TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

LIST OF TABLES

TABLE OF CONTENTS (Continued)

LIST OF FIGURES

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

LIST OF APPENDICES

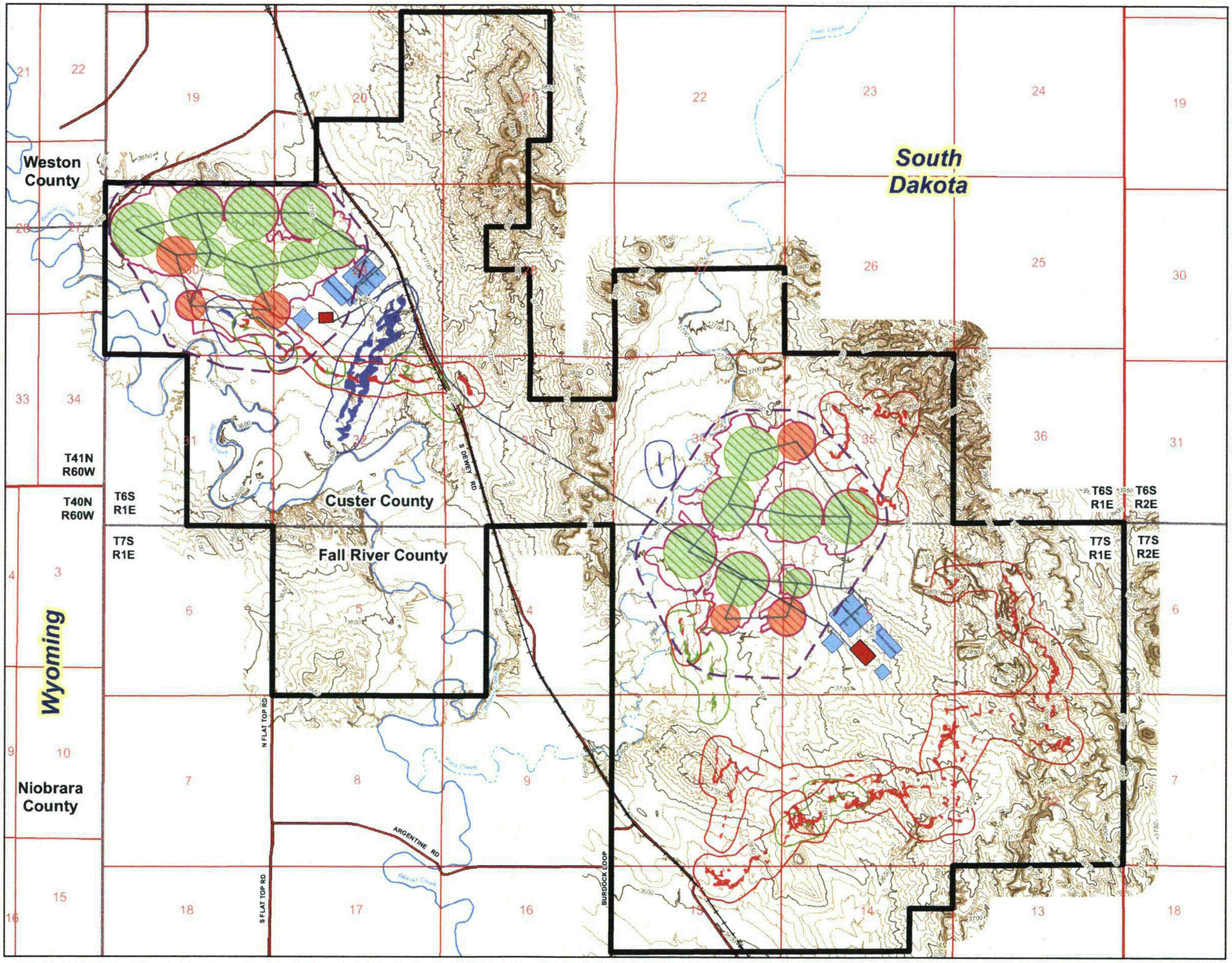


Figure 2.3-2

Proposed Land Application Systems

Dewey-Burdock Project

DRAWN BY	S. Hetrick
DATE	18-Jun-2012
FILENAME	LandApp-Systems.mxd

POWERTECH (USA) INC.

Table 3.2-1: Soil Mapping Unit Acreage within Proposed Dewey POP Zone

Map Symbol	Map Unit Description	Acreage	% Total Acreage
Ar	Arvada, 0 to 6 percent slopes	153.40	18.43
ArV	Arvada Variant Loam, 0 to 6 percent slope	3.64	0.44
Ar-SS	Arvada-Slickspots Complex, 0 to 6 percent slopes	80.46	9.67
Dg	Demar, 0 to 6 percent slopes	38.82	4.67
DA	Disturbed-Ag	0.20	0.02
GrA	Grummit, 0 to 6 percent slopes	47.95	5.76
GrB	Grummit, 6 to 15 percent slopes	16.24	1.95
GrB-RO	Grummit-Rock Outcrop Complex, 6 to 15 percent slopes	19.38	2.33
Ha	Haverson, 0 to 6 percent slopes	21.89	2.63
PeA	Pierre, 0 to 6 percent slopes	206.99	24.87
RO	Rock Outcrop	0.35	0.04
Sc-Ar	Satanta-Arvada Complex, 0 to 6 percent slopes	85.04	10.22
SS	Slickspots	131.62	15.82
ZnB	Zigweid, 6 to 15 percent slopes	17.17	2.07
ZnB-NF	Zigweid-Nihill Complex, 6 to 15 percent slopes	8.98	1.08
Total		**832.13**	**100.00**

Table 3.2-2: Soil Mapping Unit Acreage within Proposed Burdock POP Zone

Map Symbol	Map Unit Description	Acreage	% Total Acreage
Ar	Arvada, 0 to 6 percent slopes	47.31	4.51
Bc	Barnum, 0 to 6 percent slopes	176.57	16.82
Cy	Cushman, 6 to 15 percent slopes	73.17	6.97
DA	Disturbed-Ag	9.07	0.86
GrA	Grummit, 0 to 6 percent slopes	70.53	6.72
GrB	Grummit, 6 to 15 percent slopes	26.85	2.56
GrC	Grummit, 15 to 60 percent slopes	0.14	0.01
He	Hisle, 0 to 6 percent slopes	197.25	18.79
Ky	Kyle, 0 to 6 percent slopes	92.30	8.79
Lo	Lohmiller, 0 to 6 percent slopes	4.09	0.39
MP	Mine Pit	4.19	0.40
NuA	Nunn, 0 to 6 percent slopes	5.80	0.55
NuB	Nunn, 6 to 15 percent slopes	9.15	0.87
Pg	Penrose, 15 to 40 percent slopes	48.82	4.65
PeA	Pierre, 0 to 6 percent slopes	10.85	1.03
PeB	Pierre, 6 to 15 percent slopes	17.71	1.69
Sa	Samsil, 15 to 40 percent slopes	4.42	0.42
SS	Slickspots	51.42	4.89
Ta	Tillford, 0 to 6 percent slopes	196.87	18.75
W	Water	3.43	0.33
Total		**1,049.94**	**100.00**

south of the project area, but no pigs currently graze within the project area or within the proposed land application areas.

3.5 Land Use

The predominant land use within the project area is agricultural production related to grazing (rangeland). Most of the land serves as grazing land for cattle and a few horses. Approximately 390 acres of land are irrigated for hay production along Beaver Creek. Historically, some of the land within the project area was used for mining.

