APP-016-B

United States Nuclear Regulatory Commission Official Hearing Exhibit
In the Matter of: POWERTECH USA, INC.
(Dewey-Burdock In Situ Uranium Recovery Facility)
ASLBP #: 10-898-02-MLA-BD01
Docket #: 04009075
Exhibit #: APP-016-B-00-BD01
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Other:
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Stricken:

POWERTECH (USA) INC.

Dewey-Burdock Project

Application for NRC Uranium Recovery License Fall River and Custer Counties, South Dakota

Technical Report RAI Responses

June 2011

Prepared for

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

ACL	alternate concentration limit
ALARA	as low as reasonably achievable
ALI	annual limits of intake
AMS	air monitoring station
amsl	above mean sea level
ANL	Argonne National Laboratory
ANSI	American National Standards Institute
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	ASTM International
ATV	all-terrain vehicle
AWDN	Automatic Weather Data Network
bgs	below ground surface
BLM	U.S. Bureau of Land Management
BNSF	Burlington Northern Santa Fe Railway Company
CEDE	committed effective dose equivalent
CFR	Code of Federal Regulations
CGA	Compressed Gas Association
CIR	color infrared
CPP	Central Processing Plant
CV	coefficient of variation
DAC	derived air concentration
DC	direct current
DCF	dose conversion factor
DDE	deep-dose equivalent
DDW	deep disposal well
DENR	Department of Environment and Natural Resources
DHS	Department of Homeland Security
EC	Electrical Conductivity
EDE	effective dose equivalent
ELI	Energy Laboratories, Inc.
EPA	U.S. Environmental Protection Agency
ER	Environmental Report
ERG	Environmental Restoration Group
FRP	fiberglass-reinforced plastic
GDP	Groundwater Discharge Plan
GPS	global positioning system
HRI	Hydro Resources, Inc.
HV	high-volume air particulate sampler location (same as AMS)
HVAC	heating, ventilating, and air conditioning
IBC	International Building Code
ICP-MS	inductively coupled plasma mass spectrometry

List of Acronyms and Abbreviations (Continued)

ICRP	International Commission on Radiological Protection
IML	Inter-Mountain Laboratories, Inc.
IRF	intake retention fraction
IQR	interquartile range
ISL	in situ leach (In this document ISL is synonymous with ISR)
ISR	in situ recovery
IX	ion exchange
JFD	joint frequency distribution
LA	land application
LAN	land application area north (Dewey)
LAS	land application south (Burdock)
LLD	lower limit of detection
MARLAP	Multi-Agency Radiological Laboratory Analytical Protocols
MCL	maximum contaminate level
MDA	minimum detectable activity
MDC	minimum detectable concentration
MIT	mechanical integrity testing
MOA	memorandum of agreement
MOP	member of the public
MPE	measuring point elevation
MS	matrix spike
MSD	matrix spike duplicate
NAIP	National Agriculture Imagery Program
NFPA	National Fire Protection Association
NHPA	National Historic Preservation Act
NIST	National Institute of Standards and Technology
NMA	National Mining Association
NRC	U.S. Nuclear Regulatory Commission
NERC	North American Electric Reliability Corporation
NVLAP	National Voluntary Laboratory Accreditation Program
NWS	National Weather Service
O&M	operation and maintenance
OSHA	Occupational Safety and Health Administration
PIC	pressurized ionization chamber
PLC	programmable logic controller
POC	point of compliance
POE	point of exposure
Powertech	Powertech (USA) Inc.
Powertech (USA)	Powertech (USA) Inc.
PPE	personal protective equipment
PQL	practical quantitation limit
PV	pore volume
RL	reporting limit

List of Acronyms and Abbreviations (Continued)

QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
R	Range
RAI	request for additional information
RC	restoration composite
RCRA	Resource Conservation and Recovery Act
RESRAD	RESidual RADioactive
RH	relative humidity
RO	reverse osmosis
RSO	Radiation Safety Officer
RST	Radiation Safety Technician
RWP	Radiological Work Permit
SA	specific activity
SD	South Dakota
SDGF&P	South Dakota Department of Game, Fish and Parks
SDSU	South Dakota State University
SDWA	Safe Drinking Water Act
SERP	Safety and Environmental Review Panel
SF	satellite facility
SMA	surface mine area
SOP	standard operating procedure
SPAW	Soil-Plant-Atmosphere-Water
SR	Supplemental Report
SRDT	solar radiation delta-T
T	Township
TDS	total dissolved solids
TEDE	total effective dose equivalent
TLD	thermoluminescent dosimeter
TR	Technical Report
TRG	target restoration goal
TSS	total suspended solids
TVA	Tennessee Valley Authority
U-nat	natural uranium
UCL	upper control limit
UIC	Underground Injection Control
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
USDA	U.S. Department of Agriculture
USDW	Underground Source of Drinking Water
USGS	U.S. Geological Survey
VSP	Visual Sampling Plan
WIA	walk-in hunting area
WL	working level

Units of Measurement

°C	degrees Celsius
°F	degrees Fahrenheit
ac	acre
ac-ft	acre-feet
cfm	cubic feet per minute
Ci/yr	Curies per year
cm	centimeter
cm/s	centimeters per second
cm^2	square centimeters
cpm	counts per minute
dpm	disintegrations per minute
ft	feet
ft amsl	feet above mean sea level
ft/day	feet per day
ft^3	cubic feet
gpm	gallons per minute
hr	hour
in	inches
kg	kilograms
km	kilometers
kWh	kilowatt hours
lbs	pounds
m^2	square meters
mg	milligrams
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
Mgal	million gallons
mph	miles per hour
mR	milli Roentgens
mrem	millirems
mrem/yr	millirems per year
mSv	millisievert
µCi	microcuries
µg	micrograms
µg/L	micrograms per liter
µmhos/cm	micromhos per centimeter
µR	micro Roentgens
µSv	microsievert
pCi	picocuries
pCi/L	picocuries per liter
pCi/mg	picocuries per milligram
ppm	parts per million

Units of Measurement (Continued)

psi	pounds per square inch
s.u.	standard units
WL	working levels
yr	year(s)

Revised Response to TR RAIs Dated May 19, 2010

Process and Restoration

TR RAI P&R-1

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

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

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

TR RAI P&R-1 Response

The following information will be included in the revised TR. Powertech has replaced Supplement Exhibit 3.2-1 with a series of detailed exhibits. The first of these, Exhibit 3.1-4, identifies all potential well fields for the Dewey-Burdock Project, as opposed to grouping resources into future mining units. In addition, Exhibit 2.7-1 provides a cross section index for nine cross sections (Exhibits 2.7-1a through 1h and 1j) drawn through potential well fields to illustrate the scaled vertical positions of each ore body proposed for uranium recovery.

Exhibit 3.1-4 presents a map view of the project ore bodies proposed for uranium recovery and shows all lower Fall River ore bodies in “blue,” all ore bodies within the upper Chilson Member of the Lakota Formation in “green” and middle/lower Chilson ore bodies in “red.” This more detailed delineation of project-wide resources resulted in some minor changes to potential well field areas. For example, all previously identified potential well fields that were located within 1,600 feet of the project boundary have been removed from the Dewey-Burdock license application. This was done in order to establish an operational buffer between the well fields and the project boundary. As a result, no well fields are currently planned in the northern portion of the Dewey area, where Supplement Exhibit 3.2-1 depicted a Dewey Future Mine Unit III. In addition, no well fields are proposed for unsaturated Fall River ore bodies in the eastern portion of the project area.

In addition to showing the scaled vertical location of each ore body proposed for uranium recovery, the nine updated cross sections also illustrate the continuity of the Graneros Group, the Fuson Shale and the Morrison Formation, the major confining units, across the entire project area:

1) The Graneros Group is the uppermost confining unit and overlies the Fall River Formation. This marine shale sequence has a maximum thickness of 550 feet in the area of the initial Dewey well field and crops out in the eastern portion of the project area.
2) The Fuson Shale is the confining unit between the Fall River Formation and the Chilson Member of the Lakota Formation. The Fuson Shale is a low-permeability shale unit that ranges in thickness from 20 to 80 feet across the entire project area and crops out east of the project boundary.
3) The Morrison Formation is the lowermost confining unit and underlies the Chilson Member of the Lakota Formation. This low-permeability shale unit that ranges in thickness from 60 to 140 feet across the entire project area and crops out east of the project boundary.

The nine updated cross sections also provide detailed lithologic interpretations of the host sandstones within the Fall River Formation and the Chilson Member of the Lakota Formation. These interpretations show that interbedded clay beds are found locally within both the Fall River and Chilson sandstones and may be sufficiently continuous as to further subdivide the Fall River and Chilson into discrete, mappable fluvial sandstone packages (i.e., Upper Fall River, Lower Fall River, Upper Chilson, etc.). It appears that these interbedded clay beds may act as confining units within individual well fields. However, they cannot be considered as regional confining units because they are discontinuous. This will be confirmed through delineation drilling and aquifer pump tests. Potential use of these interbedded clay beds, as they relate to operational fluid control and monitoring, will be addressed in hydrogeologic packages prepared for each well field.

In this RAI, NRC staff questioned the ore body designations provided in Plate 2.6-1 of the TR. The "Typical Log" illustrated in TR Plate 2.6-1 is a single, good quality drill hole log, with the purpose of presenting the overall, general stratigraphy and the relative position of stacked ore bodies (roll fronts) within the entire Dewey-Burdock project area. This log does not precisely represent the stratigraphy within all potential well fields across the project. Plate 2.6-1 has been replaced with Figure 2.6-1, which clearly shows that there are no ore bodies within the Fuson Shale. The Fuson Shale is a confining unit, and uranium recovery will not and cannot occur within this unit. Figure 2.6-1 is included below and will be incorporated into the revised TR.

PR-7
Elev. 3655

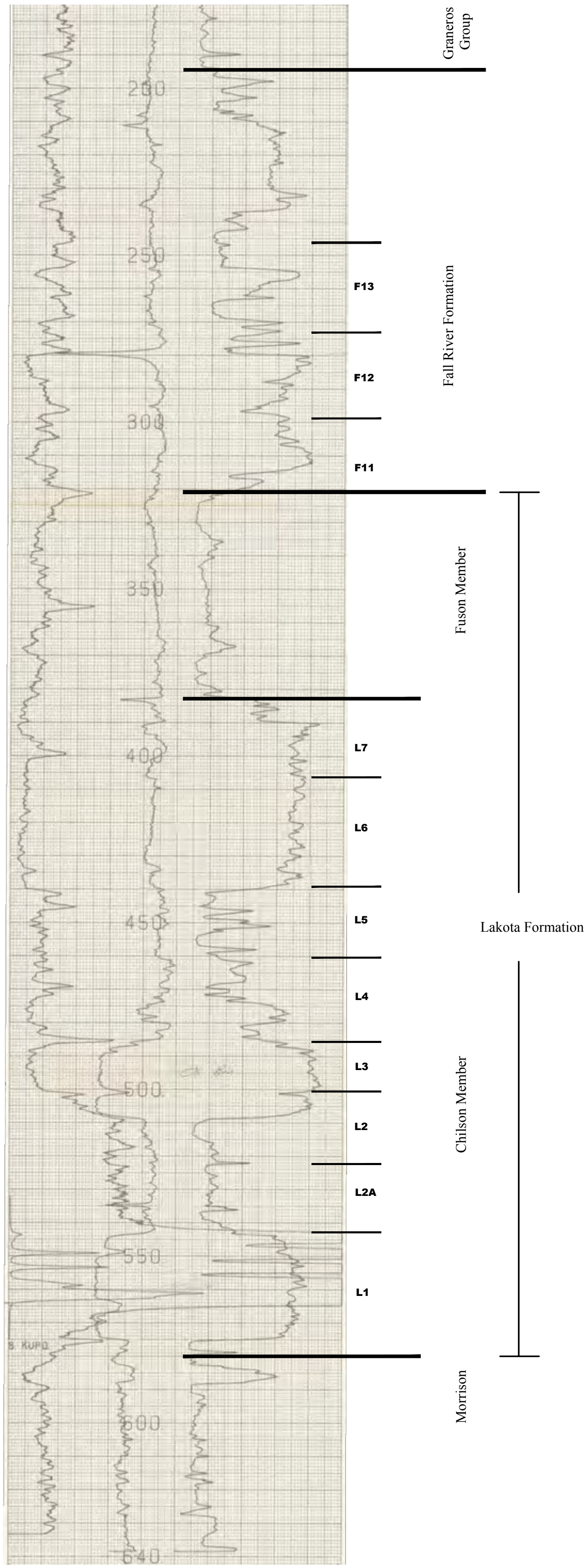


Figure 2.6-1

Type Log

Dewey-Burdock Project

DRAWN BY	R. Lichnovsky
DATE	14-Jun-2011
FILENAME	Figure 2.6-1.dwg

POWERTECH (USA) INC.

TR RAI P&R-2

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

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

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

TR RAI P&R-2 Response

The following information describes historic attempts at oil and gas production and former underground mine workings on and within 2 km of the project area. This information will be incorporated into the revised TR.

No former or actively producing oil and gas wells exist within the project boundary or within two kilometers of the boundary. Within this overall area, the locations of 12 plugged and abandoned oil test wells have been identified, 3 of which are within the project area. The locations of these abandoned test wells are depicted on Figure TR RAI P&R-2-1.

There are underground mine workings along the eastern portion of the project area associated with four former, shallow underground uranium mines and two open pit adits. These are depicted on Figure TR RAI P&R-2-2. All of the underground workings are associated with existing open-pit remnants that are clearly visible in the project area or, in the case of the Triangle mine, have been backfilled and reclaimed. There are no underground mines within the project area that are not associated with, either adjacent to, or extensions of, the open pits, all of which are within the upper Fall River Formation. The underground mines consisted of declines (downward sloping ramps) ranging in depth from 0 to 80 feet below land surface. The adits (horizontal tunnels) were driven into the sidewalls of the historic open pit mines. All underground workings were conducted within sandstones of the Fall River Formation at or above the water table and above the Fuson Shale confining unit such that these workings did not penetrate or otherwise compromise the integrity of this confining unit. These workings will not be affected by Powertech's proposed ISR operations, since Powertech will not develop well fields within Fall River Formation sandstones in this portion of the project area and the Fuson Shale confining unit is intact and undisturbed. The following discussion provides detailed information on these underground workings.

The first uranium mines in the Edgemont Mining District were developed in the 1950s by prospectors who followed mineralized Fall River outcrops into the subsurface by driving declines into the mineralized sandstones. Susquehanna-Western, Inc. consolidated all mining operations in the district in the late 1950s and operated both underground and surface mines. The locations of historic surface mining operations in the Triangle Mine area and the Darrow Mine area are depicted on Figure TR RAI P&R-2-2. Susquehanna-Western often drove adits short distances into open pit walls to recover additional uranium ore that was adjacent to but not within the pit boundary. These types of underground workings were common at historic surface mines and were considered to be extensions of the open pit mining operations.

Triangle Mine Area

As shown on Figure TR RAI P&R-2-2, the Triangle Mine was an open pit mining operation along the northeastern border of the project area in the SE/4 Section 34, T6S, R1E. Immediately east of this open pit was the Triangle Underground Mine. Although maps of the Triangle underground workings are not available, Powertech has obtained a description of this operation through personal communication with Donald Spencer (2011), a local rancher who worked in this underground mine.

Mr. Spencer advised that he worked in the Triangle underground mine in 1957-58. He showed Powertech personnel the location of the decline that was used to access the mine. The decline is located approximately 1,000 feet southeast and updip of the eastern boundary of the Triangle open pit in the NE/4 Section 35, T6S, R1E (see Photo P&R-2-A). All photo locations are depicted on Figure TR RAI P&R-2-2. As shown in the photo, the haulage road from the decline is still visible, but the entrance to the underground workings has been covered for safety reasons. There were about 1,000 feet of underground workings in the mine. The depth of these workings ranged from outcrop to 70 feet below ground surface. The mineralized sandstone of the Fall River Formation was unsaturated near the ground surface. Approximately 70 feet below the surface, the Fall River sands became saturated, resulting in 2-3 feet of water in the mine, requiring dewatering. Near the end of the underground workings, a vent shaft was installed approximately 400 feet from the eastern highwall of the Triangle open pit to provide air to the underground workings (see Photo P&R-2-B). Powertech measured the depth to the bottom of this vent shaft and found it to be 68 feet below ground surface with approximately 3 feet of groundwater. Mr. Spencer stated that after the Triangle surface mine was completed, an adit was driven into the eastern wall of the pit which recovered additional ore from the mineralized trend. This adit connected the open pit with the abandoned underground workings.

In 1960, Susquehanna-Western began to develop the Triangle surface mine. A description of the mining zone was obtained through personal communication in 2011 with James F. Davis, the Susquehanna-Western geologist who directed the delineation drilling for this mine. He stated a single mineralized

front progressed from the underground mine area through the surface mine area in an east-west direction. In the western portion of the surface mine area, the trend abruptly turned to the north and the grade of the mineralization quickly diminished. The Triangle surface mine area is down-dip from the underground workings; therefore, the depth to the mining horizon increased steadily. Mr. Spencer recalls the depth of the Triangle open pit to have been approximately 120 feet below ground surface.

Figure TR RAI P&R-2-3, Type Log, Triangle Mine, is an electric log from an historical exploration drill hole located approximately 200 feet north of the mined area. The gamma activity shown in the type log corroborates the portion of the Fall River sand that was mined in the Triangle Mine and its position relative to the Fuson Shale confining unit. The top of the mineralized sand unit in the type log is at a depth of 125 feet below ground surface. The single mineralized front present within this sand unit correlates to Powertech's F13 interval, which is the upper mineralized zone within the Lower Fall River sand, the bottom of which is approximately 45 feet above the Fuson Shale. All mining took place well above the Fuson Shale, which averages 50 feet thick in this area. Accordingly these historic mining operations did nothing to compromise the integrity of the Fuson Shale confining unit.

