained by production and restoration bleed is temporarily altered. Horizontal excursions, if left uncontrolled, would have the potential to impact the groundwater quality of USDWs surrounding the ore zone. However, as described in Section 5.6.3.2, an extensive monitoring system will be implemented to ensure that potential excursions are rapidly detected and corrected. Therefore, potential impacts to Inyan Kara groundwater quality outside of the ore zone would be brief and localized.

By properly designing, pump testing, and operating each well field and its associated monitor well network, Powertech (USA) will minimize the risk of excursions and the potential impacts resulting from excursions. By routinely sampling monitor wells for changes in water level and concentrations of highly mobile and conservative excursion parameters, Powertech (USA) will ensure that any potential excursions are identified and corrected quickly. 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, alkalinity and conductivity, which may signal that fluids are moving out from the wellfield … 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 … To date, no excursion from an NRC-licensed ISR facility has contaminated a USDW."

5.6.3.1.3.3 Potential Impacts to Overlying or Underlying Aquifers

Potential impacts to overlying or underlying aquifers could occur from a vertical excursion of ISR solutions into an overlying or underlying aquifer. This could be caused by vertical hydraulic head gradients between the production aquifer and the underlying or overlying aquifers. A vertical hydraulic head gradient could be caused by pumping from either the underlying or overlying aquifers for water supply in the vicinity of the ISR facility. Discontinuities in the thickness and spatial heterogeneities in the vertical hydraulic conductivity of confining units could also lead to vertical movement of solutions and 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 lixiviant to travel from the well bore into the surrounding aquifer. Deep monitor wells drilled through the production aquifer and confining units that penetrate aquitards could potentially create pathways for vertical excursions as well.

Section 5.6.3.2 describes how an extensive monitoring system and MIT program will be implemented to prevent vertical excursions and to provide rapid detection and corrective action in the event of a vertical excursion. Potential impacts to overlying or underlying aquifers would be brief and localized.

5.6.3.1.3.4 Potential Impacts to Alluvium

The primary potential to impact alluvial water quality would be a pipeline leak or spill. Potential impacts and mitigation measures for leaks and spills are addressed in Sections 5.6.4.1 and 5.6.4.2.

If land application is used for liquid waste disposal, the alluvial groundwater quality could be impacted in the vicinity of the land application areas. The GDP and Section 5.6.3.2 describe mitigation measures that will protect alluvial groundwater quality during land application.

5.6.3.1.4 Potential Impacts to Groundwater Hydrologic Balance

Any disturbance to the prevailing hydrologic balance of the affected land and of the surrounding area and to the quantity of groundwater both during and after ISR operations and during reclamation will be minimized in accordance with SDCL 45-6B-41. Powertech (USA) will be required to demonstrate that water is available for the proposed diversions in the Inyan Kara and Madison in order to obtain water appropriation permits from the DENR Water Rights Program. The water appropriation permit applications will demonstrate limited potential impacts to the groundwater hydrologic balance due to limited drawdown.