There are five residences within the proposed NRC license boundary, including seasonal residences. There are two residences located within ¼ mile of the land application areas, but no residences are located within the proposed POP zones. Residences and drinking water wells are depicted on Figure 3.5-1 in relation to the proposed land application areas. The drinking water well number 43 near the Burdock area is associated with a former residence that is no longer inhabitable. Well 43 will be plugged and abandoned prior to operation of the Burdock land application system as described in Section 3.7.2.3.2.

Recreational use in and around the project area is limited primarily to large game hunting. Within the project area, hunting is currently open to the public on approximately 5,700 acres. Approximately 240 acres are public lands managed by BLM. In addition, SDGF&P leases around 3,000 acres annually of privately owned land that is designated as walk-in hunting areas. Prior to commencement of operations, Powertech (USA) will work with BLM, SDGF&P and private landowners to limit hunting within the project area to the extent practicable. Temporary fencing, signage, gates and other means of restricting public access will be installed in areas of active ISR operations such as well fields, processing plants and land application areas in order to protect the public, protect workers, prevent damage to facilities, and provide security.

Within the eastern portion of the project area are historical surface and underground mine workings associated with shallow, underground uranium mines and open pits. All of the underground workings are associated with open-pit remnants that are clearly visible in the project area. There are no underground mines within the project area that are not associated with, adjacent to, or extensions of the open pits. These types of underground workings were common at historical surface mines and were considered to be extensions of the open pit mining operations. Based on historical TVA maps, an interview with a former underground mine worker, and an interview with the former Susquehanna-Western geologist who directed the

3.7.2.3 Existing Wells

Historical records and field investigations of the project area and surrounding area were used to develop an inventory of existing wells within 1.2 miles (2 km) of the project area. An initial investigation of the wells was completed in 2007, and additional surveys were conducted in 2011 to evaluate the use and condition of the wells. The well inventory included existing wells, wells with historical records that are currently not present at the surface, and wells with historical records that have been visually confirmed as plugged and abandoned. Appendix 3.7-A contains well inventory summary tables and Appendix 3.7-B contains the detailed well inventory, well completion records and associated documentation. The following sections describe the well inventories for the areas within 1 mile of the proposed Dewey and Burdock POP zones.

Proposed wells include monitor wells and ISR injection and production wells. Monitor wells associated with the GDP are described in Section 6.1. Additional monitor wells and injection/production wells will be constructed within the project area as part of the ISR operations.

3.7.2.3.1 Dewey Area

Table 3.7-3 and Figure 3.7-9 present the well inventory within 1 mile of the proposed Dewey POP zone, which includes 26 existing wells. No wells with historical records that are currently not present or confirmed abandoned have been identified within 1 mile of the Dewey POP zone. Of the 26 existing wells, 3 are currently used for domestic use, 7 for stock watering, and 16 for monitor wells.

All existing domestic wells within the project area will be removed from private use prior to ISR operations, including wells 40 and 4002. Lease agreements for the entire project area currently allow Powertech (USA) to remove and replace the water supply wells as needed. Depending on the well construction, location and screen depth, Powertech (USA) may continue to use the former domestic wells for monitoring or plug and abandon the wells. The remaining domestic well within 1 mile of the proposed Dewey POP zone, well 96, is outside of the project area and will not be impacted by the proposed ISR operations.

Powertech (USA) will work with the owner of wells 40 and 4002 to determine a) whether water supply replacement is necessary, and b) the appropriate replacement water supply alternative, if needed. The two water supply replacement alternatives include drilling a new domestic well or extending a water supply pipeline to the residence. In the first option, Powertech (USA) would drill a new well near the residence. All replacement wells will be constructed in accordance with

South Dakota well construction standards in ARSD 74:02:04. This will ensure that the wells will not create a pathway for vertical migration of potential contaminants. Further, all replacement wells will target formations outside of the ore zone of the nearest well fields, which will occur in the Fall River Formation and/or Chilson Member of the Lakota Formation. In the case of wells 40 and 4002, replacement wells, if required, will be further restricted to locations outside of the POP zone and formations outside of the alluvium in order to eliminate potential impacts from the proposed land application systems.

The second water supply replacement alternative is to extend a pipeline from one of the proposed Dewey-Burdock Project Madison aquifer supply wells to the residence. The Madison wells are currently being permitted through the Water Rights Program with the option to provide domestic and stock water to locations inside and near the project area.

Table 3.7-3: Wells within 1 Mile of Proposed Dewey POP Zone

Hydro ID	Township	Range	Section	1/4 - 1/4 Location	Coordinates East[1]	Coordinates North[1]	Screened Location[2]	Well Use
Existing Wells								
38	6S	1E	33	SWNW	1,024,328	442,289	Fall River	Stock
40	6S	1E	30	SWNW	1,013,415	447,182	Inyan Kara	Domestic[3]
41	6S	1E	31	SWNE	1,015,385	442,081	Unknown	Stock
49	6S	1E	32	NWNW	1,018,932	444,022	Fall River	Stock
96	41N	60W	22	SWSW	1,011,630	451,853	Chilson	Domestic[3]
220	6S	1E	19	SENE	1,017,872	452,334	Unknown	Stock
270	6S	1E	19	NWSW	1,014,108	451,942	Unknown	Stock
609	6S	1E	29	SWNE	1,021,735	447,808	Chilson	Monitor
610	6S	1E	29	SWNE	1,021,599	447,969	Fall River	Monitor
611	6S	1E	20	NWNE	1,021,835	453,954	Chilson	Monitor
612	6S	1E	20	NWNE	1,021,755	454,128	Chilson	Monitor
613	6S	1E	20	NWNE	1,022,125	453,775	Fall River	Monitor
614	6S	1E	20	NWNE	1,022,185	453,769	Fuson	Monitor
615	6S	1E	20	NWNE	1,022,172	453,708	Chilson	Monitor
616	6S	1E	20	SWNE	1,022,132	453,134	Chilson	Monitor
617	6S	1E	20	NENW	1,021,026	453,582	Chilson	Monitor
628	6S	1E	20	SESE	1,022,496	449,718	Fall River	Stock
656	6S	1E	31	SENW	1,014,230	442,000	Unknown	Stock
681	6S	1E	32	NENW	1,020,330	443,725	Fall River	Monitor
683	6S	1E	29	NESW	1,020,212	446,104	Fall River	Monitor
685	6S	1E	32	NWNE	1,020,690	443,409	Fall River	Monitor
687	6S	1E	32	NENW	1,020,081	443,724	Fall River	Monitor
689	6S	1E	32	NENW	1,020,316	443,789	Chilson	Monitor
691	6S	1E	32	NENW	1,020,364	443,698	Fall River	Monitor
693	6S	1E	32	NENW	1,020,327	443,661	Unkpapa	Monitor
4002	6S	1E	30	NWSW	1,013,414	446,931	Inyan Kara	Domestic

1 Coordinate system is NAD 27 South Dakota State Plane South
2 Inyan Kara indicates that screened interval includes both Chilson and Fall River
3 To be removed from service and replaced if necessary prior to ISR operations

3.7.2.3.2 Burdock Area

Table 3.7-4 and Figure 3.7-10 present the well inventory within 1 mile of the proposed Burdock POP zone, which includes 25 existing wells and 7 wells with historical records that have been confirmed as plugged and abandoned. No wells with historical records that are currently not present have been identified within 1 mile of the Burdock POP zone. Of the 25 existing wells, 1 is currently used for domestic use, 1 was formerly used for domestic use, 8 are currently used for stock watering, and 15 are currently used for monitor wells.