Darrow Mines Area

Figure TR RAI P&R-2-2 depicts the location of the Darrow Mine surface pits in the eastern portion of the project area. These pits were developed within unsaturated sandstones of the Fall River Formation at depths ranging from 50 to 90 feet below ground surface. As illustrated on Figure TR RAI P&R-2-2, the Freezeout underground mines were located approximately ½ mile north of the Darrow surface mines. These historic underground mines are outside of the project area in the SW/4 Section 36, T6S, R1E. Freezeout No. 1 and Freezeout No. 2 each have approximately 1,000 feet of underground workings. Plan view maps obtained from TVA show the underground workings at Freezeout No. 1 were accessed by two declines, and access to the workings of Freezeout No. 2 was provided by three declines. Photos P&R-2-C and P&R-2-D show the current condition of the declines for the Freezeout mines. The haulage roads are still visible but the access ways or portals to the underground workings have collapsed or have been covered. Figure TR RAI P&R-2-4 illustrates how these shallow underground mining operations were used to recover ore in this rugged terrain. It is important to note that the workings were above the water table and followed the dip of the mineralized sandstones. Accordingly, these mining operations did not intersect or compromise the integrity of the underlying Fuson Shale confining unit.

Figure TR RAI P&R-2-2, Location of Underground Mine Workings, shows the location of the Darrow underground mine, approximately 500 feet northwest of Darrow Pit No. 2, in the NE/4 of Section 2. According to personal communication with Donald Spencer (2011), this underground mining consisted of approximately 1,200 feet of workings within a 250-foot x 700-foot area, which was also accessed by declines. The surface in this area has been reclaimed and all evidence of mining operations has been

removed. Figure TR RAI P&R-2-5 is a plan view map of the Darrow underground workings taken from a TVA drill hole map. This map shows the locations of many Susquehanna-Western drill holes and air vents for the underground workings. Also shown on this map are five TVA drill holes, one of which is located less than 20 feet from one of the underground drifts. The electric log from this drill hole (DRA-36) is an excellent representation of the mining horizon in these underground workings and is shown in Figure TR RAI P&R-2-6. The gamma trace on this type log again corroborates that the top of the mining zone for this underground mine was at a depth of 73 feet below ground surface. The base of the mineralized sand lies 23 feet above the top of the Fuson Shale, which is more than 50 feet thick in this area. The Darrow underground mine workings were restricted to the mineralized sand interval, and these mining operations did not intersect or compromise the integrity of the underlying Fuson Shale confining unit.

Maps obtained from TVA show the locations of two adits within Darrow Pit No. 2 in the NE/4 Section 2, T7S, R1E (Figure TR RAI P&R-2-2). Although not classified as underground mines, these adits consisted of two separate horizontal tunnels that were driven into the pit walls in order to access additional uranium ore that was not recovered in the surface mining operations. These two adits total approximately 650 feet of workings. Because of the horizontal nature of the adits, these workings were conducted at elevations equal to or above the elevation of the bottom of the pit and were considered to be an extension of the surface mining operations. These small operations did not intersect or compromise the integrity of the underlying Fuson Shale confining unit. To document the presence of the underground mine workings in the vicinity of the proposed Burdock well fields, the location of these underground workings has also been added to Cross section F-F' (Exhibit 2.7-1f).

As previously mentioned, Powertech will not conduct recovery operations within Fall River Formation sandstones in the eastern portion of the project area. Figure TR RAI P&R-2-2 shows the spatial relationship between Powertech's potential well fields and the historic mine areas discussed above. An examination of this figure shows that Burdock Well Field 7 (B-WF7) underlies portions of the historic Darrow mine area. The targeted mining horizon for B-WF7 is the Lower Chilson. Figure TR RAI P&R-2-7 illustrates the stratigraphic separation of this Lower Chilson sand unit from the historic mining operations in sands of the Fall River Formation. The gamma activity shown within the Lower Chilson sand on the type log is representative of the proposed uranium recovery horizon in B-WF7. This interval is over 200 feet below the base of the Fall River Formation and is separated by 40 feet of the Fuson Shale confining unit, as well as two interbedded shale intervals within the Chilson Member – one 12 feet thick and the other 23 feet thick.

As also shown on Figure TR RAI P&R-2-2, Burdock Well Field 8 (B-WF8) is proposed below and horizontally adjacent to the surface expression of an area of past mining disturbance in Section 35, T6S,

R1E. Excavation in this area was underway when the Edgemont mill was closed. This operation was on land owned by the Spencer family, and Donald Spencer (2011) related that all mining operations ceased before reaching the ore horizon. The pit was backfilled and reclaimed. Powertech's targeted uranium recovery horizon for B-WF8 is the Lower Chilson. This unit is at least 200 feet beneath the base of the Fuson Shale and is well below the historic mining disturbance in the Fall River Formation noted above.

As previously stated, neither the surface mining activity nor the shallow underground workings intersected or compromised the integrity of the underlying Fuson Shale confining unit. Cross section F-F' (Exhibit 2.7-1f) illustrates the continuous Fuson Shale confining unit throughout this area. In addition, outcrop examinations of the Fuson Shale in Bennett Canyon, ½-mile up-dip from the Darrow Mine area, reveal the presence of continuous, low-permeability mudstones and shales. The targeted resources in B-WF7 & B-WF8 are well confined and unaffected by historic mining activities in overlying horizons. The plan for ISR uranium recovery from the Chilson ore bodies in this area is to avoid all open pit and underground workings. The conditions that made these areas amenable to conventional surface and underground mining (e.g., shallow cover and unsaturated conditions) make these areas unattractive for ISR operations. Conversely, the areas proposed by Powertech for ISR operations are much too deep and contain too much water for them to have been affected by historic surface or underground mining activities.

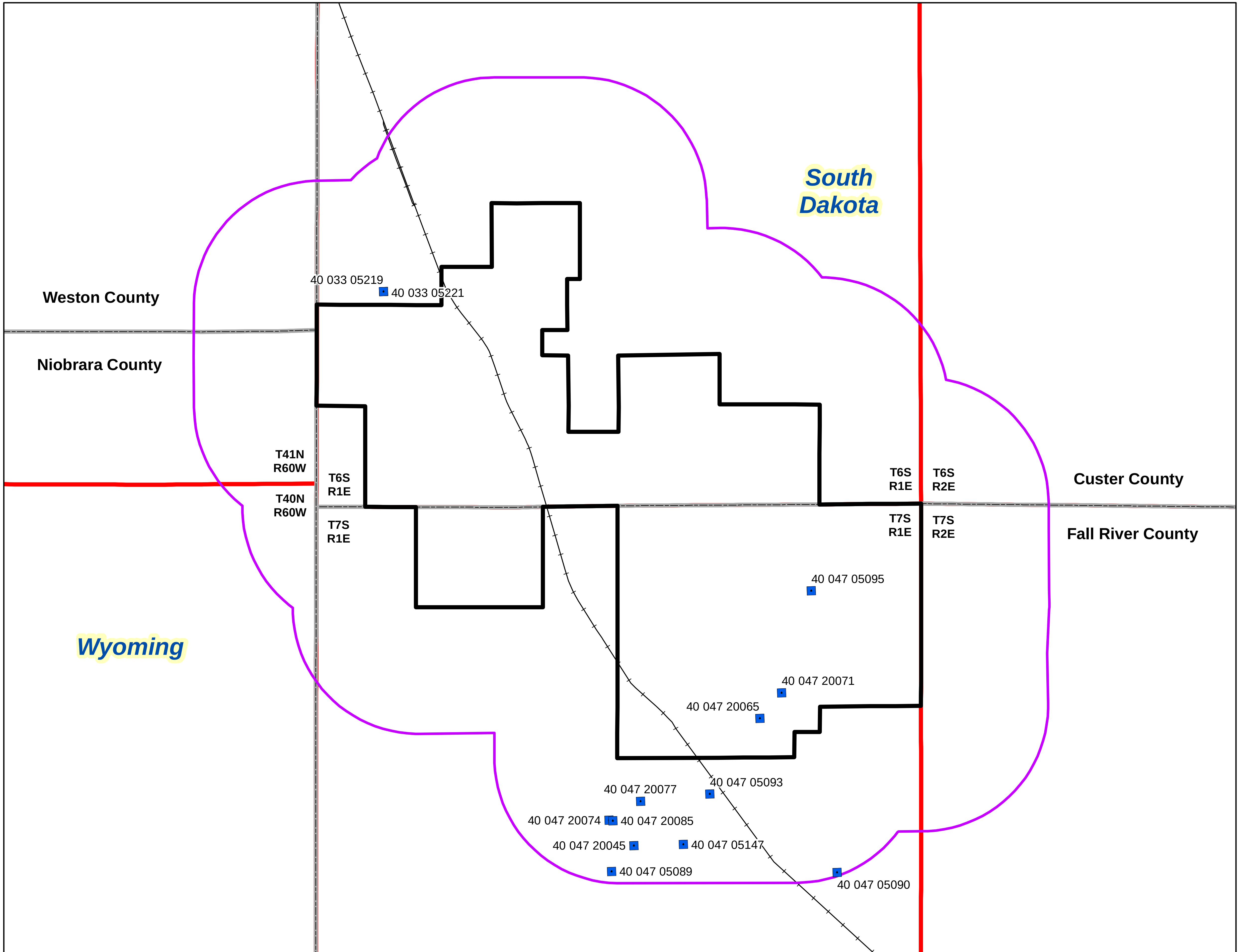


Figure TR RAI P&R-2-1

Plugged and Abandoned Oil and Gas Wells within 2 km of Project Boundary Dewey-Burdock Project

DRAWN BY	Mays, Hetrick
DATE	20-Jun-2011
FILENAME	Figure TR RAI P&R-2-1.mxd

POWERTECH (USA) INC.

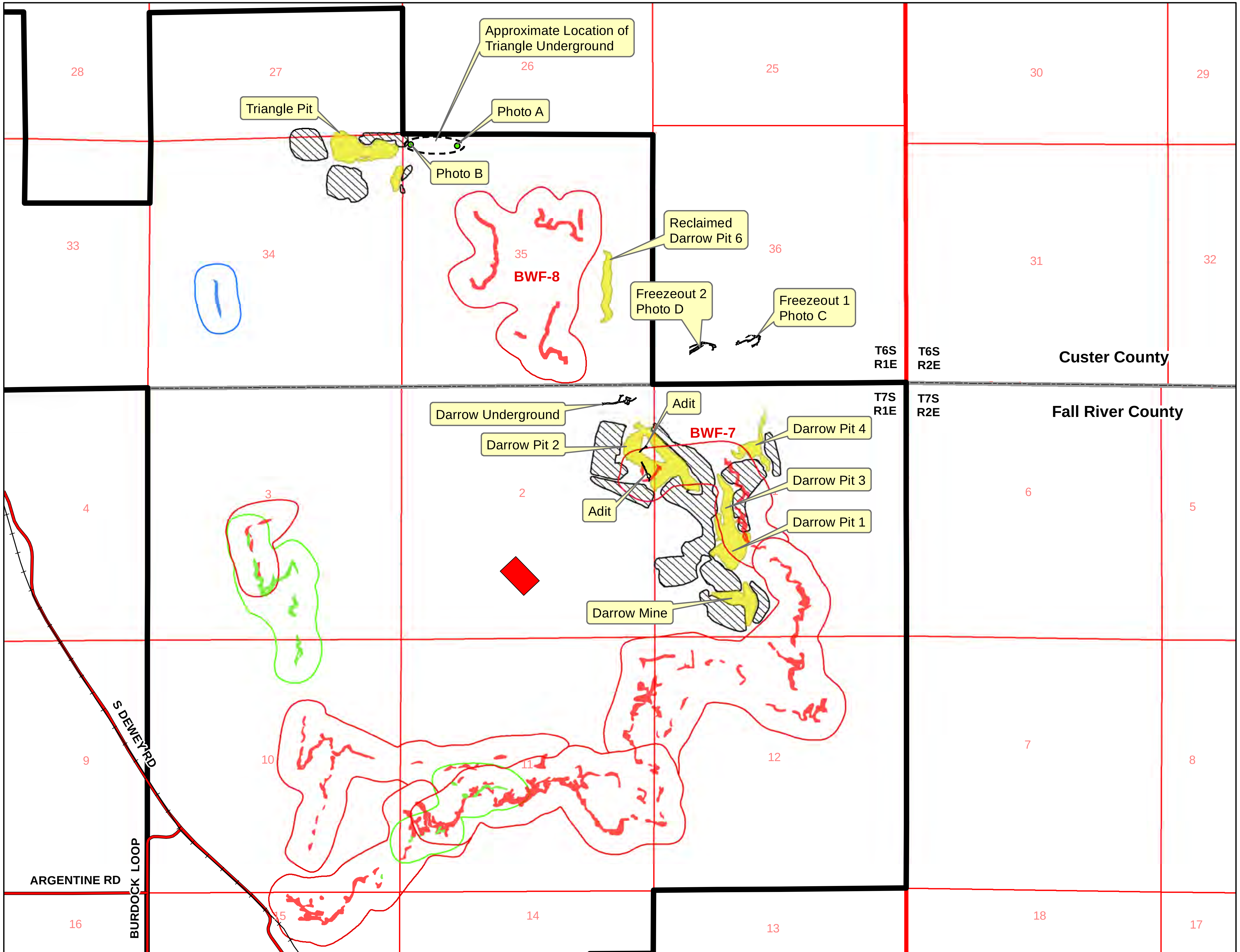


Figure TR RAI P&R-2-2

Location of Historical Underground Mine Workings

Dewey-Burdock Project

DRAWN BY	Mays, Hetrick
DATE	23-Jun-2011
FILENAME	Figure TR RAI P&R-2-2.mxd

POWERTECH (USA) INC.