All existing domestic wells within the project area will be removed from private use prior to ISR operations, including wells 13 and 43. As described in Section 3.5, well 43 is associated with a former residence that is no longer inhabitable. This well will be plugged and abandoned as described below. Well 13 will be replaced with a new domestic well or a water supply pipeline. Well replacement procedures are described in Section 3.7.2.3.1. In the case of well 13, a replacement well, if required, will be constructed in accordance with ARSD 74:02:04 well construction standards, targeting a formation outside of the ore zone of the nearest well fields and outside of the alluvium, and located outside of the POP zone in order to eliminate potential impacts from the proposed land application systems.

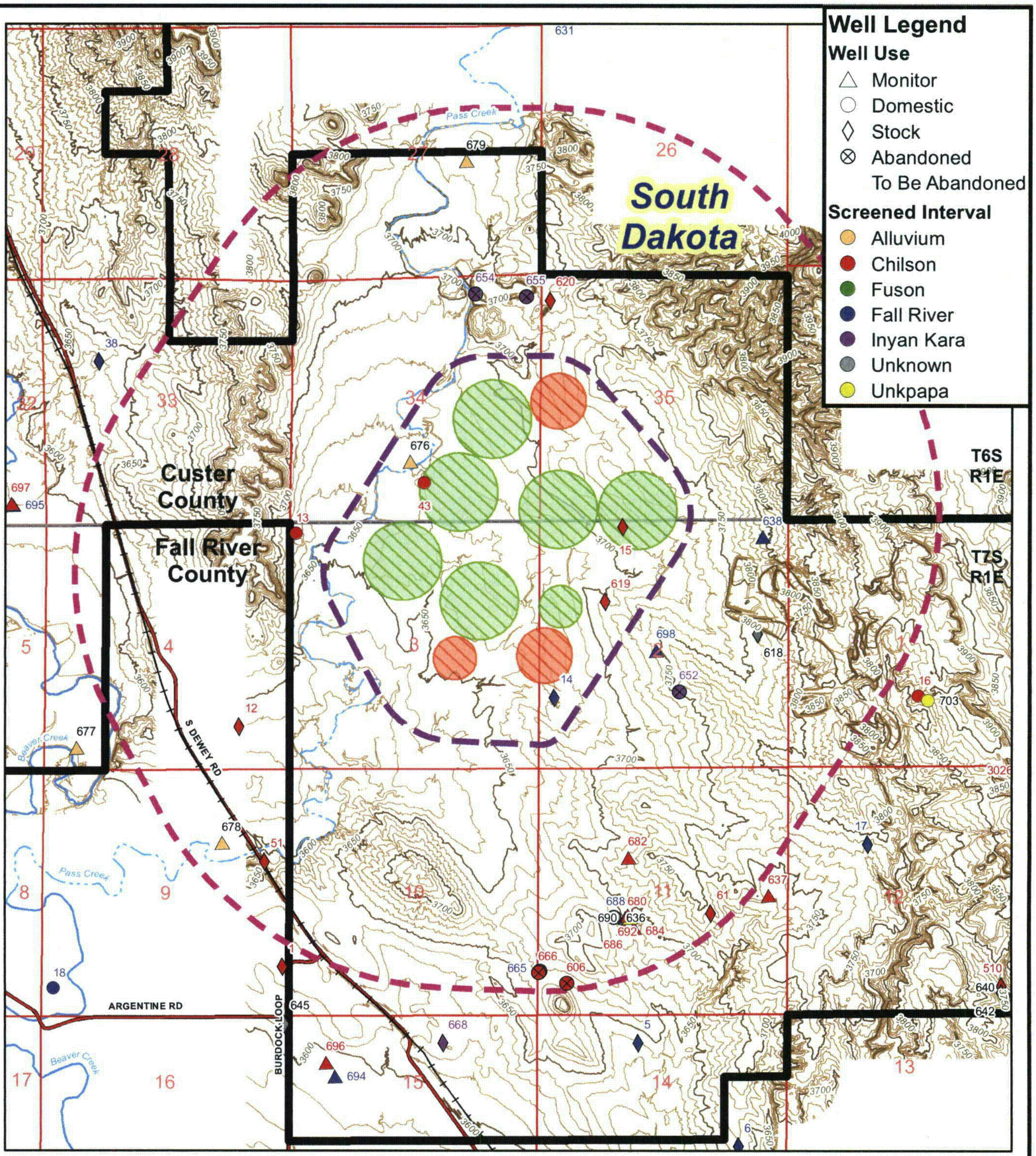
Wells 15 and 43 are both located within land application areas. Based on TVA records, both wells were constructed prior to 1977. Due to the uncertainty in the well construction methods and existing condition of these wells, Powertech (USA) will plug and abandon wells 15 and 43 prior to operation of the Burdock land application system. The wells will be plugged in accordance with ARSD 74:02:04:67 with bentonite or cement grout.

Seven wells are identified as abandoned in Table 3.7-4. Each well was visually inspected, and it has been determined that cement was placed within the well bore.

Table 3.7-4: Wells within 1 Mile of Proposed Burdock POP Zone

Hydro ID	Township	Range	Section	1/4 - 1/4 Location	Coordinates East[1]	Coordinates North[1]	Screened Location[2]	Well Use
Existing Wells								
12	7S	1E	4	SESE	1,026,978	434,378	Chilson	Stock
13	7S	1E	3	NWNW	1,028,360	438,470	Chilson	Domestic
14	7S	1E	2	NWSW	1,033,704	434,723	Fall River	Stock
15[3]	7S	1E	2	NENW	1,035,304	438,317	Chilson	Stock
43[3]	6S	1E	34	SWSE	1,031,123	439,436	Chilson	Domestic[4]
51	7S	1E	9	SENE	1,027,411	431,487	Chilson	Stock
61	7S	1E	11	NWSE	1,036,832	429,987	Chilson	Stock
618	7S	1E	2	SENE	1,038,074	435,906	Unknown	Stock
619	7S	1E	2	SENW	1,034,866	436,729	Chilson	Stock
620	6S	1E	35	NWNW	1,033,951	443,209	Chilson	Stock
638	7S	1E	2	NENE	1,038,269	437,976	Fall River	Monitor
662	7S	1E	11	SESW	1,035,381	428,928	Unknown	Monitor
676	6S	1E	34	SESW	1,030,846	439,891	Alluvial	Monitor
678	7S	1E	9	SWNE	1,026,522	431,925	Alluvial	Monitor
679	6S	1E	27	NWSE	1,032,294	446,245	Alluvial	Monitor
680	7S	1E	11	NESW	1,035,078	429,969	Chilson	Monitor
682	7S	1E	11	SENW	1,035,139	431,257	Chilson	Monitor
684	7S	1E	11	NESW	1,035,191	429,744	Chilson	Monitor
686	7S	1E	11	NESW	1,034,970	429,749	Chilson	Monitor
688	7S	1E	11	NESW	1,035,027	429,974	Fall River	Monitor
690	7S	1E	11	NESW	1,035,114	429,970	Unkpapa	Monitor
692	7S	1E	11	NESW	1,035,075	430,014	Chilson	Monitor
698	7S	1E	2	NESW	1,035,909	435,651	Fall River	Monitor
707	6S	1E	34	SWNE	1,031,935	441,809	Alluvial	Monitor
708	7S	1E	3	SESW	1,030,254	434,094	Alluvial	Monitor
Abandoned Wells								
606	7S	1E	11	SWSW	1,033,713	428,609	Chilson	None
636	7S	1E	11	NESW	1,034,774	429,982	Unknown	None
652	7S	1E	2	NWSE	1,036,360	434,742	Inyan Kara	None
654	6S	1E	34	NWNE	1,032,372	443,410	Inyan Kara	None
655	6S	1E	34	NENE	1,033,454	443,307	Inyan Kara	None
665	7S	1E	11	SWSW	1,033,153	428,901	Fall River	None
666	7S	1E	11	SWSW	1,033,128	428,870	Chilson	None

[1] Coordinate system is NAD 27 South Dakota State Plane South
[2] Inyan Kara indicates screened interval includes both Chilson and Fall River
[3] To be plugged and abandoned prior to operation of the Burdock land application system
[4] Formerly used as a domestic well; former residence is uninhabitable



Note: 10' topographic contours generated by Merrick & Co., 2008 aerial topographic survey.

Feet: 0, 1,500, 3,000
Meters: 0, 300, 600, 900

Legend

- Project Boundary
- BNSF Railroad
- County Roads
- Ephemeral Streams
- Perennial Streams
- Land Application
- Standby Land Application
- Burdock POP Zone
- 1 Mile from Burdock POP Zone

N

Figure 3.7-10

Existing and Abandoned Wells within 1 Mile of the Proposed Burdock POP Zone Dewey-Burdock Project

DRAWN BY	S. Hetrick
DATE	14-Jun-2012
FILENAME	Wells-AllBurd1Mile.mxd

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5.3 Pond Design

The storage ponds will be used to store treated water during the times when the land application systems are not operating. These ponds will include a single geosynthetic liner underlain by a 1-foot minimum thickness clay liner. The total estimated capacity per storage pond is 63.8 ac-ft, with 2.0 ac-ft reserved for containment of the 100-year, 24-hour storm event while maintaining 3 feet of freeboard. The available capacity of each pond is therefore 61.8 ac-ft. The storage pond dimensions will be approximately 465 feet x 465 feet x 30 feet deep.

Additional ponds at each site will include outlet ponds, radium settling ponds, and spare ponds designed to be used as either radium settling ponds or in the same capacity as the central plant pond. One central plant pond will also be provided at the Burdock CPP. The central plant pond capacity allows for adequate storage for CPP liquid waste during the initial project startup period when uranium recovery is occurring, but before aquifer restoration activities have started. During this time, CPP liquid waste will need to be stored for approximately 18 months until groundwater sweep water is available for blending with the CPP liquid waste. This capacity will provide flexibility for blending the liquid wastes during normal operation. The central plant pond capacity will allow storage of up to 660 days of CPP liquid water production at 12 gpm. Design information for these ponds is found within the Technical Report prepared for the NRC license application for the Dewey-Burdock Project.

Several ponds are located either wholly or partially within the proposed POP zones. In the Dewey area these include some of the storage ponds, the radium settling pond, the spare radium settling pond, the outlet pond, and the spare storage pond. In the Burdock area these include some of the storage ponds. Following is a description of the pond liners, leak detection systems, and inspection programs that will prevent potential groundwater impacts. Since the ponds will be lined they are not proposed as sources of discharge for the Groundwater Discharge Plan and are not considered in the designation of the proposed POP zones.

The storage ponds and outlet ponds will store treated water and will therefore pose minimal risk to groundwater. Nevertheless, each of these ponds will contain a single geosynthetic liner underlain by a 1-foot minimum thickness clay liner. These ponds will not include leak detection systems but will be inspected routinely as described in Section 10.

The radium settling ponds, spare ponds, and central plant pond will each contain a dual geosynthetic liner with a leak detection system, with a 1-foot minimum thickness clay liner beneath the secondary geosynthetic liner. The primary and secondary liners will be separated by

a geonet, which will provide a physical separation and allow any fluid to flow between the two liners. A minimum grade of 2 percent will be maintained across the bottom of the pond toward a leak detection sump. Any potential leakage from the primary liner will be contained by the secondary liner and collected in the leak detection sump. The sump will be routinely monitored for the presence of fluid as described below. Should a leak occur, the pond will be removed from service and dewatered by transferring the contents to a spare pond.

Routine inspections for all ponds will be conducted in accordance with NRC license requirements as discussed in Section 10. In addition, routine inspections for ponds with leak detection systems will include daily checks for water accumulation in leak detection systems and monthly inspections of the functionality of leak detection systems.

5.4 Catchment Areas

Runoff from significant precipitation events or snowmelt on the land application areas will be conveyed to collection areas downgradient from the land application areas and allowed to evaporate or infiltrate. The minimum collection area will be 35 acres at each of the Dewey and Burdock sites, and the capacity will be sufficient to contain the estimated 100-year runoff event from each center pivot area. The application rate will be maintained at an agronomic rate that will prevent runoff from the center pivot areas to the catchment areas during normal operation. The application rate will be adjusted as necessary including temporary shutdown if needed to prevent excessive ponding in the catchment areas. The catchment areas will be constructed with berms and will be graded to prevent any runoff from applied water and rainfall on the land

application areas from reaching surface water. Berms surrounding the land application areas and catchment areas will also prevent any surface water from entering or leaving the land application areas. Catchment area capacities were estimated using the SPAW model as described below.

5.5 Irrigated Crops

Irrigated crops may include one or more of the following: native vegetation (primarily warm season perennial grasses, cool season perennial grasses, and perennial shrubs), alfalfa, or salt-tolerant wheatgrass.

5.6 Land Application System Operation

The center pivot irrigation systems will typically operate 24 hours per day during the normal frost-free season, which is approximately April through October. The land application systems will have variable operation schedules to allow for adjustments due to weather conditions and other site-specific conditions. The land application system design will allow for instantaneous shutdown of any one or more center pivots as needed. Temporary shutdowns would occur in the event of a piping leak, for maintenance activities, during significant precipitation events, due to excessive ponding in a catchment area, or due to cold temperature. The land application systems will not be used when water cannot infiltrate due to frozen ground. During times when land application will not be used, the treated liquid waste stream will be temporarily stored in ponds. As discussed in Section 5.7.4, the storage ponds will have significant surplus capacity. This will provide contingency to allow for a late spring startup or an early fall stoppage of operations. In addition, Section 5.3 describes how the central plant pond will provide additional capacity for blending of process water to keep the land application water quality relatively consistent.

The land application schedule will follow the project schedule shown in Figure 2.4-1. Land application will occur during production and restoration, the total duration of which is expected to be approximately 9.25 years. During the initial production period prior to restoration, which is expected to last approximately 1.5 to 2 years, the land application rate will be relatively low. During this phase the CPP liquid waste will be stored in the central plant pond and the land application solutions will consist almost entirely of production bleed. The average annual production bleed will be less than 100 gpm, or less than one-third the design average annual application rate of 310 gpm shown in Tables 5.1-1 and 5.2-1. The land application rate will be highest during concurrent production and restoration, which is expected to last approximately 6 years. The design application rates shown in Table 5.1-1 and 5.2-1 are based on this period of operation. The final project phase will be restoration without concurrent production. The land application rate during this relatively brief phase (approximately 0.25 year) will be slightly less

than the values shown in Tables 5.1-1 and 5.2-1, since there will not be disposal of production bleed.

5.7 Hydrologic Land Application and Pond Simulations

Disposal capacity for the land application system was estimated using the SPAW (Soil-Plant-Atmosphere-Water) model, which is described below. In addition to estimating the water budget for agricultural landscapes, the SPAW model also was used to estimate the water budget for the storage ponds and catchment areas.