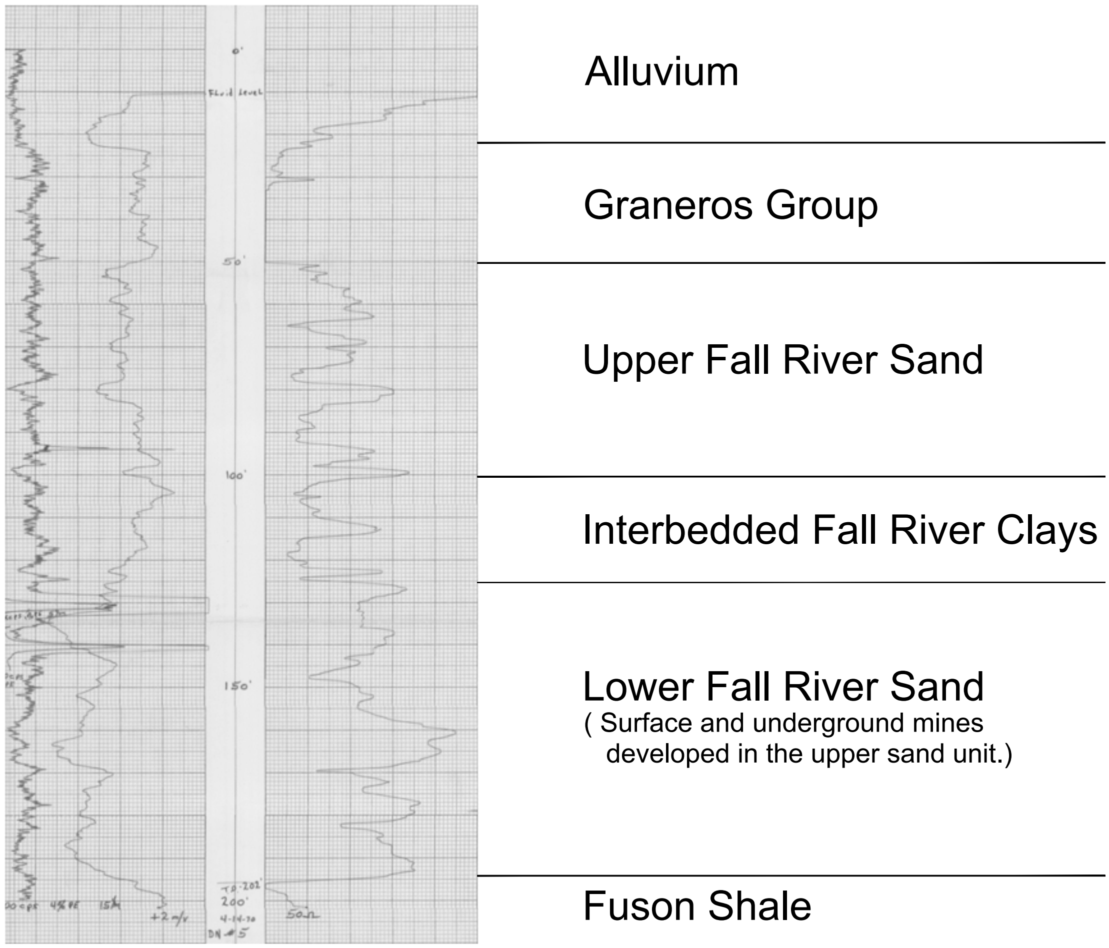


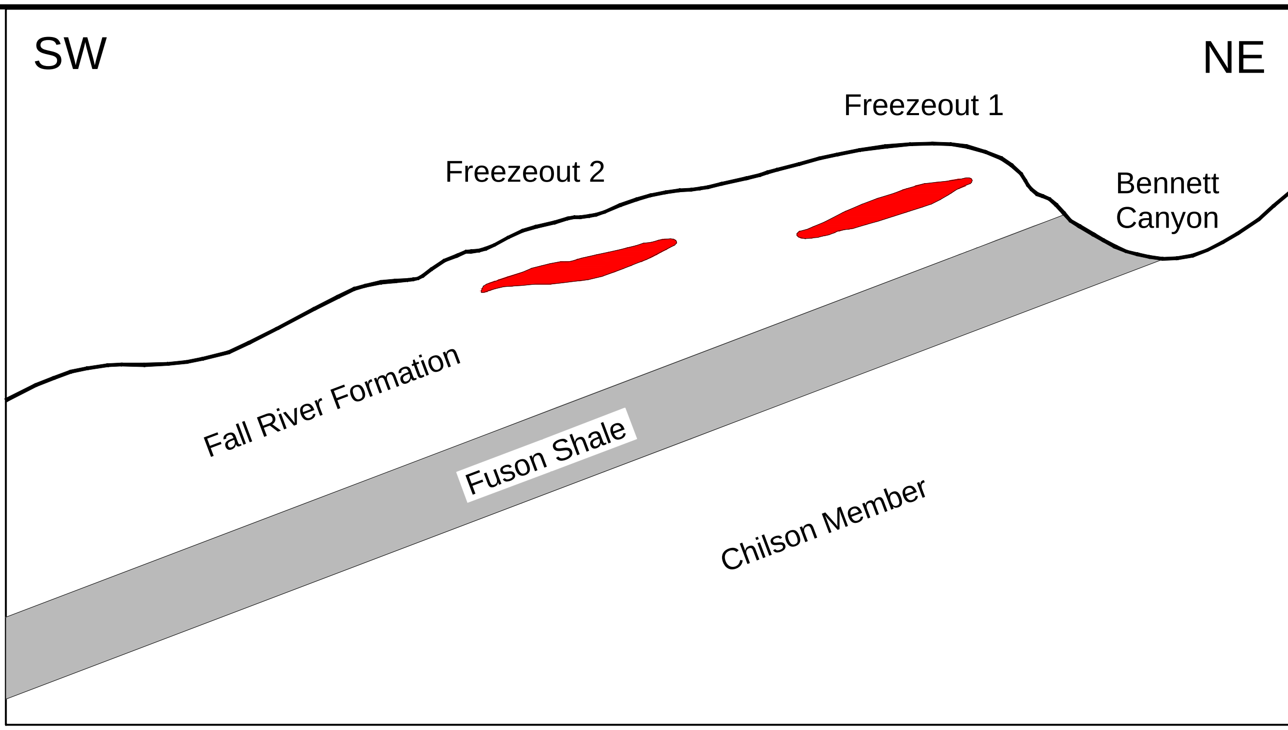
Figure TR RAI P&R-2-3

Type Log
Triangle Mine Area

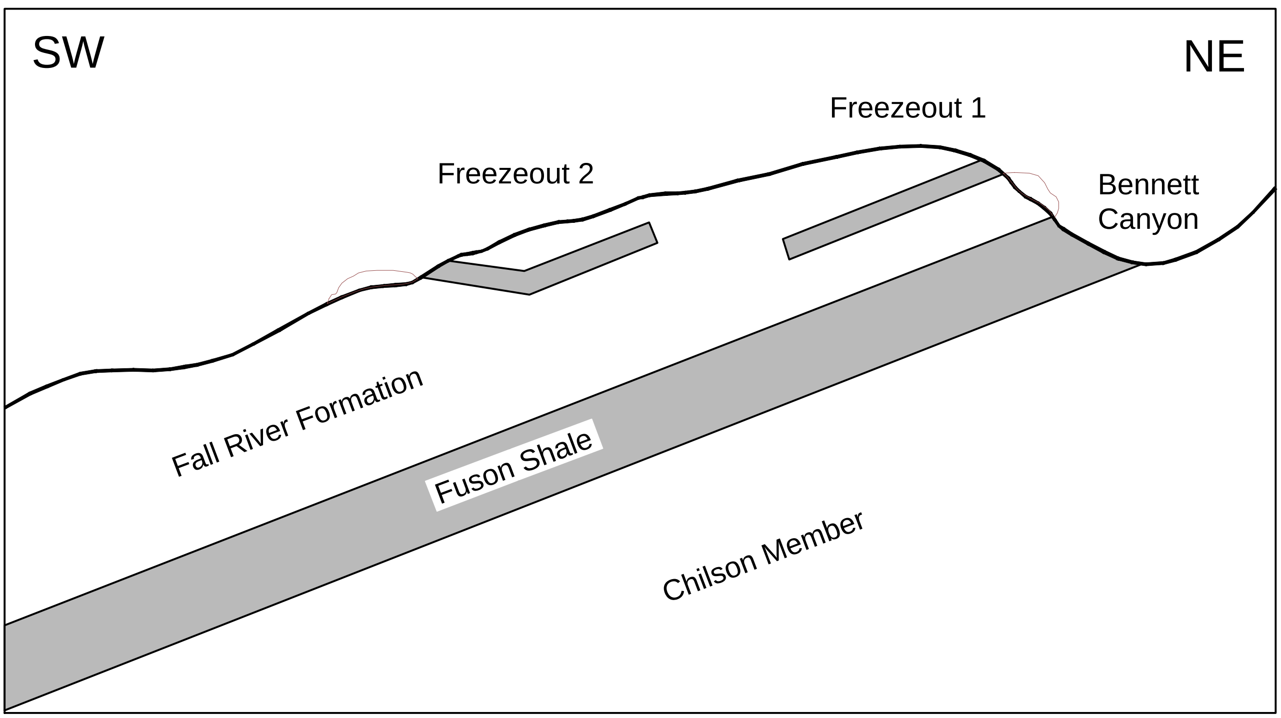
Dewey-Burdock Project

DRAWN BY	R. Patton
DATE	13-Jun-2011
FILENAME	Figure TR RAI P&R-2-3.dwg

POWERTECH (USA) INC.



A. Shallow ore bodies in Fall River



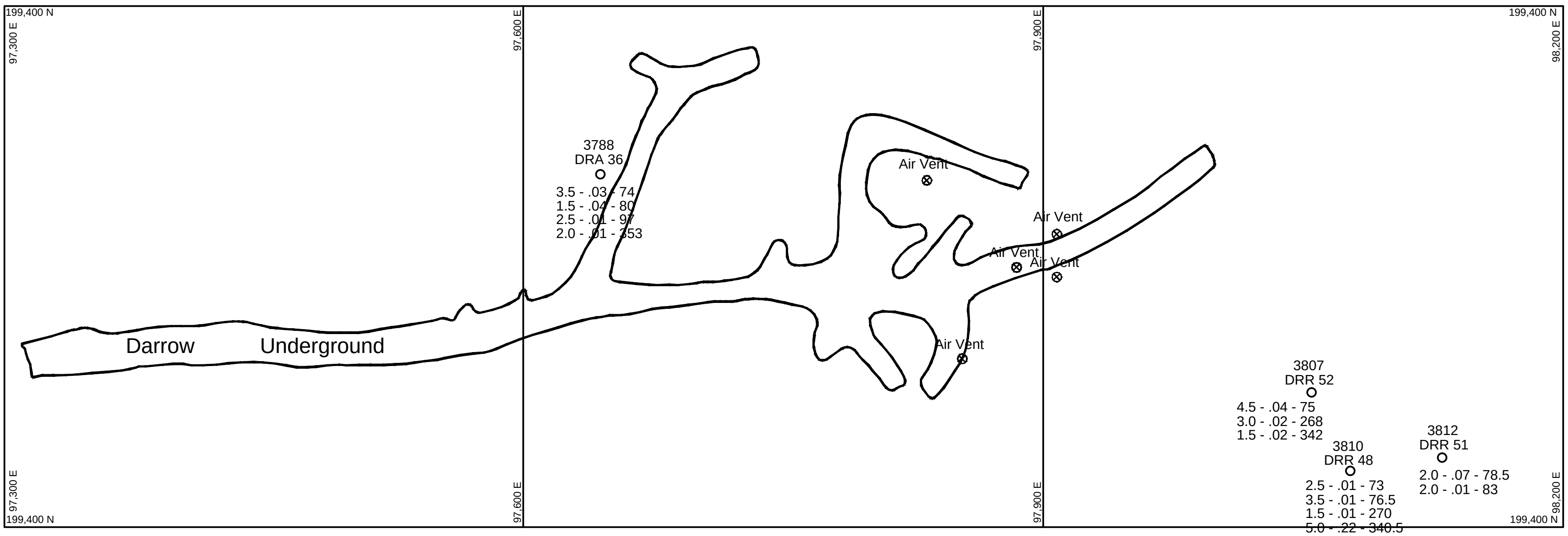
B. Declines developed to access Fall River ore bodies.

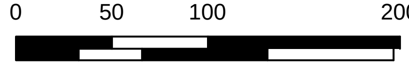
Figure TR RAI P&R-2-4

Schematic - Underground Workings - Freezeout Mines

Dewey-Burdock Project

DRAWN BY	R. Patton	POWERTECH (USA) INC.
DATE	20-Jun-2011	
FILENAME	Figure TR RAI P&R-2-4.dwg	





Legend

DRR 52 o Boreholes

Source: TVA drill hole map

Figure TR RAI P&R-2-5

Plan View - Darrow Underground Mine

Dewey-Burdock Project

DRAWN BY	R. Patton
DATE	21-Jun-2011
FILENAME	Figure TR RAI P&R-2-5.dwg

POWERTECH (USA) INC.

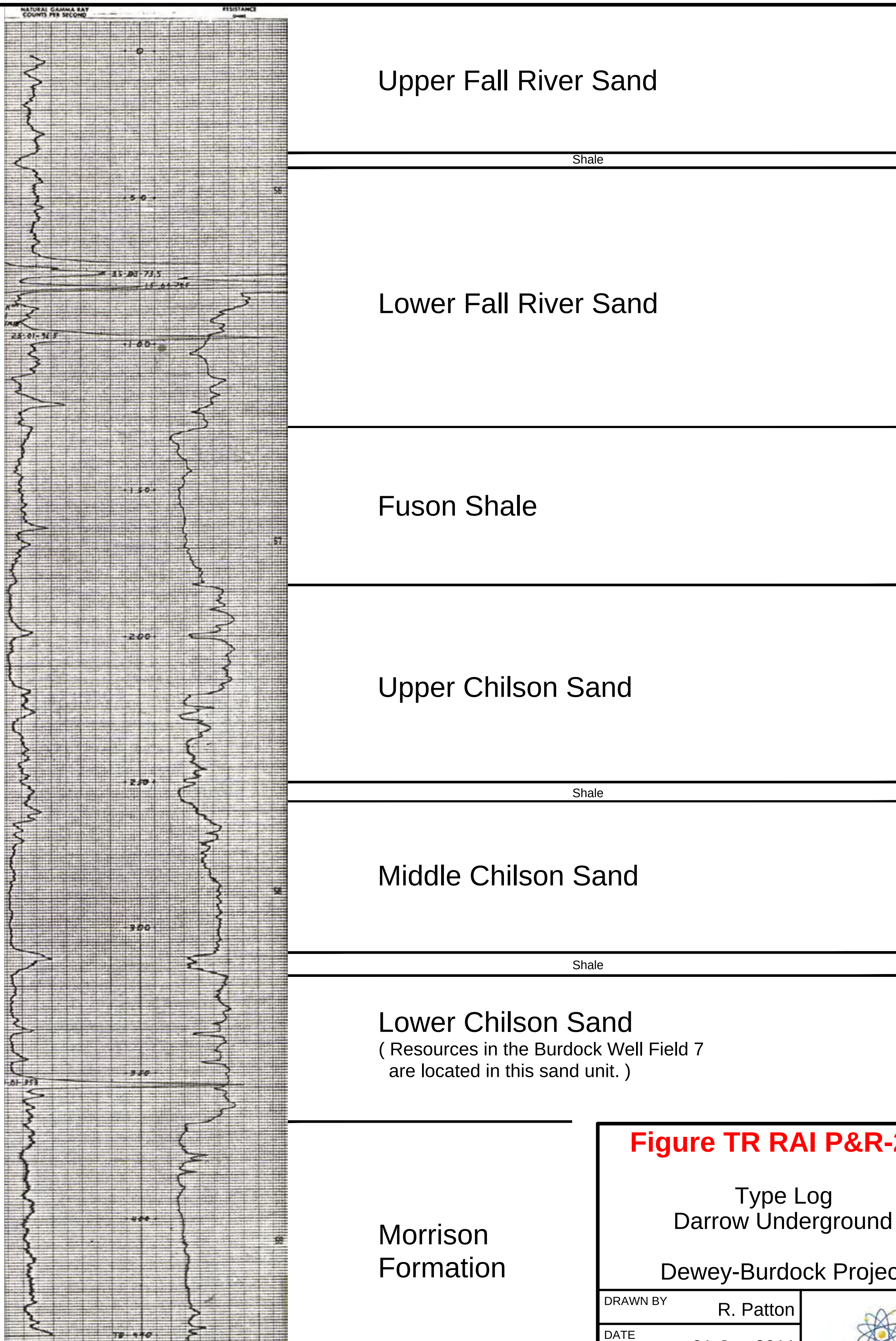


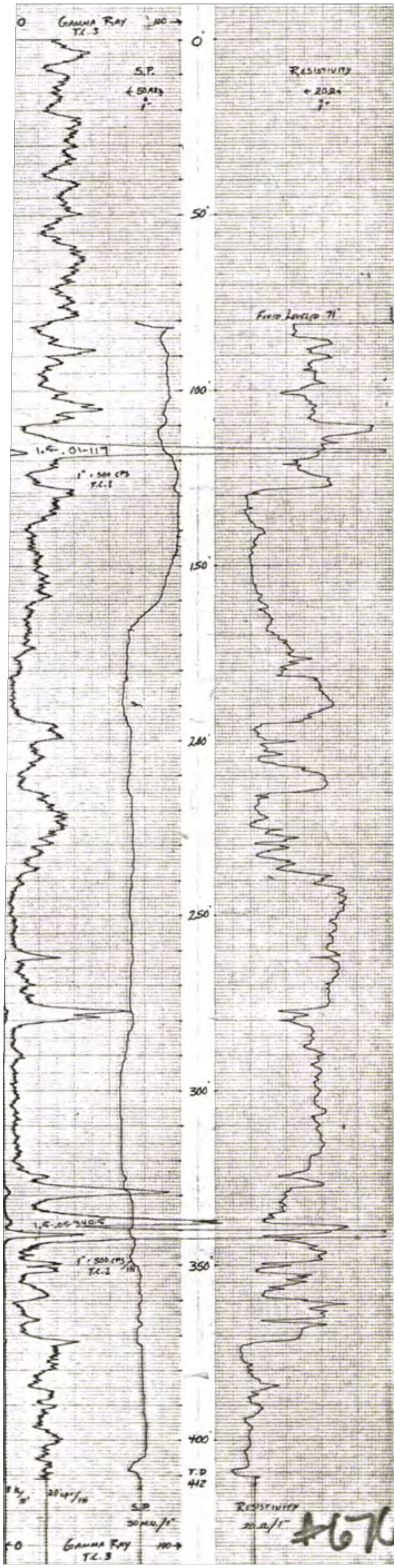
Figure TR RAI P&R-2-6

Type Log
Darrow Underground

Dewey-Burdock Project

DRAWN BY	R. Patton
DATE	21-Jun-2011
FILENAME	Figure TR RAI P&R-2-6.dwg

POWERTECH (USA) INC.



Upper Fall River Sand

Top estimated pick from structure map

Lower Fall River Sand
(surface mines and shallow underground
workings located within this unit.)

Fuson Shale

Upper Chilson Sand
(Sand with interbedded Clays.)

Interbedded Chilson Clays

Middle Chilson Sand

Lower Chilson Sand
(Host sand for resources in Burdock
Well field 7.)

Morrison
Formation

Figure TR RAI P&R-2-7

Type Log
Darrow Mine Area

Dewey-Burdock Project

DRAWN BY	R. Patton
DATE	21-Jun-2011
FILENAME	Figure TR RAI P&R-2-7.dwg

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Photo P&R-2-A: Former Triangle Underground Mine Decline

Photo P&R-2-B: Triangle Underground Mine Vent Shaft

Photo P&R-2-C: Former Freezeout Mine Decline

Photo P&R-2-C: Former Freezeout Mine Decline

Photo P&R-2-D: Former Freezeout Mine Decline

TR RAI P&R-3
Expand seismic evaluation to include the seismic event north of Dewey, South Dakota.

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

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

TR RAI P&R-3 Response

The following text and a revised and updated Appendix 2.6-G will be incorporated into the revised TR. Appendix 2.6-G has been updated to place the search radius near the center of the project area and to use the most recent data available. This appendix is included with this response package.

The seismic event referenced in TR RAI P&R-3, which is shown on Figure 2.6-4 of the TR and listed in Appendix 2.6-G, occurred approximately 8 miles north of the center of the Dewey-Burdock project area on January 5, 2004, making it the closest seismic event in the USGS earthquake database to the project area. The magnitude of the event was reported to be 2.8 on the Richter Scale, which is approximately equivalent to a modified Mercalli intensity of III (Burchett, 1979). This magnitude is near the low end of the range of 2.3 to 3.7 (Richter Scale) reported for seismic events within a 100-km radius of the project area (Appendix 2.6-G). Other information included in Appendix 2.6-G specific to this event includes the origin time, depth, and latitude and longitude.