5.7.1 SPAW Model Description

The SPAW (Soil-Plant-Atmosphere-Water) model was developed by the USDA (Saxton and Willey, 2006) to simulate the daily hydrologic water budgets of agricultural landscapes by two connected routines, one for farm fields and one for impoundments such as irrigation ponds. The field hydrology simulation is represented by: 1) daily climatic descriptions of precipitation, temperature, and evaporation, 2) a soil profile of interacting layers each with unique water holding characteristics, and 3) annual crop growth with management options for rotations, irrigation, and fertilization. The model output for the field hydrology routine includes a daily vertical, one-dimensional water budget depth for all major hydrologic processes such as runoff, infiltration, evapotranspiration, soil water profiles, and percolation. Water volumes for each component of the water balance are estimated by multiplying the water budget depth times the associated field area.

Pond hydrology simulations provide water budgets by multiple input and depletion processes for impoundments whose water source is runoff from agricultural fields and/or water produced by wells or other sources. Model outputs for the pond hydrology routine include daily values of depth, volume, precipitation, evaporation, and change in storage for the period of simulation. The version of the SPAW model used was Version 6.02.75. The model has been extensively tested by the developers using research data and real-world applications.

5.7.2 Model Input Parameters

5.7.2.1 Meteorological Parameters

The local climate at the project site is continental, with hot summers, cold winters, and an average annual precipitation of 16 to 17 inches. The wettest months are from May to July. May and June are the months of highest average precipitation, with occasional thunderstorms that can be severe. Typical average daily temperatures range from 23 °F in January to 73 °F in July.

PET for each month was then calculated by dividing the monthly PET by the number of days in the month. Table 5.7-3 shows the estimated average monthly and annual potential evapotranspiration at the site calculated using this method.

Table 5.7-3: Average Monthly and Annual Potential Evapotranspiration at Project Site (inches)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
0.92	1.23	1.98	3.30	4.40	5.76	7.08	6.95	5.50	3.74	2.02	1.10	44.0

5.7.2.2 Material Properties

To characterize the soils at the site, eleven test pits were excavated on July 11 and 12, 2008. Samples were collected at various depths and analyzed for particle size distribution, dry bulk density, permeability, and other geotechnical parameters. Test pits 1 through 5 were excavated at the Dewey land application area, and test pits 6 through 11 were excavated in and near the Burdock land application area. The test pit locations are shown on Figure 3.2-1. Section 3.2.5 provides a summary of the soil properties.

5.7.3 Modeling Approach

The general assumptions for the SPAW model include the following:

1. The model is a one-dimensional vertical model.
2. The model assumes that the modeled area is spatially uniform in soil, crop and climate characteristics.
3. Model inputs and outputs are based on daily values.
4. The model does not does not include flow routing or channel descriptors.
5. Daily runoff is estimated as an equivalent depth over the simulation field by the USDA/SCS Curve Number method.
6. The field budget utilizes a one-dimensional vertical system beginning above the plant canopy and proceeding downward through the soil profile to a depth sufficient to represent the complete root penetration and subsurface hydrologic processes (lateral soil water flow is not simulated).

Specific assumptions related to this project are as follows:

1. Daily precipitation and temperature data used in the model are based on 28 years of record from the Edgemont, South Dakota station.
2. SPAW modeling was done for two land application and pond areas, the Dewey site and the Burdock site.

excess production solution withdrawn to maintain a cone of depression so native groundwater continually flows to the center of the production zone.

Table 5.8-1 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 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.

The typical water quality during land application will be better than that shown in Table 5.8-1, since the water quality will be continually improving during aquifer restoration. Table 5.8-2 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 will typically 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. This will be accomplished through treating the water as follows.

Prior to discharge to the storage ponds, Powertech (USA) will treat all land application water 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. This 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 and lead-210 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 Appendix B limits.

As stated in Section 2.2.1 the land application water will not contain any domestic (septic) waste water.

The values shown in Tables 5.8-1 and 5.8-2 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 5.8-1. 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

Compliance wells are proposed hydrologically down-gradient from the land application systems at the POP zone boundaries. These wells will serve as compliance monitoring locations for potential impacts to alluvial water quality outside of the POP zone.

Interior wells are proposed within each POP zone to measure potential changes in alluvial water quality within the POP zones. Per ARSD 74:54:02:06(9)(a), the interior wells will be positioned approximately 1/3 the distance between the point of application (pivot areas) and the compliance monitoring points.

Other wells are proposed to measure ambient alluvial water quality within the project area. These include wells located upgradient of the proposed land application systems and downgradient wells outside of the POP zones. Many of these wells will be monitored as a condition of the NRC license and are not directly associated with the GDP. Nevertheless, Powertech (USA) will provide the monitoring results for these other wells to DENR.

Tables 6.1-1 and 6.1-2 present the proposed alluvial monitor wells. The wells are depicted on Figures 6.1-1 and 6.1-2.

Table 6.1-1: Proposed Alluvial Monitor Wells, Dewey Land Application System

Category	Well ID	Qtr-Qtr	Section	Township	Range	Status
Compliance wells	DC-1	NWSW	30	6S	1E	Proposed
	DC-2	SESW	30	6S	1E	Proposed
	DC-3	NENW	31	6S	1E	Proposed
	DC-4	NWNW	32	6S	1E	Proposed
Interior wells	DI-1	SWNW	30	6S	1E	Proposed
	DI-2	SESE	30	6S	1E	Proposed
	DI-3	SWSW	29	6S	1E	Proposed
Other wells	TBD	NWNW	30	6S	1E	Proposed
	TBD	NWSE	32	6S	1E	Proposed
	677	SWSW	4	6S	1E	Existing

Table 6.1-2: Proposed Alluvial Monitor Wells, Burdock Land Application System

Category	Well ID	Qtr-Qtr	Section	Township	Range	Status
Compliance wells	BC-1	NWSW	3	7S	1E	Proposed
	BC-2	SESW	3	7S	1E	Proposed
	BC-3	NWNW	4	7S	1E	Proposed
Interior wells	BI-1	SENW	3	7S	1E	Proposed
	BI-2	NWSE	3	7S	1E	Proposed
	BI-3	NWNE	3	7S	1E	Proposed
	BI-4	NWNW	3	7S	1E	Proposed
Other wells	676	SESW	34	6S	1E	Existing
	678	SWNE	9	7S	1E	Existing
	679	NWSE	27	6S	1E	Existing
	707	SWNE	34	6S	1E	Existing
	708	SESW	3	7S	1E	Existing