According to Burchett (1979), a magnitude 2.8 earthquake (Richter Scale) would not result in people feeling any earth movement, nor would there be any structural damage. Seismic stability analyses for the pond designs are discussed in Sections 3.11.4 and 3.11.5 of the Dewey-Burdock Pond Design Report (Supplemental Report Appendix B), which concludes, "The factors of safety indicate that the inner and outer slopes are stable under static and maximum credible earthquake seismic loading conditions."

All buildings, structures, foundations, and equipment will be designed in accordance with recommendations in the latest versions of the International Building Code and ASCE-7 published by the American Society of Civil Engineers. Maps published in ASCE-7, and the latest version of the USGS Earthquake Ground Motion Tool, along with information regarding soil characteristics provided by the project professional geotechnical engineer, will be used to determine seismic loadings and design requirements.

TR RAI P&R-4

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

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

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

TR RAI P&R-4 Response

Powertech received clarification from NRC staff on this RAI. Due to the importance of the Morrison Formation as the lowermost confining unit for the Dewey-Burdock Project, the intent of this RAI is to obtain information on exploratory drill holes that penetrated through the Morrison Formation – not the overlying Lakota Formation. Information on Morrison Formation thickness was requested to assure NRC staff that the Morrison Formation is present across the entire project area and has not been removed by erosion.

The following discussion, including the exhibits, will be added to Section 2.6 of the TR.

The confining properties of the Morrison Formation are well documented. An article entitled "Clay Mineralogy of the Morrison Formation – Black Hills Area," published in the Bulletin of the American Association of Petroleum Geologists, Vol. 40, No. 5, by Ronald Warren Tank (1956), provides an excellent description of Morrison clays in this area. The Morrison Formation is an extensive, low-permeability, terrestrial clay unit, with illite being the dominant clay mineral. Illite is a stable clay mineral that is usually deposited in fairly stagnant waters in an alkaline pH. Further, analyses of Morrison Formation core by Powertech indicate very small vertical permeabilities ranging from 0.012 to 0.043 millidarcies. The continuity, thickness, and lithology of the Morrison Formation ensure hydraulic isolation of the overlying Chilson sandstones.

Exploration holes drilled to evaluate the economic geology of the Lakota Formation were generally not continued the additional 100 feet required to penetrate the entire Morrison Formation. Powertech drilled eight holes that penetrated through the Morrison Formation, and records indicate that 16 historical TVA exploration holes penetrated the entire Morrison Formation. Two electric logs from plugged and abandoned oil test holes in the project area are also available to assist with evaluation of the Morrison Formation. Table TR RAI P&R-4-1 provides a listing of these 26 identified Morrison Formation penetrations.

Exhibit 2.6-1 is a structure contour map of the top of the Morrison Formation. This map was developed in response to ER RAI WR-6, which requested information on holes that penetrated into the Morrison Formation. This structure map shows the Morrison Formation generally dipping 2½ degrees to the southwest – away from the southwestern flank of the Black Hills Uplift. As shown on this exhibit, the irregular contour lines in the Dewey and Burdock areas may indicate some minor scouring into the top of the Morrison Formation and subsequent deposition of the Lower Chilson sands. This minor scouring has not cut deeply into the Morrison clays, and the overall 60- to 140-foot thickness of this formation has not been significantly affected.

Table TR RAI P&R-4-1: Drill Holes Penetrating the Morrison Formation

	Hole No.	Easting (ft)	Northing (ft)	Elevation (ft amsl)
1.	CAT1	1028330	444666	3738
2.	DRJ90	1037602	438720	3762
3.	FBR31	1038131	433097	3800
4.	RONA81	1033459	429385	3688
5.	PM159	1032551	433100	3651
6.	DWT48	1025864	444053	3702
7.	DWT49	1025235	442634	3661
8.	ELT14	1017626	444849	3617
9.	DWT40	1022610	445875	3681
10.	DWW190	1032799	450521	3760
11.	DWW192	1033149	450479	3740
12.	DY12	1025946	450088	3820
13.	DY17	1027335	455821	3818
14.	DY308	1012901	445124	3616
15.	HDA1	1028537	448585	3780
16.	TRM38	1035605	441152	3749
17.	DB07-11-31	1038312	429998	3731
18.	DB07-11-16C	1035139	429992	3698
19.	DB08-11-18	1035133	429986	3700
20.	DB08-32-12	1022352	439368	3590
21.	DB08-32-11	1020339	443666	3627
22.	DB08-5-1	1017626	444849	3629
23.	DB08-1-7	1042271	434137	3913
24.	DB09-21-1	1028628	453319	3822
25.	API 40 047 05095	1038166	433840	3792
26.	API 40 047 05093	1032429	423452	3576

Note: Coordinate system is NAD 27 South Dakota State Plane South

A good understanding of the Morrison Formation is important to the Dewey-Burdock Project. For this reason, in addition to providing the structure contour map of the Morrison Formation, Exhibit 2.6-2 provides an isopach map of the Morrison Formation. This map was based on the 26 drill holes that fully

penetrated the Morrison Formation and shows the thickness of the Morrison varying from approximately 60 to 140 feet beneath the project area. Also shown on this isopach map is the location of cross section A-A’-A’’.

Exhibit 2.6-3 shows geologic cross section A-A’-A”, which depicts the surface to the base of the Morrison Formation based on 10 of the drill holes used in the development of the isopach map. The electric logs shown on this cross section illustrate a consistent thick sequence of Morrison clays across the project area. Copies of all electric logs from test holes that penetrate the Morrison Formation are contained in Appendix 2.6-H. The A–A’ portion of the cross section traverses the project in an “updip” direction through the initial proposed well field in the Dewey area. Due to the 2½ degree dip, the Fall River Formation is shown to rise from a depth of 550 feet below ground surface in the Dewey area to outcrop along the eastern edge of the project area near A’ (drill hole DB08-1-7). The A’-A’’ portion of the cross section proceeds in a “downdip” direction from the outcrop and continues through the initial proposed well field in the Burdock area.

Cross section A-A’-A” also illustrates the presence of the project’s uppermost confining unit (the Graneros Group) and the Fuson Shale confining unit between the Fall River Formation and the Chilson Member of the Lakota Formation. The thickness of the Graneros Group ranges from 0 feet at its outcrop within the eastern portion of the project area to over 550 feet in the southwestern portion of the project area. The Fuson Shale ranges from 20 to 80 feet thick throughout the project area.

TR RAI P&R-5

Hydraulic connection between Fall River aquifer and the ground surface.

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

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

TR RAI P&R-5 Response

Section 2.7 of the TR will be updated to reflect the following information. The figures developed for this RAI response will also be included within the updated TR.

Powertech does not intend to conduct ISR operations in the Fall River sands in the eastern portion of the project area where it is partially saturated (i.e., hydraulically unconfined). Powertech is, however, proposing to conduct ISR operations in the underlying Chilson at these locations. The Chilson is physically and hydraulically separated from the Fall River by the Fuson Shale. The Fuson Shale has been identified and delineated by Powertech from geophysical logs for exploration holes and is more than 20 feet thick everywhere within the project area; the Fuson Member of the Lakota, which contains the Fuson Shale, is in aggregate 40 to 80 feet thick.

The uppermost portion of the Fall River Formation crops out in the eastern portion of the project area in the vicinity of the Darrow pits, and the full section crops out further east in Bennett Canyon. In these areas, the Fall River is geologically unconfined. As the Fall River rises to the east, it becomes partially saturated as the top of the formation rises above the groundwater table as shown on Exhibit 2.7-1a (cross section A-A′). The approximate boundaries between fully-saturated and partially-saturated conditions in the Fall River and underlying Chilson are shown on Figures TR RAI P&R-5-1 and TR RAI P&R-5-2, respectively. As the Fall River dips basinward to the southwest, the potentiometric surface is above the top of the formation as shown on Exhibit 2.7-1a. Beneath the Beaver Creek and Pass Creek drainages the potentiometric surface of the Fall River is above the ground surface.

The areas where the Fall River subcrops below the surface alluvium and crops out near the eastern edge of the project area are recharge areas for the Fall River sands. A similar area of recharge occurs north of the project area where Pass Creek alluvium crosses the subcrops of the Fall River and the Chilson. Recharge was observed during runoff events in 2011 where flowing streams disappeared into the Fall River and Chilson sandstones. There is no evidence of surface discharge from the Fall River via seeps or springs in those areas of recharge.

The bottoms of the Darrow pits, with the exception of Pit #2, are above the Fall River potentiometric surface. These Darrow pits are usually dry but occasionally contain water that collects from runoff events. Darrow Pit #2, however, usually contains water suggesting that the base of the pit may be below the potentiometric surface of the Fall River. The pH of the water in Darrow Pit #2 is low (i.e., acidic), suggesting that acid mine drainage may be influencing the water chemistry in the pit. This implies that at least a portion of the water in Darrow Pit #2 is derived from surface runoff.

The bottom of the Triangle Pit is below the potentiometric surface of the Fall River. The Triangle Pit is therefore hydraulically connected to the Fall River Formation.

As discussed in the response to TR RAI P&R-12(b), there is a small area in the southwestern corner of the project area in the N/2NE/4 S15, T7S, R1E where groundwater discharge to the ground surface has been identified. The significance of this area as it relates to ISR operations will be evaluated further after license issuance during delineation drilling and well field-scale pumping tests prior to any well field development.

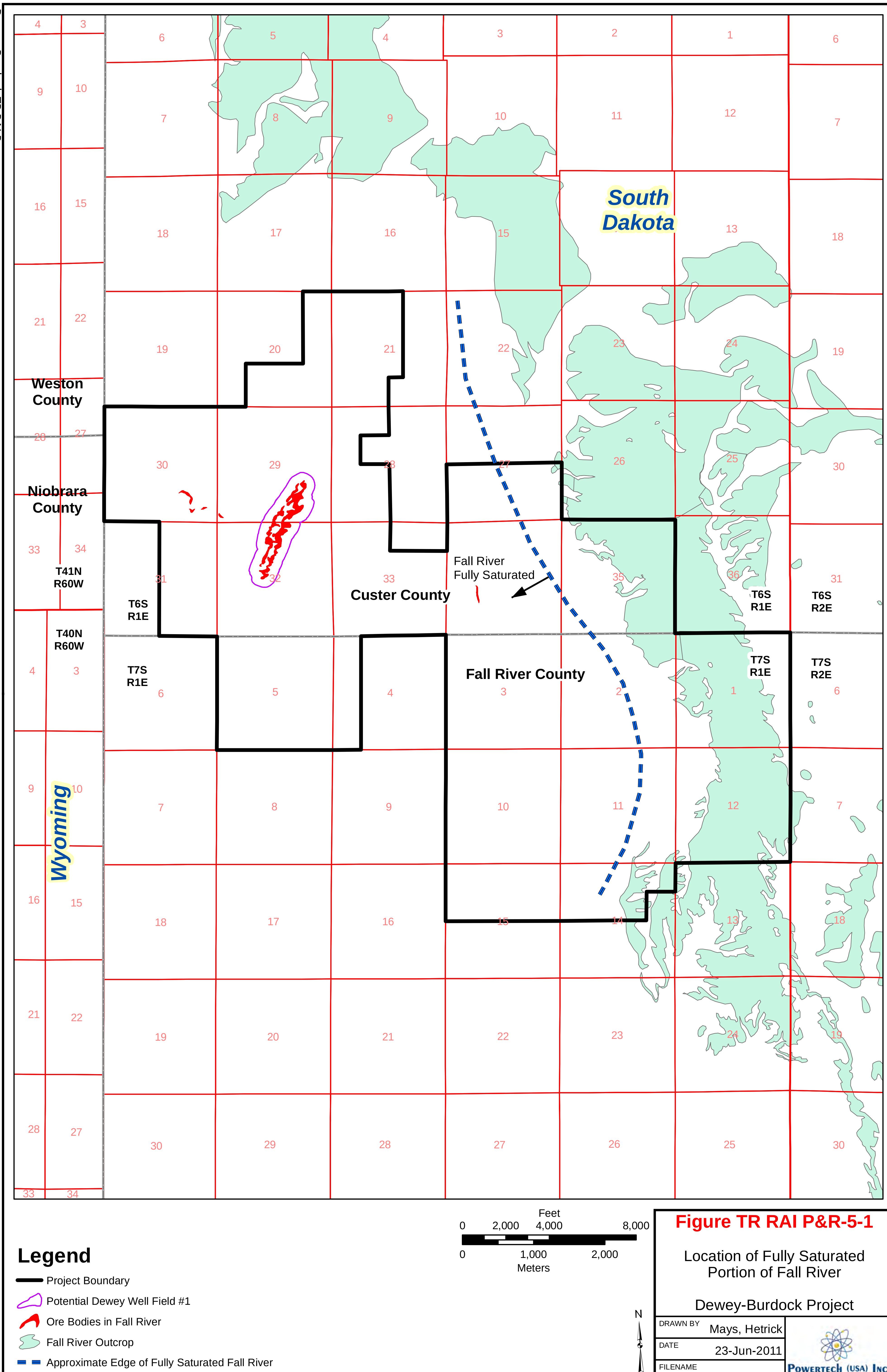
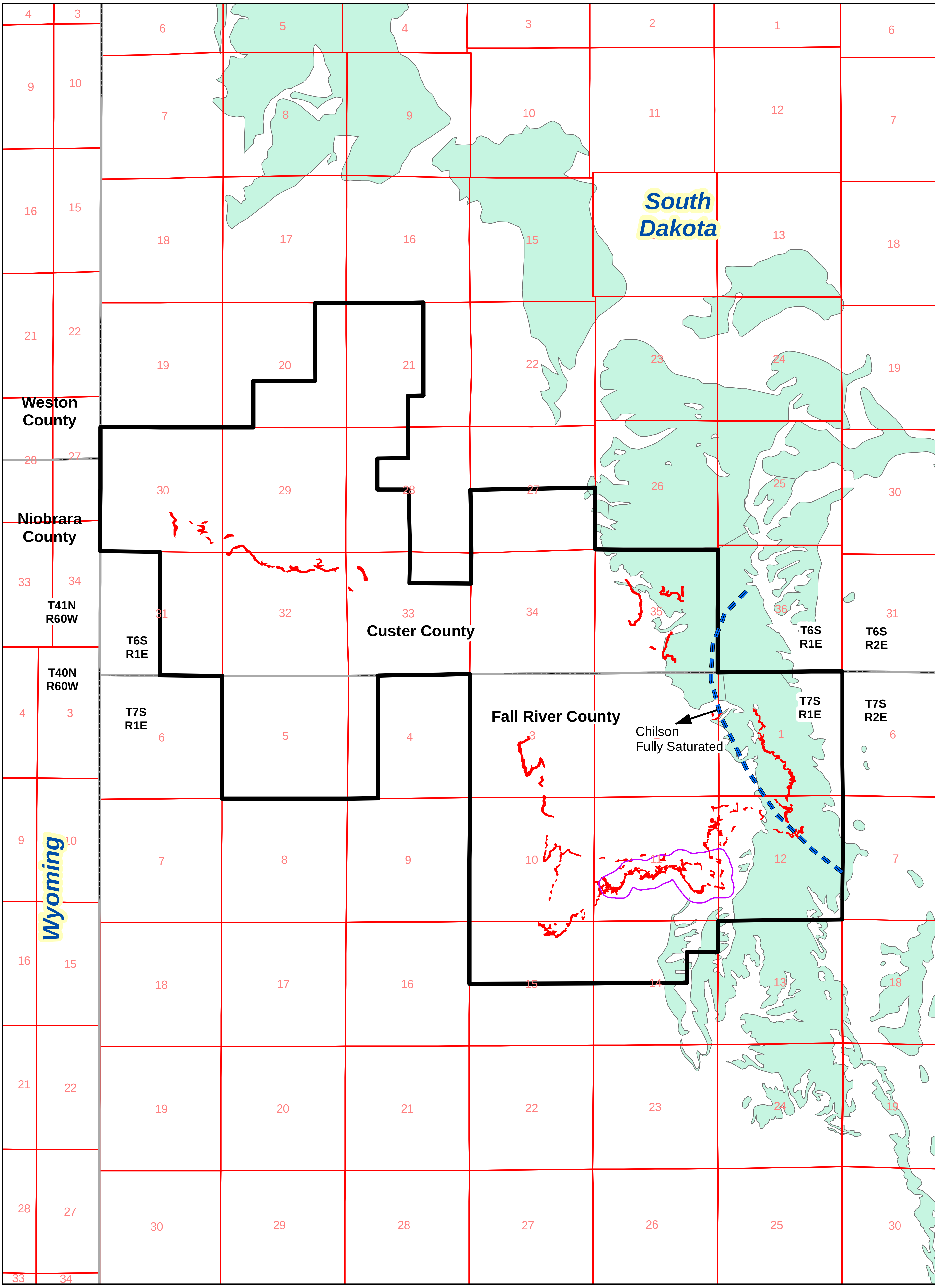


Figure TR RAI P&R-5-1

Location of Fully Saturated Portion of Fall River

Dewey-Burdock Project



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

N

Legend

- Project Boundary
- Potential Burdock Well Field #1
- Ore Bodies in the Chilson Member
- Fall River Outcrop
- Approximate Edge of Fully Saturated Chilson

Figure TR RAI P&R-5-2

Location of Fully Saturated Portion of Chilson

Dewey-Burdock Project

DRAWN BY	Mays, Hetrick
DATE	23-Jun-2011
FILENAME	Figure TR RAI P&R-5-2.mxd

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<u>TR RAI P&R-6</u>
Confining capacity of Fuson Member in areas of unconfined Fall River and Chilson production.