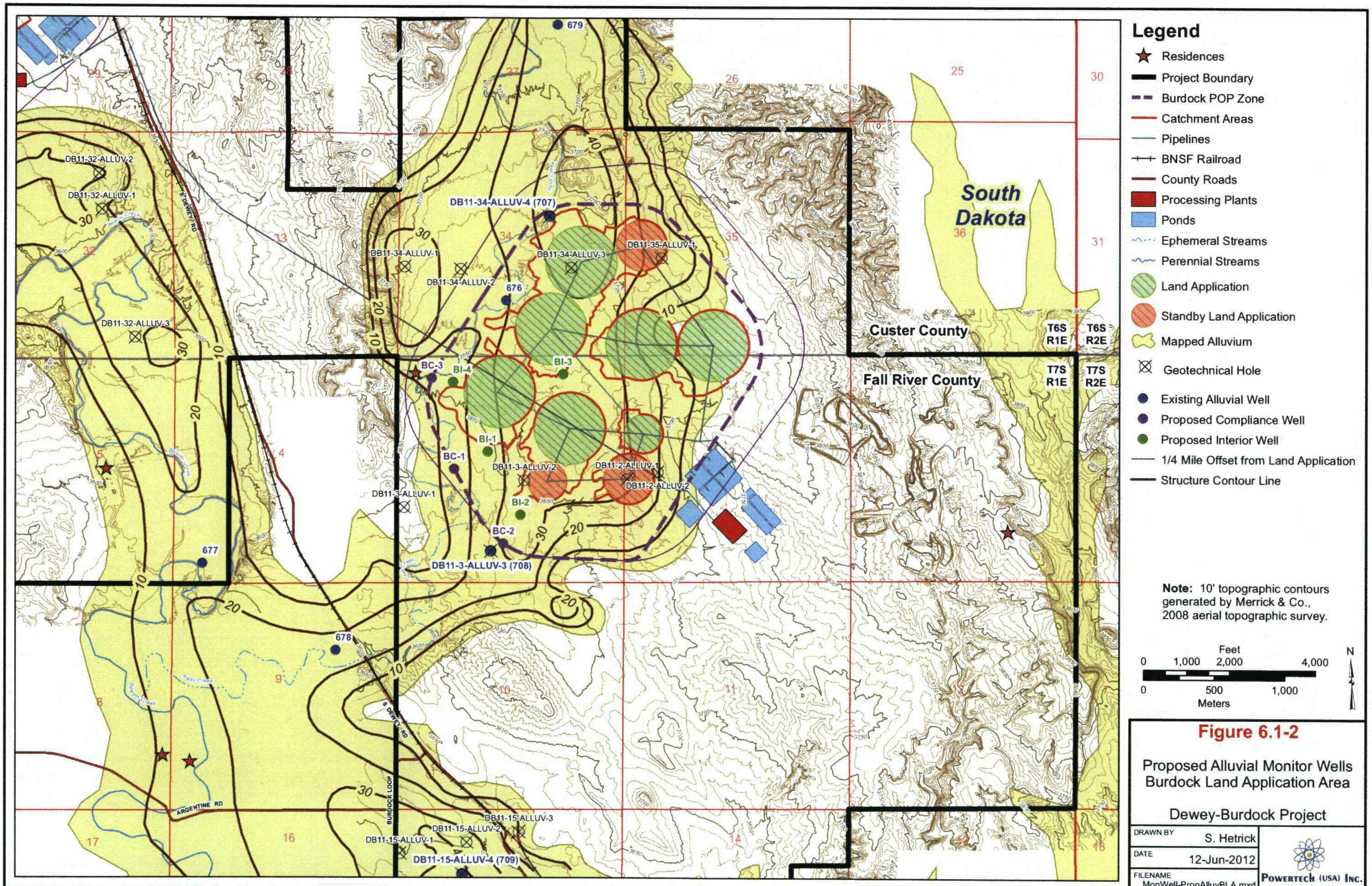

Figure 6.1-2

Proposed Alluvial Monitor Wells
Burdock Land Application Area

Dewey-Burdock Project

DRAWN BY	S. Hetrick
DATE	12-Jun-2012
FILENAME	MonWell-PropAlluvBLA.mxd

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During operation of the land application systems, pore water samples will be collected once prior to each irrigation season, once during each irrigation season (for lysimeters installed beneath operational pivots and catchment areas only), and once after each irrigation season. Samples will be analyzed for the same parameters as pre-operational monitoring.

6.1.4 Domestic Wells

Domestic wells within 1.2 miles (2 km) of the project area will be monitored prior to and during ISR operations, including operation of the proposed land application systems. In accordance with NRC license conditions, samples will be collected quarterly for four quarters prior to operations and annually during operations. Samples will be analyzed for the constituents in Table 6.1-3. To demonstrate protection of drinking water wells during operation of the proposed land application systems, Powertech (USA) will provide the sample results to DENR.

6.2 Surface Water

6.2.1 Streams

Prior to ISR operations, Powertech (USA) will establish upstream and downstream sampling sites on Beaver Creek and Pass Creek. The locations of the stream sampling sites are listed in Table 6.2-1 and depicted on Figure 6.2-1. These locations are different from those described in Section 4.1. The new stream sampling sites better meet NRC regulatory guidance. The upstream sites on each creek will be positioned approximately at the upstream boundaries of the NRC license area and will represent ambient water quality. The downstream location on Beaver Creek is downstream of the Dewey land application system, and the downstream location on Pass Creek is downstream of the Burdock land application system.

Table 6.2-1: Operational Stream Sampling Locations

Site ID	Name	Sample Type	Location (feet)[1]	
			Northing	Easting
BVC11	Beaver Creek Downstream	Grab	433,638	1,022,546
BVC14	Beaver Creek Upstream	Grab	446,829	1,012,976
PSC11	Pass Creek Downstream	Passive sampler	431,452	1,028,064
PSC12	Pass Creek Upstream	Passive sampler	446,470	1,031,222

[1]Coordinate system is NAD 27, South Dakota State Plane South

Prior to ISR operations, Powertech (USA) will sample each stream sampling site monthly for 12 consecutive months. Grab samples will be collected from sites BVC11 and BVC14. Passive samplers will be installed at sites PSC11 and PSC12 to collect samples during ephemeral flow events. Water samples will be analyzed for constituents listed in Table 4.1-2.

During ISR operations, including operation of the land application systems, streams will be sampled by grab sampling or with automatic samplers. Grab samples will be collected quarterly from the perennial stream sampling locations on Beaver Creek. Passive samplers (single-stage samplers) will be installed at Pass Creek sampling sites from April through October. These will automatically collect samples when the flow rate in the channel reaches a field-adjustable minimum depth threshold. Following the runoff event the water will be manually transferred