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

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

<u>TR RAI-P&R-6 Response</u>
The following discussion will be incorporated into the revised TR.

The only area where the Fall River Formation is unconfined is in the eastern part of the project area in the general vicinity of the Darrow pits (see response to TR RAI P&R-5). As stated previously, Powertech does not propose to conduct ISR operations in the Fall River in this area, but does propose to conduct ISR operations in the underlying Chilson Member of the Lakota where ISR operations would not be affected by the presence of historical workings. The Chilson throughout the project area is physically and hydraulically separated from the overlying Fall River Formation by the Fuson Shale.

Based on Powertech's borehole and geophysical logs for more than 3,000 exploratory holes, the Fuson Shale is continuous and no less than 20 feet thick throughout the entire project area. An isopach map showing the thickness and continuity of the Fuson Shale throughout the Dewey-Burdock project area is presented as Exhibit 2.6-7 of the TR. Powertech will update this exhibit with the most current information available and include the updated exhibit in the TR. A database providing the information to generate the Fuson isopach was provided to the NRC staff on November 4, 2010 in response to a request for clarification by NRC staff. The pervasive occurrence and continuity of the Fuson Shale throughout the project area is shown on the revised geologic cross sections (Exhibits 2.7-1a through 1h and 1j).

The shales and mudstones within the Fuson Shale are highly stratified and anisotropic. Due to the highly stratified nature of the interbedded shales and mudstones, the vertical permeability is estimated to be several orders of magnitude smaller than the horizontal permeability. Estimates of vertical hydraulic conductivity of the Fuson Shale developed from pumping tests conducted in the Fall River and Chilson near Burdock in 1979 range from 1×10^{-7} to 4.6×10^{-8} cm/s (Boggs and Jenkins, 1980). Detailed pump

tests to be conducted after license issuance as a part of the well field hydrologeologic packages will provide additional quantification of the small hydraulic conductivity of the confining units.

For clarification, the Fuson Shale is differentiated from the Fuson Member of the Lakota Formation by Powertech for the purpose of characterizing the site geology. The Fuson Shale has been mapped by Powertech and consists of 20 to 80 feet of low-permeability shales and clays, which generally occur at or near the base of the unit. The Fuson Member of the Lakota, in comparison, has been mapped by the U.S. Geological Survey and others to be from 40 to 80 feet thick and consisting of interbedded fluvial shales, clays, mudstones, and sands.

The Fuson Member, being of fluvial origin, locally contains sand deposits (see Schnabel and Charlesworth, 1963). The presence of the sand facies within the Fuson Member does not diminish the confining capacity of the Fuson Shale within the Fuson Member as defined and mapped by Powertech. The geologic map of the Burdock quadrangle (Schnabel and Charlesworth, 1963) indicates that the Fuson Shale may pinch out in some areas. In particular, the interpretive fence diagram presented by Schnabel and Charlesworth shows an area approximately 1½ miles east and northeast of the project area, across Bennett Canyon, in the E/2 Section 30, T6S, R2E, where the Fuson Member pinches out. However, based on Powertech’s borehole logs no evidence of Fuson Shale pinch-out locations has been identified within the project area. The Fuson Shale is clearly continuous with a thickness of more than 20 feet across the entire project area.

<u>TR RAI P&R-7</u>
Provide additional aquifer test information.

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

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

<u>TR RAI P&R-7 Response</u>
The following information will be included in the revised TR.

The TVA reports referenced in this RAI are: (1) "Hydrogeologic Investigation at Proposed Uranium Mine near Dewey, South Dakota" (Boggs, J.M., 1983) and (2) "Analysis of Aquifer Tests Conducted at the Proposed Burdock Uranium Mine Site Burdock, South Dakota" (Boggs, J.M. and A.M. Jenkins, 1980).

Copies of these reports are included with the RAI responses as Appendix 2.7-K and will be included with the revised TR. Within the project area a total of five pump tests have been performed which include:

1) A constant discharge rate test performed by the Tennessee Valley Authority (TVA) in the Chilson in April 1979.
2) A second pump test conducted in the Fall River by TVA in July 1979.
3) A TVA pump test in February 1982 in the Chilson.
4) A Powertech pump test in the Dewey area (NE/4NW/4 Section 32, T6S, R1E) using a well completed within the Fall River (2008).
5) A Powertech pump test in the Burdock area (NE/4SW/4 Section 11, T7S, R1E) using a well completed in the Chilson (2008)

The results of the pump tests conducted by Powertech are presented in the 2008 Pumping Test Report (TR Appendix 2.7-B). The tables in this appendix have been revised as described in the response to TR RAI P&R-11 and are included as Appendix 2.7-B to this RAI response package.

TVA also conducted several pumping tests prior to the 1979 test referenced above. The results of these earlier tests, however, were regarded as being of limited value by TVA due to problems with well construction, variable pumping rates, etc.

Details regarding each of these pump tests will be summarized within Section 2.7 of the revised TR.

<u>TR RAI P&R-8</u>
Cross sections with geophysical log results.

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

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

<u>TR RAI P&R-8 Response</u>
Powertech received clarification from NRC staff on the portion of this RAI requesting that cross sections in the Dewey area include logs from all test holes that penetrated through the Lakota Formation. The clarification indicated that Powertech is not required to include all test holes that penetrated the Lakota Formation – instead, a representative number of test holes are to be included.

As described in the response to TR RAI P&R-1, Powertech developed a more detailed illustration of the geology of the potential well fields for the Dewey-Burdock Project. The following information and exhibits will be incorporated into the revised TR. Cross sections, with geophysical logs, have been prepared for Dewey Well Fields 2, 3 & 4 (formerly Dewey Future Mine Unit III) and Burdock Well Fields 2, 3 & 4 (formerly Burdock Future Mine Unit III). Well field nomenclature as shown on Exhibit 3.1-4 is D-WF1 for Dewey Well Field 1 and B-WF1 for Burdock Well Field 1. Other potential well fields (2, 3, 4) follow the same naming convention. As also described in the response to TR RAI P&R-1, due to a 1,600-foot operational buffer assigned to all uranium ore bodies in the project area, the former Dewey Future Mine Unit II will not be included in Powertech's proposed operations.

Cross section J-J' (Exhibit 2.7-1j) is drawn through potential Dewey Well Fields 2, 3 & 4. As shown on the cross section, exploration hole DB08-32-11 penetrates a 97-foot thick sequence of the Morrison Formation, the entire thickness of the Unkpapa Sandstone and bottoms in the Sundance Formation. The log for this exploration hole provides an excellent cross sectional view of the lowermost confining unit (Morrison Formation) as well as deeper stratigraphy below the Dewey-Burdock site. As shown in this cross section, proposed D-WF2 targets ore bodies in the Middle Chilson sandstone, proposed D-WF3 addresses resources in the Lower Fall River sandstone and proposed D-WF4 targets ore bodies in the Upper Chilson sandstone. There is not a high density of exploratory drilling in these potential well field areas, and a future delineation drilling program will be implemented to thoroughly delineate resources and to accurately define well field limits. However, this conceptual approach to identifying potential

well fields is an important step in visualizing the spatial relationships of host formations and ore bodies to be developed in the future.

Cross sections C-C’ (Exhibit 2.7-1c) and D-D’ (Exhibit 2.7-1d) depict subsurface conditions at potential well fields in the Burdock area immediately east of B-WF1. There are no Fall River ore bodies within this portion of the project area; only Chilson sandstones are targeted. Cross section C-C’ (Exhibit 2.7-1c) illustrates the subsurface beneath B-WF2 and B-WF4, which are proposed to target ore bodies within the Middle Chilson sandstone. Although there also is uranium mineralization present in the Upper and Lower Chilson sandstones, to date no ore bodies have been identified in these sand units in this area. The Fuson Shale, which overlies and confines the Chilson sandstones, maintains a thickness of 50 to 60 feet along this cross section.

Cross section D-D’ (Exhibit 2.7-1d) is drawn through the vicinity of potential Burdock well fields B-WF2 and B-WF4. Both well fields target the Middle Chilson sandstone. Also shown is Burdock well field B-WF3 that targets ore bodies within the Upper Chilson sandstone. Overlying the Chilson sandstones in this area is a 50-foot thickness of Fuson Shale. As shown on the cross section, exploration hole RONA-81 fully penetrates the Morrison Formation, which is 85 feet thick at this locale and demonstrates the integrity of the lowermost confining unit in this portion of the project area.

These cross sections show that the major geologic units are continuous throughout the project area, with consistent upper and lower confinement zones. These are virtually ideal conditions for a successful ISR operation, providing optimal control of fluids and minimal opportunity for vertical excursions.

The extent of current potential well fields is based on available drill hole data. Further delineation will take place after license issuance and will be used to prepare detailed well field hydrogeologic data packages for each potential well field.

<u>TR RAI P&R-9</u>
Clarify plugging and abandonment of all exploration holes.

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

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

<u>TR RAI P&R-9 Response</u>
As with any other site proposed for ISR uranium recovery, historical exploration holes and wells are present within the project area. Powertech will use the best available information and best professional practices to locate boreholes or wells in the vicinity of potential well field areas, including historical records, use of color infrared imagery, field investigations, and potentiometric surface evaluation and pump testing conducted for each well field as part of the development of complete well field hydrogeologic packages. As with other ISR facilities, Powertech anticipates that some unplugged holes or wells may be encountered during well field design. Consistent with standard industry operating practices and experience, the following describes the procedures Powertech will implement to detect and mitigate any unplugged holes or wells that have the potential to impact the control and containment of well field solutions. This information will be incorporated into the revised TR.

Powertech commits to properly plugging and abandoning or mitigating any of the following should they pose the potential to impact the control and containment of well field solutions within the project area:

1) Historical wells and exploration holes
2) Holes drilled by Powertech for the purposes of delineation and exploration
3) Any wells failing mechanical integrity testing (MIT) including those installed by Powertech and those installed before Powertech

Powertech will attempt to locate with best professional practices any presently unknown boreholes or wells in the vicinity of every potential well field. Historical records will be used to determine the presence of previous boreholes and wells. Pump testing conducted as part of routine well field hydrogeologic package development will use an array of monitor wells designed to detect and locate any unknown boreholes or wells. The pump testing also will be designed to provide sufficient hydrogeologic data to demonstrate that the well field design and monitoring systems are sufficient to control and detect any potential excursions. Details of the pump testing program are provided in greater detail in the response to TR RAI 5.7.8-14.

Should any hole or well at or near potential well fields be suspected of being improperly plugged and abandoned, Powertech will use best professional practices to precisely locate and re-enter the suspected problem hole with a drill rig or tremmie pipe. Powertech will evaluate mitigation alternatives including plugging and abandoning the hole or well with grout as described below. Powertech may enter the well with logging equipment prior to plugging and abandoning the well to confirm that the well poses a potential problem.

It is not surprising that there is little evidence of unplugged drill holes in the project area, even though there is a long history of mineral exploration in this area and much of this occurred prior to enactment of modern laws and regulations governing plugging and abandoning drill holes. This is because of the well-known natural tendency of drill holes to seal themselves by collapsing, caving and swelling of the formations through which the holes are drilled. During exploration, drill holes must be logged promptly after drilling in order to minimize the risk of losing logging tools or losing the ability to access the full depth of the holes due to the processes described above. During the pump testing that will be done as part of the preparation of the hydrogeologic package for each well field, special attention will be paid to known or suspected locations of exploration holes to detect evidence of interaquifer communication that might be the result of unplugged drill holes.

Plugging and Abandonment Procedures

Powertech's standard operating procedures will include plugging and abandoning all boreholes completed during the process of exploration and delineation drilling. Any wells installed by Powertech which fail MIT and cannot be repaired also will be plugged and abandoned.

Powertech will plug all wells or exploration holes with bentonite or cement grout. The weight and composition of the cement will be sufficient to control artesian conditions and meet the well abandonment standards of the State of South Dakota, including Chapter 74:11:08 (Capping, Sealing, and Plugging Exploration Test Holes) and Section 74:29:11:18 (Requirements for Plugging Drill Holes and Repair, Conversion, and Plugging Wells) of the South Dakota Administrative Rules. Cementing will be completed from total depth to surface using a drill pipe. Records will be kept of each well or exploration hole cemented including at a minimum the following information:

- well or hole ID, total depth, and location
- driller, company, or person doing the cementing work
- total volume of cement placed down hole
- viscosity and density of the slurry used

Powertech will remove surface casing and set a cement plug to a depth 6 ft below the ground surface on each well or borehole plugged and abandoned.

Mitigation and Avoidance

Boreholes or wells which may potentially impact control of well field operations will be evaluated using pump test data and groundwater modeling. Should it be determined that it is not possible to mitigate potential adverse impacts from any unplugged borehole or well that is discovered, the affected well field will be designed to minimize any potential impacts. The monitoring system will be designed to demonstrate well field control. This may include monitor wells in addition to those provided for normal well field operations (refer to response to TR RAI 5.7.8-12). All of these details will be included in the well field hydrogeologic data package that will be prepared for each well field and reviewed by Powertech's SERP prior to operation of that well field.

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

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

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

<u>TR RAI P&R-10 Response</u>

Revised tables presenting the inventory of all wells within 2 km (1.2 miles) of the project boundary are provided within this response. Well completion records and associated documentation will be provided in Appendix 2.2-A in the revised TR. Exhibit 3.1-1 of the TR has been revised to include all wells within 2 km of the project boundary and is included with this response package. The revised Exhibit 3.1-1 also will be included with the revised TR. The following information will be incorporated into the revised TR.

<u>Well Inventory</u>

Historical records and field investigations of the project area and 2 km surrounding area were used to develop the well inventory. A preliminary investigation of the wells was completed in 2007, and additional surveys were conducted in 2011 to evaluate the use and condition of the wells. A total of 107 wells are currently identified within 2 km of the project area. There are also 28 wells with historical records that are currently not present at the surface and 8 wells with historical records that have been visually confirmed as plugged and abandoned.

Table P&R-10-1 presents the well inventory within 2 km of the project boundary. Those wells have one of the following uses:

Domestic: Are currently used or can reasonably be expected to be used for drinking water use, including wells which are also used for livestock watering (19 wells).

Stock: Watering of livestock is sole use; well cannot be used for drinking water use (i.e., no piping to domestic water system, etc.) (41 wells)

Monitor: Sole use is for monitoring (47 wells)

In Table P&R-10-1, no wells are identified as “other types of use” or “unknown use.”

Table P&R-10-2 lists the wells identified in historical records that were not evident at the surface during the field investigations. These wells are depicted on Figure TR RAI P&R-10-1. Several of these wells are suspected to be plugged and abandoned. Powertech will continue to search for these wells. During design of well fields, pump testing will be designed to locate any such wells and to detect any potential impacts from such wells on the ISR operations.

Table TR RAI P&R-10-3 provides all of the wells within 2 km of the project area that have been confirmed plugged and abandoned by Powertech. Each well was visually inspected, and it has been determined that cement was placed within the well bore.

Lease Agreements

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

> *“DENVER URANIUM shall compensate LESSOR for water wells owned by LESSOR at the execution of this lease, as follows: Any such water which falls within an area to be mined by DENVER URANIUM, shall be removed from LESSOR’s use. Prior to removal, DENVER URANIUM shall arrange for the drilling of a replacement water well or wells, outside of the mining area, in locations mutually agreed upon between LESSOR and DENVER URANIUM, as may be necessary to provide water in a quantity equal to the original well and of a quality which is suitable for all uses the original water well served at the time such well was removed from LESSOR’s use.”*

Well Replacement Procedures

During the design of each potential well field, all nearby water supply wells will be evaluated for the potential to be impacted by ISR operations or the potential to interfere with ISR operations. If needed, this evaluation will also include groundwater modeling. The results of the evaluation will be contained within a well replacement plan described in the hydrogeologic data package for each well field.

At a minimum, all domestic wells within the project area and all stock wells within ¼ mile of well fields will be removed from private use. Depending on the well construction, location and screen depth, Powertech may continue to use the well for monitoring or plug and abandon the well.

The well owner will be notified in writing prior to removing any well from private use. Powertech will work with the well owner to determine whether a replacement well or alternate water supply is more appropriate.

Replacement wells will be located an appropriate distance from the potential well fields and will target an aquifer outside of the ore zone that provides water in a quantity equal to that of the original well and of a quality which is suitable for the same uses as the original well, subject to the lease agreement and South Dakota State water law.

An example of a replacement well is provided in Figure TR RAI P&R-10-2, which shows use of the proposed project Madison well to supply water by pipeline to local stock tanks.

Wells to be Removed from Use

All existing domestic wells within the project area will be removed from private use prior to ISR operations, including wells 13, 16, 40, 42, 43, 703, 704, 4002. Depending on the well construction, location and screen depth, Powertech may continue to use the wells for monitoring or plug and abandon the wells.

Stock wells within the project area will be evaluated as potential well fields are designed. At a minimum all stock wells that are within ¼ mile of any well field will be removed from private use prior to operation of that well field. In addition, stock wells that could be adversely affected by or could adversely affect ISR operations will be removed from private use. The stock wells currently anticipated to be removed from private use include wells 17, 38, 49, 61, 618, and 668. Currently, well 628 is not expected to be removed from private use as it is more than ¼ mile from any potential well field areas. Additional delineation drilling after license issuance may change the extent of the potential well field areas or provide additional well field areas within the project area. Therefore, each potential well field will be evaluated with regard to existing nearby stock water use and an evaluation will be included within the well field hydrogeologic data package for each well field.

Figure TR RAI P&R-10-3 shows the location of all domestic and stock wells currently anticipated to be removed from private use.

Prior to ISR operations, Powertech will assume control of all wells within the project area boundary listed as “monitor” in Table TR RAI P&R-10-1. These will be secured at the well heads to prevent unauthorized use.

Table TR RAI P&R-10-1: Wells within 2 km of the Project Boundary

Hydro ID	Township	Range	Section	1/4 - 1/4 Location	Coordinates East	Coordinates North	Screened Location	Well Use
1	7	1	9	SESE	1027696	429227	Chilson	Stock
2	7	1	16	SESE	1026724	423922	Chilson	Domestic
3	7	1	22	SWNW	1028593	421104	Chilson	Stock
4	7	1	15	SESE	1032516	423080	Unknown	Stock
5	7	1	14	NENW	1035181	427284	Chilson	Stock
6	7	1	14	NESE	1037218	425012	Unknown	Stock
7	7	1	23	NWNW	1033304	422417	Fall River	Domestic
8	7	1	23	SWSE	1036052	418515	Fall River	Domestic
9	7	1	23	NENE	1038003	421806	Fall River	Stock
12	7	1	4	SESE	1026978	434378	Chilson	Stock
13	7	1	3	NWNW	1028360	438470	Chilson	Domestic
14	7	1	2	NWSW	1033704	434723	Fall River	Stock
15	7	1	2	NENW	1035304	438317	Chilson	Stock
16	7	1	1	NESW	1041428	434446	Chilson	Domestic
17	7	1	12	SENW	1040223	431329	Fall River	Stock
18	7	1	9	SWSW	1022812	428960	Fall River	Domestic
37	7	2	18	NWSW	1044183	423947	Unknown	Stock
38	6	1	33	SWNW	1024328	442289	Fall River	Stock
40	6	1	30	SWNW	1013415	447182	Inyan Kara	Domestic
41	6	1	31	SWNE	1015385	442081	Unknown	Stock
42	7	1	5	SWNE	1021144	436481	Chilson	Domestic
43	6	1	34	SWSE	1031123	439436	Chilson	Domestic
49	6	1	32	NWNW	1018932	444022	Fall River	Stock
51	7	1	9	SENE	1027411	431487	Chilson	Stock
61	7	1	11	NWSE	1036832	429987	Chilson	Stock
96	41N	60W	22	SWSW	1011630	451853	Chilson	Domestic
102	6	1	18	SWNE	1016825	458312	Chilson	Domestic
106	6	1	18	NENE	1018099	459625	Unknown	Stock
107	6	1	18	SWNE	1017018	458158	Fall River	Domestic
108	6	1	18	SWNE	1016478	458698	Fall River	Domestic
109	6	1	17	NENW	1020801	459625	Chilson	Domestic
110	6	1	17	NENE	1023777	459643	Chilson	Stock
111	6	1	17	NWNE	1022074	459586	Fall River	Stock
112	6	1	16	SESE	1027864	455881	Fall River	Stock
113	7	2	6	NESW	1046437	434417	Unknown	Stock
114	7	2	7	SESW	1045410	428654	Unkpapa	Stock
115	6	1	18	SENE	1017697	457640	Fall River	Domestic
116	6	1	18	SENE	1017992	458111	Fall River	Stock
117	6	1	8	SWSE	1022177	460796	Unknown	Stock
138	6	1	18	NENE	1017537	459030	Fall River	Domestic
147	6	1	17	NESW	1020879	456566	Chilson	Monitor
220	6	1	19	SENE	1017872	452334	Unknown	Stock
270	6	1	19	NWSW	1014108	451942	Unknown	Stock
436	6	1	20	NWNE	1021450	454700	Fall River	Monitor
506	7	2	8	SWNW	1050129	430704	Unkpapa	Stock
510	7	1	12	SESE	1042933	428178	Chilson	Stock
609	6	1	29	SWNE	1021735	447808	Chilson	Monitor
610	6	1	29	SWNE	1021599	447969	Fall River	Monitor
611	6	1	20	NWNE	1021835	453954	Chilson	Monitor
612	6	1	20	NWNE	1021755	454128	Chilson	Monitor
613	6	1	20	NWNE	1022125	453775	Fall River	Monitor
614	6	1	20	NWNE	1022185	453769	Fall River	Fuson
615	6	1	20	NWNE	1022172	453708	Chilson	Monitor
616	6	1	20	SWNE	1022132	453134	Chilson	Monitor
617	6	1	20	NENW	1021026	453582	Chilson	Monitor

Table TR RAI P&R-10-1: Wells within 2 km of the Project Boundary (Continued)

Hydro ID	Township	Range	Section	1/4 - 1/4 Location	Coordinates East	Coordinates North	Screened Location	Well Use
618	7	1	2	SENE	1038074	435906	Unknown	Stock
619	7	1	2	SENW	1034866	436729	Chilson	Stock
620	6	1	35	NWNW	1033951	443209	Chilson	Stock
622	6	1	20	NENE	1022776	454033	Chilson	Monitor
623	6	1	20	NENE	1022686	454311	Fall River	Monitor
628	6	1	20	SESE	1022496	449718	Fall River	Stock
631	6	1	23	SWSW	1034177	449309	Fall River	Stock
635	7	1	14	NENW	1004085	427131	Sundance	Monitor
637	7	1	11	NESE	1038075	430320	Unknown	Monitor
638	7	1	2	NENE	1038269	437976	Fall River	Monitor
639	7	2	7	SENW	1045704	430722	Unknown	Stock
640	7	1	12	SESE	1043010	427965	Unknown	Stock
642	7	1	12	SESE	1042926	428042	Unknown	Stock
645	7	1	16	NENE	1027681	427998	Unknown	Stock
650	7	1	1	SESE	1043781	433331	Chilson	Stock
656	6	1	31	SENW	1014230	442000	Unknown	Stock
657	6	1	20	NWNE	1021483	454729	Chilson	Monitor
662	7	1	11	SESW	1035381	428928	Unknown	Monitor
668	7	1	15	NWNE	1031029	427450	Inyan Kara	Stock
676	6	1	34	SESW	1030846	439891	Alluvial	Monitor
677	7	1	4	SWSW	1023527	434077	Alluvial	Monitor
678	7	1	9	SWNE	1026522	431925	Alluvial	Monitor
679	6	1	27	NWSE	1032294	446245	Alluvial	Monitor
680	7	1	11	NESW	1035078	429969	Chilson	Monitor
681	6	1	32	NENW	1020330	443725	Fall River	Monitor
682	7	1	11	SENW	1035139	431257	Chilson	Monitor
683	6	1	29	NESW	1020212	446104	Fall River	Monitor
684	7	1	11	NESW	1035191	429744	Chilson	Monitor
685	6	1	32	NWNE	1020690	443409	Fall River	Monitor
686	7	1	11	NESW	1034970	429749	Chilson	Monitor
687	6	1	32	NENW	1020081	443724	Fall River	Monitor
688	7	1	11	NESW	1035027	429974	Fall River	Monitor
689	6	1	32	NENW	1020316	443789	Chilson	Monitor
690	7	1	11	NESW	1035114	429970	Unkpapa	Monitor
691	6	1	32	NENW	1020364	443698	Fall River	Monitor
692	7	1	11	NESW	1035075	430014	Chilson	Monitor
693	6	1	32	NENW	1020327	443661	Unkpapa	Monitor
694	7	1	15	NWNW	1028717	426836	Fall River	Monitor
695	6	1	32	SESE	1022385	439312	Fall River	Monitor
696	7	1	15	NWNW	1028538	427141	Chilson	Monitor
697	6	1	32	SESE	1022350	439347	Chilson	Monitor
698	7	1	2	NESW	1035909	435651	Fall River	Monitor
703	7	1	1	SWSE	1041621	434334	Unkpapa	Domestic
704	7	1	5	SWNE	1020966	436647	Chilson	Domestic
705	6	1	21	NENE	1028624	453314	Chilson	Monitor
706	6	1	21	NENE	1028589	453276	Fall River	Monitor
707	6	1	34	SWNE	1031935	441809	Alluvial	Monitor
708	7	1	3	SESW	1030254	434094	Alluvial	Monitor
709	7	1	15	SENW	1029286	426603	Alluvial	Monitor
3026	7	1	12	NENE	1043638	432833	Chilson	Monitor
4002	6	1	30	NWSW	1013414	446931	Inyan Kara	Domestic
7002	7	1	23	NWNW	1033333	421931	Chilson	Stock

Notes: [1] Coordinate system is NAD 27 South Dakota State Plane South
[2] Inyan Kara indicates that screened interval includes both Chilson and Fall River.

Table TR RAI P&R-10-2: Historical Wells Not Present

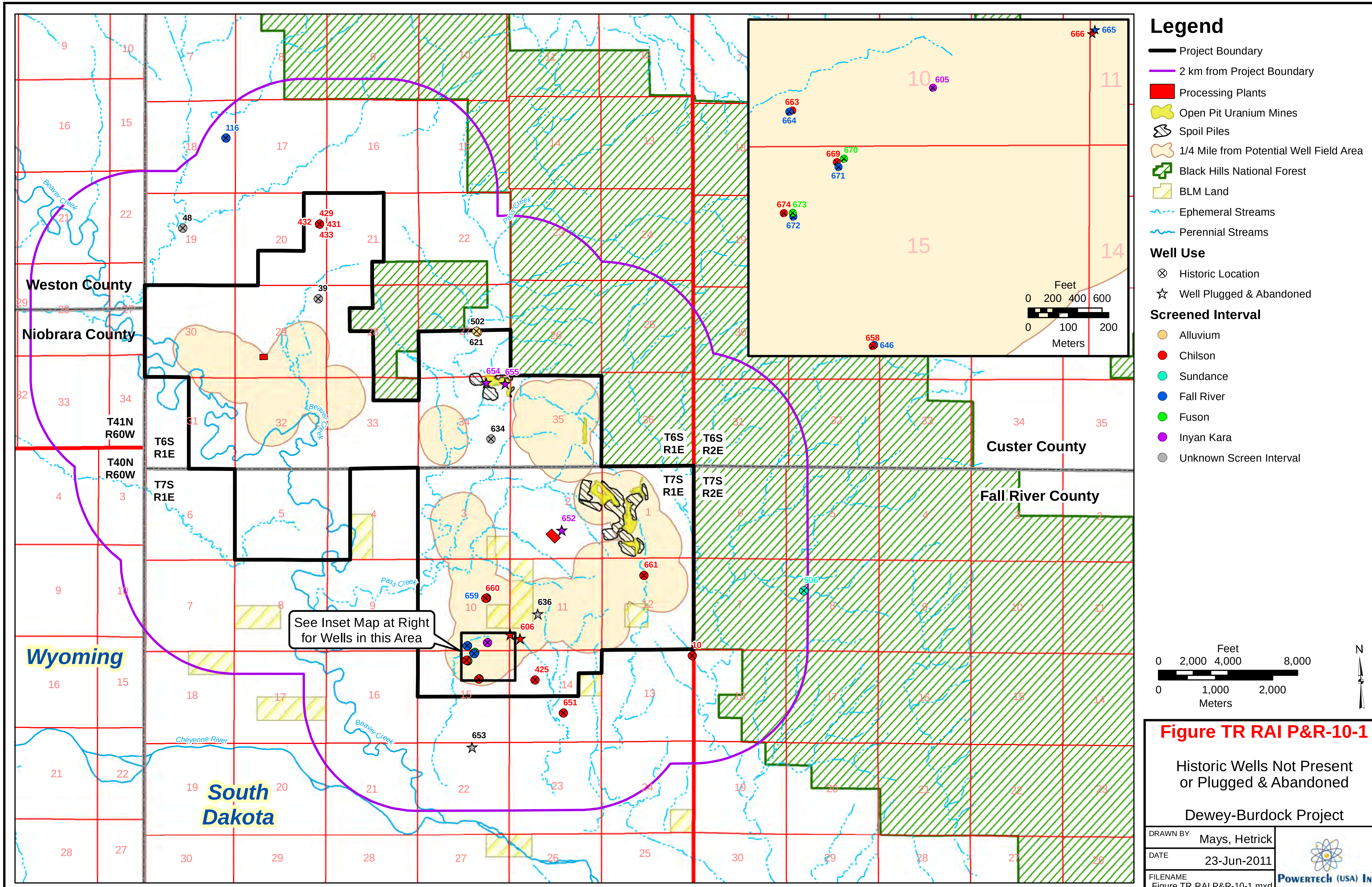
Hydro ID	Township (S)	Range (E)	Section	1/4 - 1/4 Location	Easting[1]	Northing[1]	Screened Location[2]
10	7	1	13	NENE	1011956	427239	Chilson
39	6	1	29	NENE	991314	448657	Unknown
48	6	1	19	SENW	983693	453037	Unknown
116	6	1	18	SENE	986390	458112	Fall River
425	7	1	14	SENW	1002848	426208	Chilson
429	6	1	20	SENE	991556	452954	Chilson
431	6	1	20	SENE	991556	452954	Chilson
432	6	1	20	SENE	991556	452954	Chilson
433	6	1	20	SENE	991556	452954	Chilson
502	6	1	27	NWSE	1000389	446361	Alluvial
506	7	2	8	SWNW	1018528	430704	Sundance
605[3]	7	1	10	SWSE	1000213	428484	NA
621	6	1	27	NWSE	1000329	446398	Alluvial
634	6	1	34	NESE	1000901	440168	Unknown
646	7	1	15	SWNE	999646	426409	Fall River
651	7	1	14	NWSE	1004408	424246	Chilson
658	7	1	15	SWNE	999633	426398	Chilson
659	7	1	10	SWNE	1000274	431049	Fall River
660	7	1	10	SWNE	1000221	431030	Chilson
661	7	1	12	NENW	1009376	431971	Chilson
663	7	1	10	SWSE	999058	428346	Chilson
664	7	1	10	SWSE	999033	428338	Fall River
669	7	1	15	NWNE	999404	427910	Chilson
670	7	1	15	NWNE	999464	427937	Fuson
671	7	1	15	NWNE	999415	427870	Fall River
672	7	1	15	NWNE	999031	427480	Fall River
673	7	1	15	NWNE	999027	427512	Fuson
674	7	1	15	NWNE	998954	427513	Chilson

Notes: [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] 605 is not a well but a pipeline from well 668.

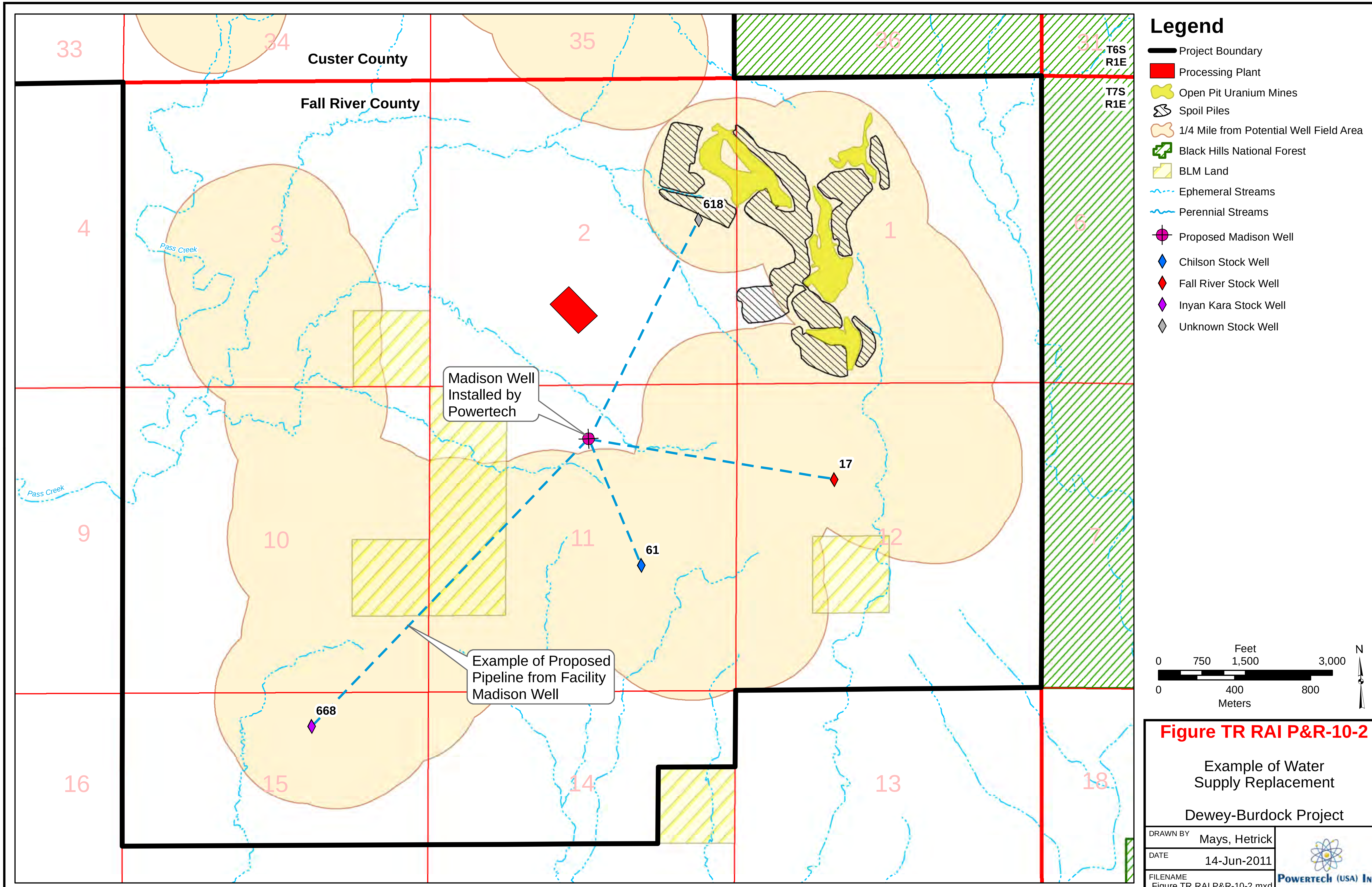
Table TR RAI P&R-10-3: Historical Wells Plugged and Abandoned

Hydro ID	Township (S)	Range (E)	Section	1/4 - 1/4 Location	Easting[1]	Northing[1]	Screened Location[2]
606	7	1	11	SWSW	1033713	428609	Chilson
636	7	1	11	NESW	1034774	429982	Unknown
652	7	1	2	NWSE	1036360	434742	Inyan Kara
653	7	1	22	NWNE	1030679	422487	Unknown
654	6	1	34	NWNE	1032372	443410	Inyan Kara
655	6	1	34	NENE	1033454	443307	Inyan Kara
665	7	1	11	SWSW	1033153	428901	Fall River
666	7	1	11	SWSW	1033128	428870	Chilson

Notes: [1] Coordinate system is NAD 27 South Dakota State Plane South.
[2] Inyan Kara indicates that screened interval includes both Chilson and Fall River.