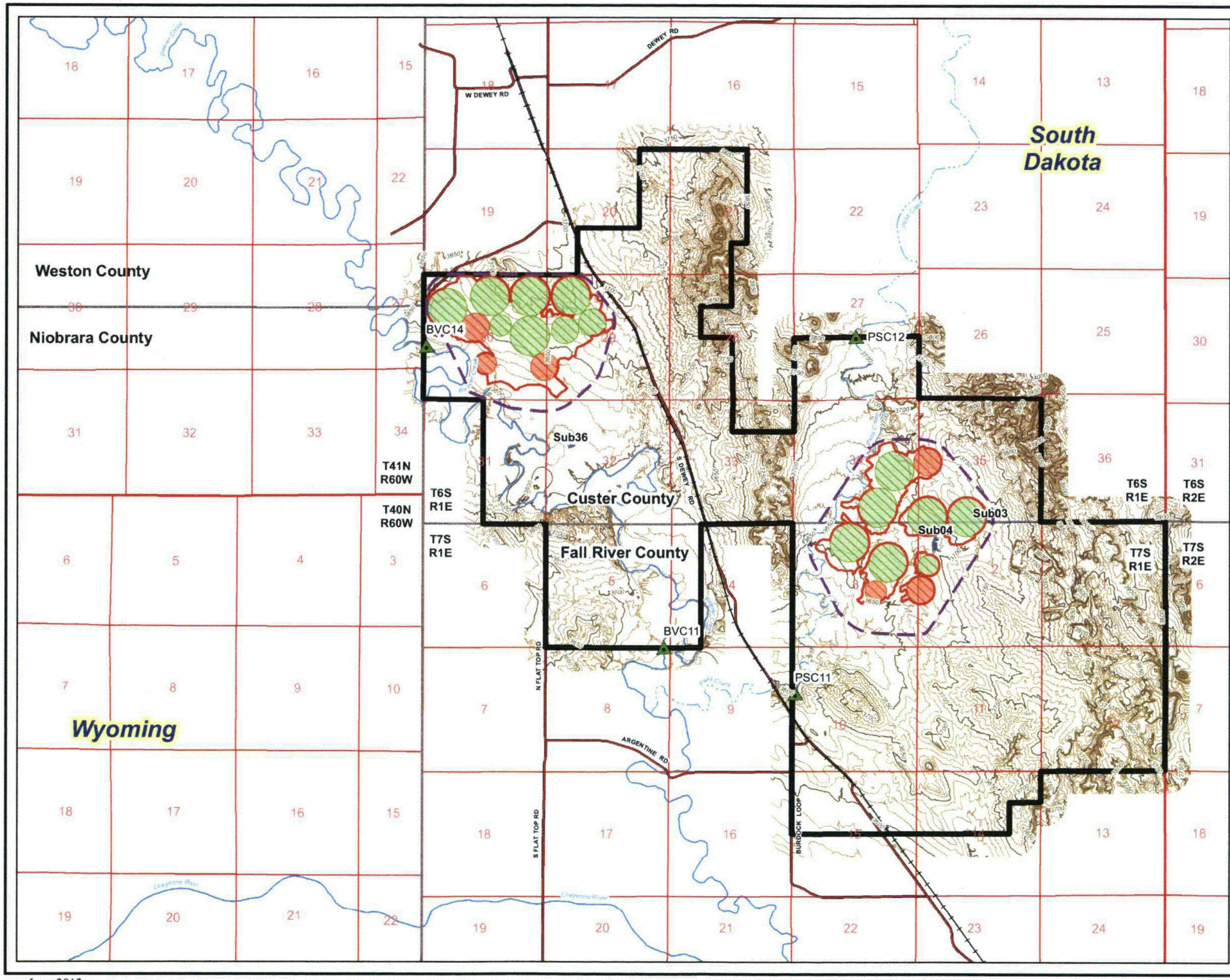

Figure 6.2-1

Operational Surface Water Sampling Locations

Dewey-Burdock Project

DRAWN BY	S. Hetrick
DATE	14-Jun-2012
FILENAME	OperSurfH2OSampLoc.mxd

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8.0 MITIGATION OF POTENTIAL IMPACTS

The following sections describe the mitigation measures that will be used to minimize the potential impacts to groundwater, surface water, soil, vegetation, livestock and wildlife.

8.1 Groundwater

8.1.1 Alluvial Groundwater

Mitigation measures used to protect alluvial groundwater quality are described below and include:

- Siting the land application areas at locations where natural conditions make it highly unlikely that the land application water will reach the alluvium,
- Plugging and abandoning existing wells within the land application areas,
- Design and construct well fields and land application systems to avoid any potential conflicts and minimize potential risks,
- Applying the water at agronomic rates,
- Treating the land application water to remove radionuclides,
- Providing sufficient pond storage capacity to stabilize the water quality over long periods of time,
- Implementing an extensive monitoring program, and
- Implementing a contingency plan to address increasing trends in groundwater quality constituents within the POP zones in order to avoid potential impacts to groundwater outside of the POP zones.

Natural Conditions

Potential impacts to alluvial groundwater will be minimized by natural conditions that make it highly unlikely that the land application water will reach the alluvial groundwater. Figure 3.4-6 depicts shallow geologic cross sections drawn through the Burdock land application area. The figure shows that the depth to the top of the alluvial gravel ranges from about 12 to 33 feet and is typically 15 to 25 feet. The depth to alluvial groundwater, where encountered, is typically 25 to 35 feet. By comparison, the SPAW model simulations predict that the land application water will not percolate deeper than 8 feet.

In the Dewey area, groundwater was not typically encountered in the alluvial drilling program completed in May 2011. The primary reason is the composition of the clay-rich alluvial material along Beaver Creek in the project area, which generally contains less gravel than the alluvium along Pass Creek. Many of the Beaver Creek alluvial characterization holes encountered no gravel from the surface to the well-defined contact with the Granerous Group shales. Due to the limited occurrence of gravel and water within the Beaver Creek alluvium, there is even less potential to impact alluvial groundwater from the proposed land application system.

The soil hydraulic properties beneath the land application areas will help prevent the migration of water into the alluvial groundwater. Table 3.2-3 shows that the soils sampled from test pits in and around the land application areas predominantly contain clay and silt, with lesser amounts of sand and virtually no gravel to a depth of 7 to 10 feet. The primary mapped soil units in the Dewey land application area are Arvada fine sandy loam, Pierre clay, and slickspots. The permeability of each of these units is very slow as described in Appendix 3.2-A. The primary mapped soil units in the Burdock land application area include some with very low permeability (Arvada and Hisle silt loam) and others with moderate permeability (Barnum very fine sandy loam, Tilford silt loam, and Cushman very fine sandy loam).

Soil permeability was measured on samples from three test pits at each of the land application areas. Table 3.2-3 shows the permeability in the Dewey area ranged from 3.2 x 10^{-5} to 8.3 x 10^{-5} cm/sec (TP-01, TP-03 and TP-05). The permeability in the Burdock area was lower on average, ranging from 1.6 x 10^{-7} to 5.7 x 10^{-4} cm/sec. The differences in permeability for the two land application areas were taken into account in the SPAW model simulations.

The results of the May 2011 alluvial drilling program (Appendix 3.6-A) show similar soils as those sampled from the test pits to greater depths. Only the bottom 0 to 15 feet of the alluvium typically contains gravel, and this is typically a mixture of silt, clay and sand with scattered gravel. The top of the alluvium contains a mixture of silt, clay and sand as described in Section 3.6.2.2.

Plugging and Abandoning Existing Wells within Land Application Areas

Powertech (USA) has not identified any existing wells within the proposed Dewey land application area. Within the proposed Burdock land application area, there are two existing wells. As described in Section 3.7.2.3.2, these include one former domestic well (well 43) and one stock well (well 15). Both of these wells will be plugged and abandoned prior to operation of the Burdock land application system. The wells will be plugged in accordance with ARSD

74:02:04:67 with bentonite or cement grout. This will eliminate the potential for vertical migration of land application solutions through these existing wells.

Design and Construction of Well Fields and Land Application Systems to Avoid Potential Conflicts and Minimize Potential Risks

The potential well field areas are shown on Figure 2.3-2 along with the proposed land application areas. The figure shows limited overlap between the potential well field areas and the proposed land application systems. In the Dewey area, the only land application areas that will potentially overlap with well fields are designated for standby operation. These standby areas generally will not be used at the same time as the underlying well fields, but there is potential for simultaneous operation of the standby land application systems and overlapping well fields. Potential impacts will be mitigated as described below.

In the Burdock area, there will be very limited potential overlap between the proposed land application systems and potential well field areas. In this case overlap will likely be limited to perimeter monitor wells, which are shown as rings 400 feet from the ore bodies on Figure 2.3-2.

Although overlap between active land application areas and potential well field areas will be limited, there may be times that production, injection and monitor wells are operated within active land application areas. Powertech (USA) will design and construct the well fields and land application systems to avoid any potential conflicts and minimize potential risks. The irrigation nozzles will be suspended above the well head covers, and wells and fences will be positioned to avoid the center pivot wheel pathways. Injection, production and monitor wells will have sealed well heads to prevent entry of the land application water. The well heads also will have sufficient aboveground casing to ensure that surface water cannot enter the wells. Injection and production pipelines will be buried and will not conflict with land application systems. Perimeter monitor wells will have pressure transducers that will allow remote monitoring of water levels. If necessary, discharge piping and pressure transducer cable will be installed from the monitor wells to remote sampling locations outside of the land application area. This would allow Powertech personnel to measure water levels and sample monitor wells without traveling through active land application areas.