Legend
Project Boundary
2 km from Project 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
Well Use
Historic Location
Well Plugged & Abandoned
Screened Interval
Alluvium
Chilson
Sundance
Fall River
Fuson
Inyan Kara
Unknown Screen Interval
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
See Inset Map at Right for Wells in this Area
Feet
0 200 400 600
0 100 200
Meters
Feet
0 2,000 4,000 8,000
0 1,000 2,000
Meters
N
Figure TR RAI P&R-10-1
Historic Wells Not Present or Plugged & Abandoned
Dewey-Burdock Project
DRAWN BY Mays, Hetrick
DATE 23-Jun-2011
FILENAME Figure TR RAI P&R-10-1.mxd
POWERTECH (USA) INC.


Legend
Project Boundary
Processing Plant
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 Madison Well
Chilson Stock Well
Fall River Stock Well
Inyan Kara Stock Well
Unknown Stock Well
Custer County
Fall River County
T6S R1E
T7S R1E
Pass Creek
Madison Well Installed by Powertech
Example of Proposed Pipeline from Facility Madison Well
618
17
61
668
33
34
35
36
31
4
3
2
1
6
9
10
11
12
7
16
15
14
13
18
Feet
0 750 1,500 3,000
0 400 800
Meters
N
Figure TR RAI P&R-10-2
Example of Water Supply Replacement
Dewey-Burdock Project
DRAWN BY Mays, Hetrick
DATE 14-Jun-2011
FILENAME Figure TR RAI P&R-10-2.mxd
Powertech (USA) Inc.

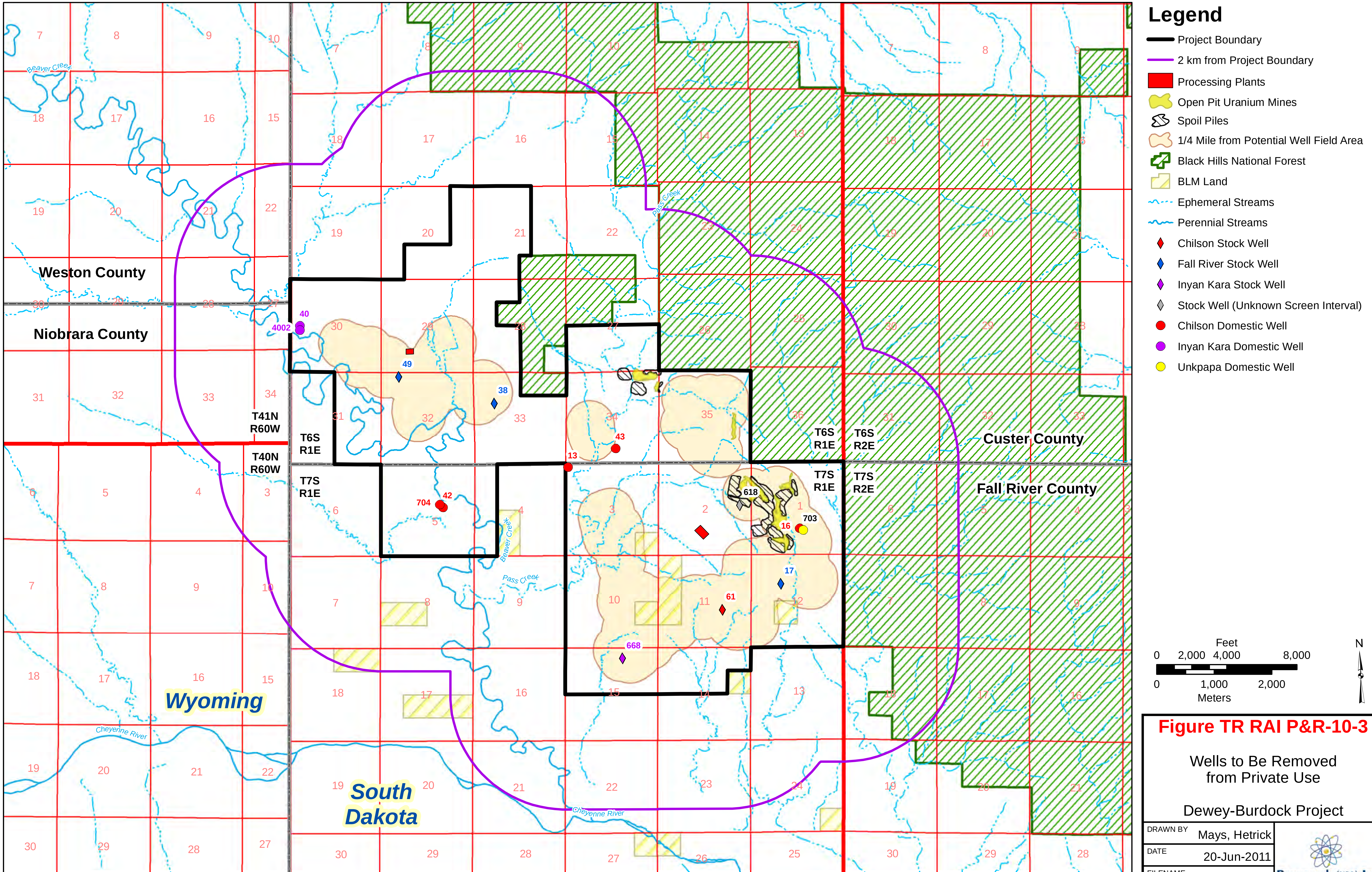


Figure TR RAI P&R-10-3

Wells to Be Removed from Private Use

Dewey-Burdock Project

DRAWN BY	Mays, Hetrick
DATE	20-Jun-2011
FILENAME	Figure TR RAI P&R-10-3.mxd

Powertech (USA) Inc.

<u>TR RAI P&R-11</u>
Details of the applicant's pumping test for independent review.

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

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

<u>TR RAI P&R-11 Response</u>

Portions of Powertech's 2008 Pumping Test Report have been revised and are included as Appendix 2.7-B to this RAI response package. Tables B.2-1, B.3-1, C.2-1, and C.3-1 in Appendices B and C to the revised 2008 Pumping Test Report have been revised to include water level elevations and observed drawdowns in the pumping and observation wells for the Dewey and Burdock pumping and recovery tests. The complete revised pumping test report will be included with the revised TR.

TR RAI P&R-12
Clarification of breccia pipes

TR RAI P&R-12(a)

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

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

TR RAI P&R-12(a) Response

There are no breccia pipes in the project area. The potential presence of breccia pipes in the proposed project area is a theory for which no supporting evidence has been found, as demonstrated by the following discussion, which will be incorporated into the revised TR.

The source of information used to illustrate the possible locations of breccia pipes or collapse features on the "Location of Breccia Pipe or Collapse Structure" map (TR Supplement Exhibit 2.2-1) was Plate 4 of USGS Professional Paper 763 (Gott et al., 1974). Gott et al. identified three categories of features (using the terminology of Gott et al.): 1) "breccia pipes or collapse features," 2) "structures of possible solution origin" and 3) "topographic depressions." Only the first category, "breccia pipes or collapse features," was plotted on TR Supplement Exhibit 2.2-1.

As stated by Gott et al. (1974), the primary purposes of USGS Professional Paper 763 were to describe the stratigraphy of the Inyan Kara Group along the southern flank of the Black Hills Uplift and to present a working theory on the localization of uranium deposits. The geologic mapping and stratigraphic descriptions contained in this report are comprehensive and have provided an important source of information on the stratigraphy and depositional environment of Inyan Kara sediments in this region. However, theories presented on uranium mineralization emplacement that are centered on and related to the presence of breccia pipes penetrating the Inyan Kara Group have not been proven and have been replaced by the classic "roll front" theory of uranium emplacement. Moreover, there appears to be no credible basis to support the theory that collapse features are acting as "conduits" for large volumes of ascending water to recharge the Inyan Kara Group.

Breccia pipes and collapse breccias were mapped in the southern Black Hills by Darton (1909). Gott et al. (1974) state that these collapse features originate in anhydrite and gypsum sequences within the upper portion of the Minnelusa Formation of Pennsylvanian age. Dissolution of these evaporite

sequences by underlying Minnelusa and/or Madison artesian water created solution cavities into which overlying Permian sediments collapsed. On Plate 4 of Gott et al. (1974), locations of classic Black Hills collapse breccias occurring within Paleozoic sediments were identified. In addition, many other more speculative features occurring higher in the stratigraphic column were mapped. All breccia pipes or collapse structures shown on TR Supplement Exhibit 2.2-1 and labeled as occurring in the Minnelusa Formation, Opeche Shale, Minnekahta Limestone or basal Spearfish Formation should be considered to be “documented” breccia pipe locations. All of these Paleozoic breccias pipes are located 8-25 miles north and east of the Dewey-Burdock project area.

Geologic mapping and water resource reports have set limits on the expected areal extent of Minnelusa-based collapse breccias. As an example, Figure TR RAI P&R-12a-1, is based on an illustration in an article by Jack B. Epstein published in USGS Water-Resource Investigation Report 01-4011 (2001) and describes the maximum downdip limit of a dissolution front within the evaporite sequence of the upper Minnelusa Formation. In the Black Hills region, extensive dissolution of gypsum and anhydrite beds of the upper Minnelusa has taken place in the surface or near-surface environment. Up to 150 feet of these highly soluble sediments have been removed from the upper Minnelusa through a dissolution process. As illustrated in Photo P&R-12a-A, behind (up-gradient of) the dissolution front the upper Minnelusa has a distinctive appearance at the outcrop. In addition to an obvious lack of anhydrite and gypsum, its appearance indicates oxidation and weathering. The remaining sediments are extremely distorted, cavernous, brecciated and exhibit numerous flow features. The subsidence within this unit, due to the dissolution process, results in down-dropping of, and collapse breccias within, overlying sediments. Epstein shows that this dissolution extends only a few miles down-gradient in the subsurface, where he shows it stopping at a dissolution front. Down-dip from this front, no dissolution occurs and the evaporite sequences within the upper Minnelusa are intact. With no dissolution, no subsidence, collapse or brecciation can take place.

The presence of a dissolution front within the upper Minnelusa has been recognized for more than a half century. In 1955-56, the USGS mapping team of Braddock, Carter and Bridge compiled the geologic mapping for the Jewel Cave SW 7 ½ minute quadrangle map (Exhibit 2.6-4). This mapping included the upper Minnelusa Formation in the area of Hell Canyon, in which extensive dissolution has taken place. Within the sediments overlying the upper Minnelusa in this area, there are many collapse breccia features. In fact, this area of lower Hell Canyon (not within the project area) is one of the best locations to view classic Black Hills breccia pipes. Photo P&R-12a-B shows a small collapse breccia developed in the Minnekahta Limestone within Hell Canyon. Disoriented blocks of Minnekahta Limestone and smaller breccia material can be seen in this collapse structure. Less than 2 miles down-gradient from the location of this breccia pipe, the USGS mapping team annotated on the geologic map “Probable limit

of collapse breccias in Minnelusa Formation" – showing the down-dip extent of the dissolution front. This boundary for Minnelusa breccia pipes is 5 miles north of the Dewey-Burdock project area.

Exhibit 2.6-5 was prepared as a replacement for Supplement Exhibit 2.2-1. This revised exhibit is based on Plate 4 of Gott et al. (1974) and shows all suggested locations for the three categories of collapse features. It also illustrates the outcrop areas of the Minnelusa Formation and the Inyan Kara Group. The "red line" on this exhibit corresponds to locations where the downdip limit of the dissolution front in the upper Minnelusa has been mapped or projected. North of this line classic Black Hills breccia pipes have been mapped and identified. South of this line suggested locations of collapse features are more speculative and many features are identified as "structures of possible solution origin" and "topographic depressions." The identification and mapping of a solution front within the upper Minnelusa is critical to determining the presence of breccia pipes at the Dewey-Burdock project area. As previously described, dissolution of the anhydrites and gypsum within the upper Minnelusa is essential for subsequent collapse brecciation and breccia pipe formation in overlying sediments. In areas where there has been no dissolution, there is no geologic foundation for the creation of breccia pipes in overlying sediments. Also shown on Exhibit 2.6-5 is the outline of the Jewel Cave SW 7½ minute quadrangle map (Exhibit 2.6-4) and the locations of all photographs.

Figure TR RAI P&R-12a-2 shows the Mesozoic and a portion of the Paleozoic stratigraphy below the project site. This electric log is from an abandoned oil & gas test well (the Darrow well) in Section 2, T7S, R1E that penetrated the Minnelusa Formation. The character of the upper Minnelusa Formation under the project area is extremely important because all Black Hills breccia pipes are "rooted" in this unit. Three observations from Figure TR RAI P&R-12a-2 are of major significance to this matter.

1) As discussed above, the dissolution front in the upper Minnelusa has been mapped north of the project area. This test well is located approximately 7 miles further down-gradient from and beyond the dissolution front. The electric log signature shows thick sequences of evaporites. There has been no dissolution within the upper Minnelusa under the project area.
2) The thickness of the upper Minnelusa in the Darrow test well also supports the fact that this test hole is located well in advance of a dissolution front. Hayes (1999) discusses the collapse brecciation at Cascade Springs and provides stratigraphic descriptions of the upper Minnelusa. He describes this interval as beginning at a red, mudstone-rich marker bed, locally known as the Red Marker and continuing upward to the Opeche Shale. He states that a 300-foot thickness of the upper Minnelusa is common in areas where anhydrite has been removed by solutions and breccia pipes occur. Basinward (downdip), the upper Minnelusa is 150 feet thicker in the subsurface where dissolution of anhydrite beds has not taken place. The thickness of the upper Minnelusa in the Darrow test well is 442 feet, again indicating that there has been no dissolution under the project area.

3) As shown in the left margin of Figure TR RAI P&R-12a-2, the stratigraphic horizons that host classic Black Hills breccia pipes are the upper Minnelusa Formation, Opeche Shale, Minnekahta Limestone and the lower 200 feet of the Spearfish Formation. These geologic units are fully intact and over 1,000 feet below the ground surface at the Dewey-Burdock project area.

The following Powertech geological evaluations and environmental baseline analyses present additional evidence demonstrating that breccia pipes are not present at the Dewey-Burdock site.

1) Exploration Drilling - The large number of exploration drill holes (more than 4,000) completed within the project area without any indication of solution collapses bolsters the hypothesis that no breccia pipes have penetrated the Inyan Kara Group (Figure TR RAI P&R-12a-3). If such an event had occurred, evidence of solution collapses would be observed in the correlation of the electric logs or from the structure maps developed on top of the Morrison Formation, Chilson Member, Fuson Shale or Fall River Formation. Any subsidence, collapse features or down-dropped sediments would have been evident while preparing cross sections or structure contour maps.
2) Field Investigations for Breccia Pipes - In Professional Paper 763, Gott et al. presented the theory that breccia pipes may extend upward into the Inyan Kara sediments. While there were no features identified within the project boundary, Powertech's field investigation focused on "proposed" collapse features within Jurassic and Cretaceous sediments northeast of the project. Due to the high-grade uranium deposits that have been mined within breccia pipes in the Arizona Strip of northwest Arizona, the uranium industry has extensive experience in surface exploration techniques for these features (Figure TR RAI P&R-12a-4). As a comparison, Arizona Strip evaluation criteria were applied to the proposed Black Hills features. These criteria consisted of displaced sediments, brecciation, dip changes of surface beds, fracture patterns and alteration patterns. In addition, due to the Gott et al. theory that breccia pipes were conduits for high volumes of ascending groundwater as recharge to the Inyan Kara aquifer, the Powertech geologic team specifically searched for evidence of solution movement at these sites. Investigation sites correspond to photo locations shown on Exhibit 2.6-5.
    A. The first site examined was Cascade Springs, a classic Black Hills breccia pipe located south of Hot Springs, South Dakota. This breccia pipe area was the subject of the previously mentioned USGS Water-Resource Investigation Report 99-4168 (Hayes, T.S., 1999). Powertech staff believed it was important to examine a verified collapse breccia feature and collect "ground truth" before investigating other sites. At the subject site, the surface Minnekahta Limestone met several of the Arizona Strip evaluation criteria, including major fracture patterns, brecciation within the limestone, dip changes of surface beds in the fractured areas and obvious evidence of solution movement. Also of major importance, this feature is located upgradient or updip of the mapped upper Minnelusa dissolution front. Photos P&R-12a-C and D illustrate some of these observed evaluation criteria.
    B. The second site focused on "breccia pipes" mapped by Gott et al. within Jurassic sediments approximately 2 miles north of the project area. This area is located 2 miles down-gradient from the mapped downdip limit of the dissolution front and no evidence of collapse or brecciation was observed. Instead, these features were found to be small normal faults within the Dewey Fault Zone. As shown in Photos P&R-12a-E and F, the

sediments were subject to high compressional forces within the fault zone, resulting in folding and normal faulting. The area met none of the Arizona Strip evaluation criteria.