Water Application Rate

The land application rate has been specifically designed to minimize percolation below the rooting zone. The typical seasonal application rate over each of the land application areas will be

about 19 inches of water, which is a typical agronomic application rate for growing alfalfa and grasses in this region. The instantaneous rate will be adjusted as needed to avoid excessive ponding in the catchment areas. Section 8.2 also describes how Powertech (USA) will pump water from the catchment areas if necessary. Infiltration from the catchment areas will only occur sporadically. The annual average infiltration rate from the catchment areas is expected to be much lower than that from the center pivot areas, and thus potential alluvial groundwater impacts from catchment area infiltration will be lower than those from the center pivot areas. Due to the extensive monitoring system available within each land application area, including

8.1.2 Bedrock Groundwater

Bedrock groundwater quality will be protected from potential impacts from the land application systems by the thickness and confining properties of the Graneros Group shales, which separate the proposed land application systems from bedrock aquifers.

8.1.3 Domestic Wells

Powertech (USA) will protect domestic wells in and near the project area throughout all phases of the Dewey-Burdock Project. As described in Section 3.7.2.3.1, Powertech (USA) will remove all domestic wells within the project area from private use prior to ISR operations. Domestic well replacement procedures are described in Section 3.7.2.3.1 will include drilling a new domestic well or extending a Madison water supply pipeline to the residence. Replacement wells will be protected from potential impacts by locating wells outside of the POP zones, constructing them in accordance with ARSD 74:02:04, and completing them in formations outside of the ore zone targeted in the nearest well fields. This will ensure that there is no plausible pathway for contamination of domestic wells from the proposed land application systems. This will be verified through operational monitoring as described in Section 6.1.4.

8.1.4 Modeling Potential Postclosure Impacts

The SPAW model was used to estimate the potential postclosure impacts of the land application system. The objective of the postclosure modeling was to determine if there would be a potential for continuing downward migration of water and salts after cessation of land application operations. In order to conservatively estimate potential operational and postclosure impacts, the wettest 15-year period of record was modeled during operations and repeated for two cycles after operations (30-year postclosure modeling period). The wettest 15-year period of record was 1986 to 2000. This period of record yielded the deepest penetration of the water during the operational land application modeling simulations.

During the 15 years of operational monitoring, the irrigation parameters described in Section 5.7.3 were used. The SPAW model was continued for 30 additional years by repeating the 15-year precipitation and temperature inputs. During the 30-year postclosure modeling period, no irrigation water was input.

Table 8.1-1 presents the 15-year modeling results for the Dewey land application area during operations. The average input and output values match those shown in Table 5.7-5 for simulation number 7. Table 8.1-2 presents the 30-year postclosure modeling results for the Dewey land

application area. The results show lower average annual runoff during the postclosure period (4.3 versus 5.5 inches), lower annual average infiltration (9.3 versus 18.8 inches), lower annual average percolation (-0.01 versus 0.08 inch), no deep percolation, and a reversal of the change in soil moisture (-0.02 versus 0.42 inch).

Table 8.1-3 presents the 15-year modeling results for the Burdock land application area during operations. The average input and output values match those shown in Table 5.7-5 for simulation number 7. Table 8.1-4 presents the 30-year postclosure modeling results for the Burdock land application area. As with the Dewey model, the results show similar decreases during the postclosure period in average annual runoff, infiltration, percolation, and soil moisture.

The results of the postclosure modeling show that using the wettest 15-year period of record for climatic inputs, there would be no net downward movement of water beneath the land

Decommissioning will begin with a gamma survey to determine if there are areas requiring soil cleanup. Areas exhibiting contamination will be excavated and the affected soil disposed at an appropriately permitted facility. Compliance with cleanup standards will be verified through radiological gamma surveys and soil sampling with laboratory analysis. Upon completion of decommissioning activities, the NRC will release the site for unrestricted (i.e., any) use.

Metals and Metalloids

The concentrations of metals and metalloids, including arsenic and selenium, are anticipated to be low as shown in Table 5.8-2. 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. Table 8.3-1 presents the proposed trigger values for arsenic and selenium in surface and subsurface soil.

Table 8.3-1: Trigger Values for Arsenic and Selenium in Soil

Parameter	Units	Trigger Value
Arsenic	mg/kg-dry	Baseline average concentration plus 2 standard deviations
Selenium	mg/kg-dry	Baseline average concentration plus 2 standard deviations

Powertech (USA) has evaluated the baseline concentrations of arsenic and selenium within the project area and determined that significant natural variability occurs in these parameters. Therefore, Powertech (USA) proposes to base the arsenic and selenium trigger values on the baseline concentration and natural variability. Specifically, Powertech (USA) proposes to collect four samples from each of two sample depths in each center pivot area as described in Section 6.4. For each sampling depth within each center pivot area, the trigger value will be established as the average baseline concentration plus two standard deviations.

Recognizing the potential for buildup of metals and metalloids other than arsenic and selenium, Powertech (USA) commits to sample an extensive list of metals and other trace elements as described in Section 6.4. Powertech (USA) will analyze the results of monitoring for all soil parameters in Table 6.4-1 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 following each land application cycle described in Section 11.

Soil Fertility

Powertech (USA) may apply fertilizer to the land application areas to maximize crop production and maintain adequate soil fertility. Fertilizer will contain one or more of the three primary nutrients of nitrogen (N), phosphate (P_2O_5), and potash (K_2O). The alluvial water quality parameter list in Table 6.1-3 includes nitrate and potassium and will be adequate to detect any potential impacts to alluvial water quality from the use of fertilizer. These parameters are better indicators of potential impacts from fertilizer than phosphorus, which tends to adsorb to soil surfaces.

11.0 REPORTING

Powertech (USA) will establish and maintain records and prepare and submit reports in accordance with the requirements of SDCL 34A-2-44 and ARSD 74:54:02.

In accordance with ARSD 74:54:02:19, Powertech (USA) will verbally notify DENR upon commencement of operation of the land application system. Written notice of the start-up will follow within 30 days. DENR will also be notified of the discontinuance of land application and the reason for the stoppage within 10 days with written notice within 30 days. If stoppage is due to an upset condition, such as spill or leak, DENR will be notified immediately.

Per ARSD 74:54:02:20, Powertech (USA) will submit a written report to the DENR following each land application cycle. Prior to the end of each year, Powertech (USA) will prepare and submit a written report including the following information for each of the land application systems (Dewey and Burdock):

1) The total amount of land application solution applied
2) The total hydraulic loading rate per acre
3) The total metals loading rate per acre, including all of the trace and minor elements and radiological parameters in Table 6.1-3
4) All sampling data, including alluvial groundwater, Fall River Formation groundwater, streams and impoundments, domestic wells, land application discharge water, soil, vegetation, and livestock
5) An analysis of potential increasing trends in the concentration of all soil sampling parameters in Table 6.4-1 and proposed additional trigger values, if applicable
6) A general discussion of the success of the system

Powertech (USA) will notify DENR by phone of any out-of-compliance conditions, including groundwater sample results, soil or vegetation sampling results, or release of land application solutions outside of the ponds, center pivot areas, or catchment areas within 24 hours. This includes reporting within 24 hours any spill, leak, or accidental release which threatens waters of the State in accordance with ARSD 74:54:02:25. A written statement confirming the oral report will be submitted to DENR within 30 days.

Records of all sampling activities and laboratory analyses will be maintained as hard copy originals or stored electronically. All records will be stored in a manner to prevent loss from fire, flood, or other unforeseen events beyond the control of Powertech (USA). All records will be maintained both on-site and at an off-site location until Groundwater Discharge Permit termination, except postclosure monitoring reports, which will be maintained off-site until the postclosure monitoring is terminated.