C. The third and fourth sites examined were areas where Gott et al. mapped "breccia pipes" within Inyan Kara sediments approximately 2-3 miles northeast of the project area. These features were of primary interest because they had purportedly penetrated the Morrison Formation and Inyan Kara sediments. Powertech geologists spent two days investigating these features. These features were located in Sections 21 and 24, T6S, R2E and were 2 miles down-gradient from the mapped dissolution front. These features were found in the bottoms of deep canyons with Chilson Member sandstones forming steep cliffs along the canyon walls. There was no evidence of collapse or brecciation and, as shown in Photos P&R-12a-G and H, it appears the features were the result of surface erosion and slump blocks caving off the steep canyon walls. The area met none of the Arizona Strip evaluation criteria.

In addition to the above sites, other "structures of possible solution origin" were investigated. All of these sites were located down-gradient of the mapped downdip limit of the dissolution front and met none of the Arizona Strip criteria. Further, there was no evidence of springs to indicate flow of ascending groundwater into the Inyan Kara aquifer. The signature surface expressions for breccia pipes are lacking in all areas examined; no surface geologic evidence could be found to support the presence of breccia pipes on or adjacent to the project area.

3) Inyan Kara Water Temperatures - Gott et al. also theorized that the rapidly ascending groundwater from the deeper Minnelusa Formation would have a higher temperature than the water in the Inyan Kara aquifer. This theory proposes that "water probably has been heated in deeper aquifers and then has ascended to the Inyan Kara Group" through breccia pipes. As supporting evidence of this theory, Gott et al. cite the presence of high geothermal gradients within Inyan Kara wells averaging 1.5º C per 100 feet, as opposed to an average geothermal gradient of 0.9º C per 100 feet for pre-Cretaceous rocks in the Black Hills area.

As part of Powertech's environmental baseline analyses, field parameters (including groundwater temperature) were collected at each sampled well (Appendix 2.7-G). Water temperature measurements from 16 wells completed within the Inyan Kara aquifer were used to geothermal gradients within the Inyan Kara aquifer at the Dewey-Burdock Project. In addition to these field measurements, Powertech also has accurate information on the screened interval for each of these wells, which provides reliable depths to groundwater (top of screened intervals).

Depths to groundwater in the 16 Inyan Kara wells ranged from 30 to 715 feet below ground surface. Water temperatures ranged from 11.55º C (in the shallowest well) to 15.39º C (in the deepest well). The average geothermal gradient of these 16 wells was calculated to be 0.42º C per 100 feet – well below one-half the gradient cited by Gott et al. for the Inyan Kara aquifer. Based on Powertech's more accurate and concentrated water sampling results within the Dewey-Burdock project area, all evidence indicates the presence of a normal geothermal gradient within the Inyan Kara aquifer – not an elevated gradient due to rapidly ascending, heated groundwater from underlying aquifers as theorized by Gott et al.

4) Regional Pumping Tests - As described previously, the pumping tests conducted by TVA in the early 1980s (Appendix 2.7-K) and by Powertech in 2008 (Appendix 2.7-B) were “regional tests” aimed specifically at evaluating hydraulic transmission and storage characteristics of the mineralized zones within the Fall River Formation and the Chilson Member of the Lakota Formation and the intervening Fuson Shale confining unit.

   Based on the results of the regional pumping tests that have been conducted within the project area, the Fuson Shale, which is the confining unit between the overlying Fall River Formation and the underlying Chilson Member, may locally be “leaky”; that is, the observed aquifer response in the Fall River and Chilson suggests possible hydraulic communication between these units. In none of the aquifer tests that have been conducted to date, however, has a “recharge boundary” been observed which would suggest the existence of a significant source of water such as postulated by Gott et al. (1974). In other areas of the Black Hills, the surface discharge through breccia pipes is on the order of several cubic feet per second.

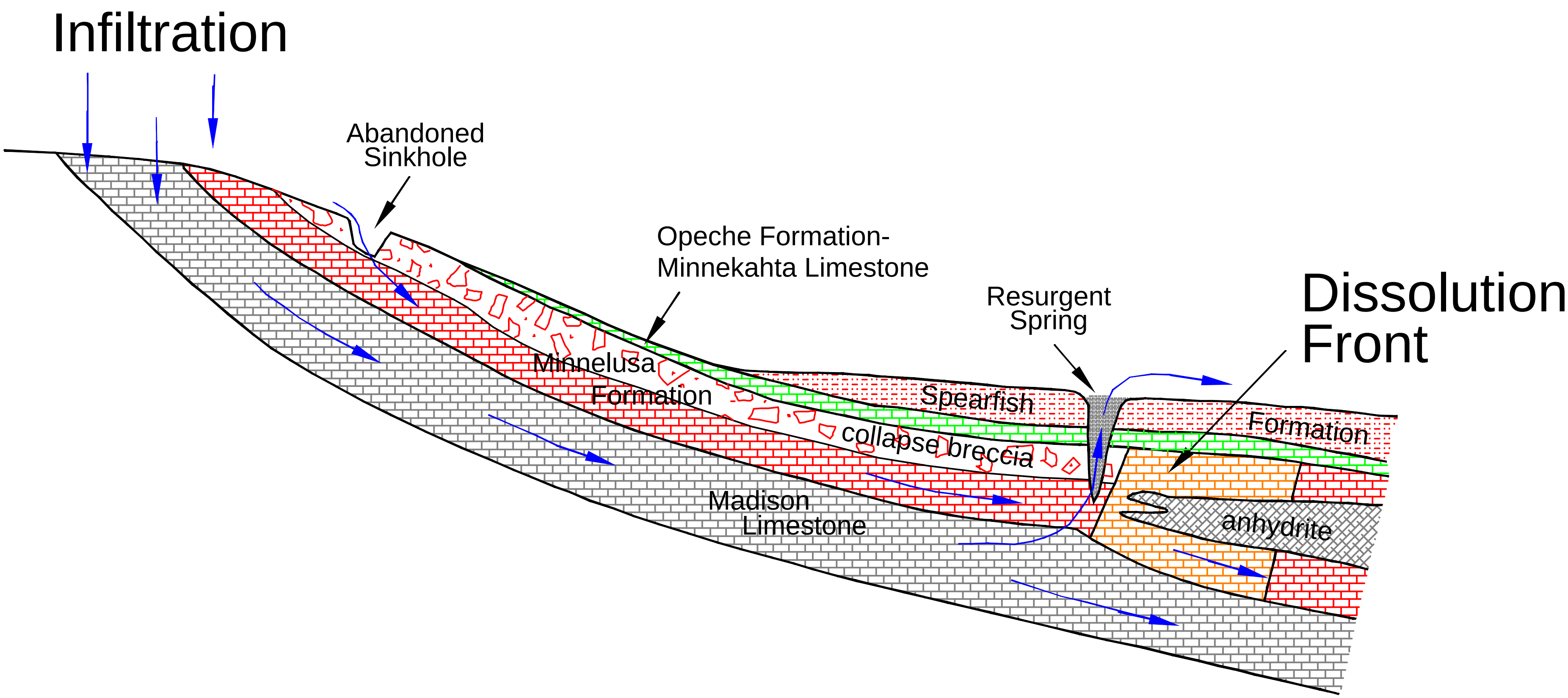
   As noted, further delineation drilling and “well field scale” pumping tests will be undertaken prior to the development of each well field. These well field scale pumping tests will specifically address potential leakage through confining beds, through improperly-sealed or unplugged exploration boreholes, or associated with naturally-occurring geologic features such as faulting, breccia pipes, etc.

5) Color Infrared (CIR) Imagery - 2010 CIR satellite imagery was obtained for an approximately 10-square-mile area, including the project area and surrounding vicinity. The imagery obtained through the National Agriculture Imagery Program (NAIP) of the USDA Farm Services Agency has a resolution of one meter. For additional information, refer to the response to TR RAI 2.7-9.

   The imagery was examined visually for any anomalies that may suggest groundwater discharge at or near surface, such as from upward flow through a breccia pipe, an open borehole or a natural spring. Using a combination of CIR and field investigations, all surface water features within the project area were identified and no surface water features or groundwater flow sources were found within the project area indicative of a breccia pipe flowing to the surface.

6) Numerical Groundwater Modeling - An integral component of the groundwater modeling efforts that are in progress will be to simulate the aquifer response to “point-source recharge” such as might occur as a result of upward leakage through improperly-plugged or unplugged boreholes or a breccia pipe. These simulations will include an evaluation of how leakage would be manifested in the observed aquifer response to pumping and during ISR operations.

   The results of the groundwater modeling will follow the submittal of the RAI responses.



Source: USGS Water-Resources Report 01-401, 2001, Jack B. Epstein, pp. 30-37

Figure TR RAI P&R-12a-1

Minnelusa Dissolution Front
Southern Black Hills
South Dakota
Dewey-Burdock Project

DRAWN BY	J. Bonner
DATE	21-Jun-2011
FILENAME	Figure TR RAI P&R-12a-1.dwg

POWERTECH (USA) INC.

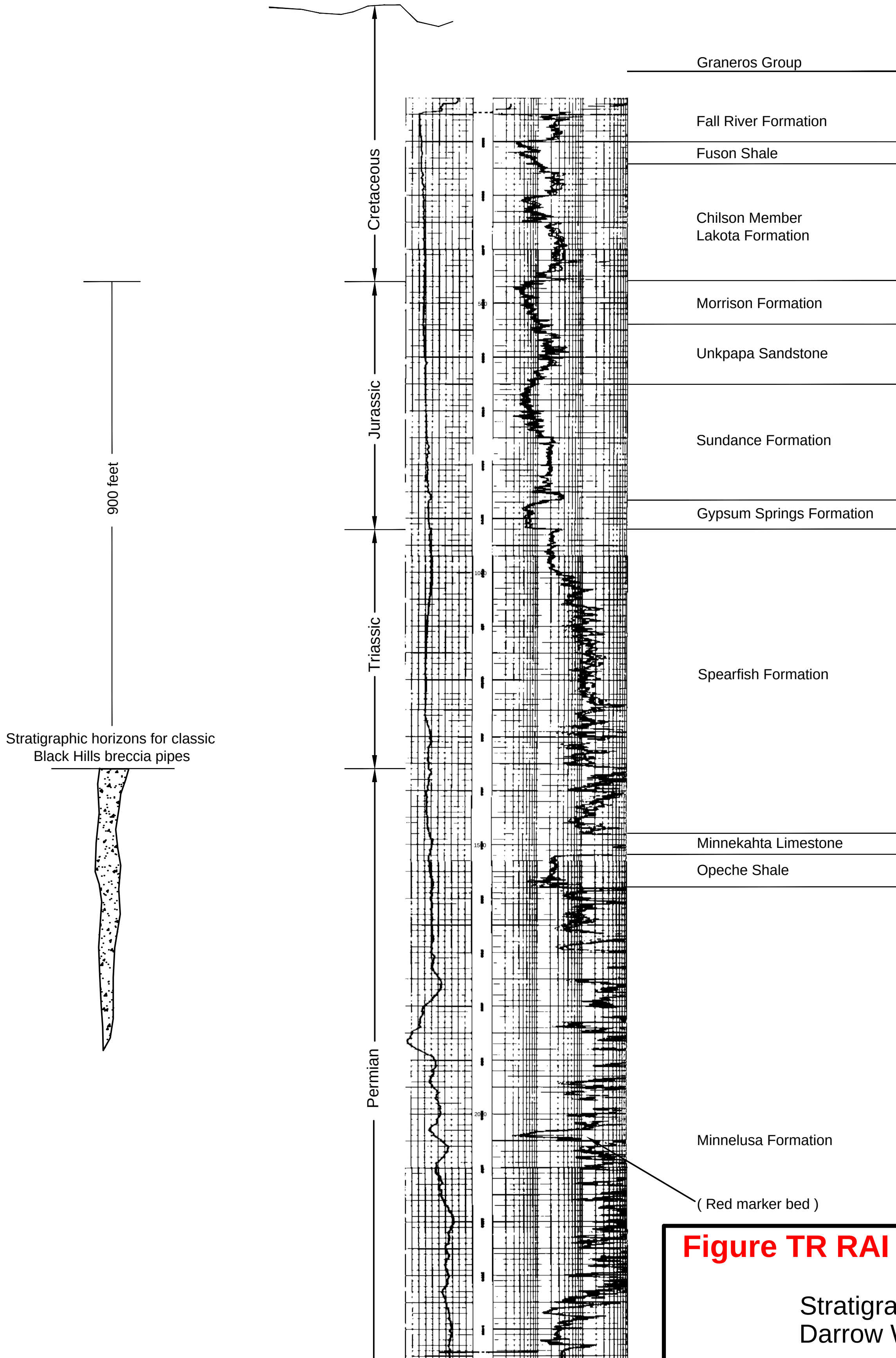


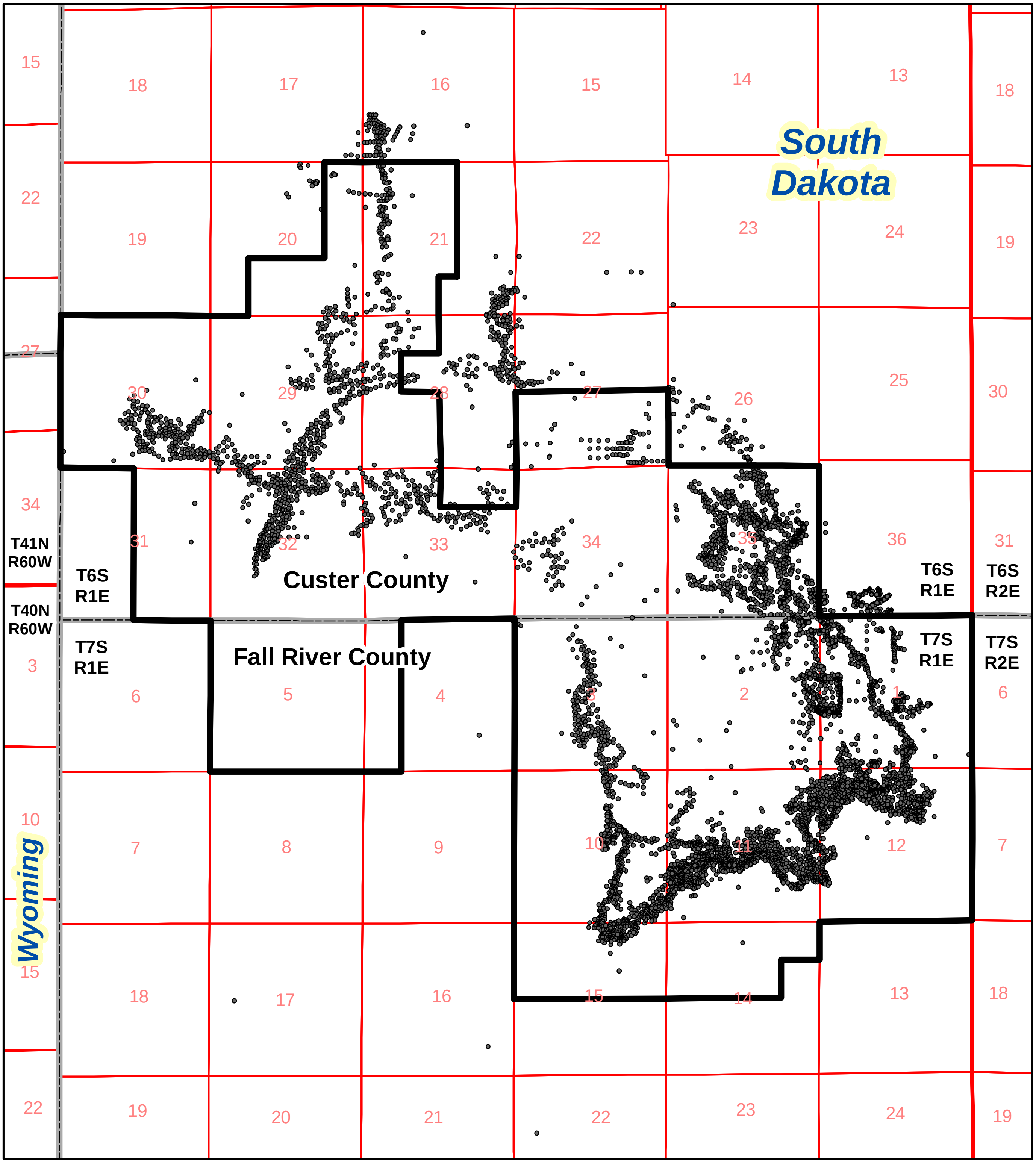
Figure TR RAI P&R-12a-2

Stratigraphy
Darrow Well

Dewey-Burdock Project

DRAWN BY	R. Patton
DATE	20-Jun-2011
FILENAME	Figure TR RAI P&R-12a-2.dwg

POWERTECH (USA) INC.



Legend

Project Boundary

Drill Hole Locations

Feet
0 2,500 5,000
0 1,000 2,000
Meters

N

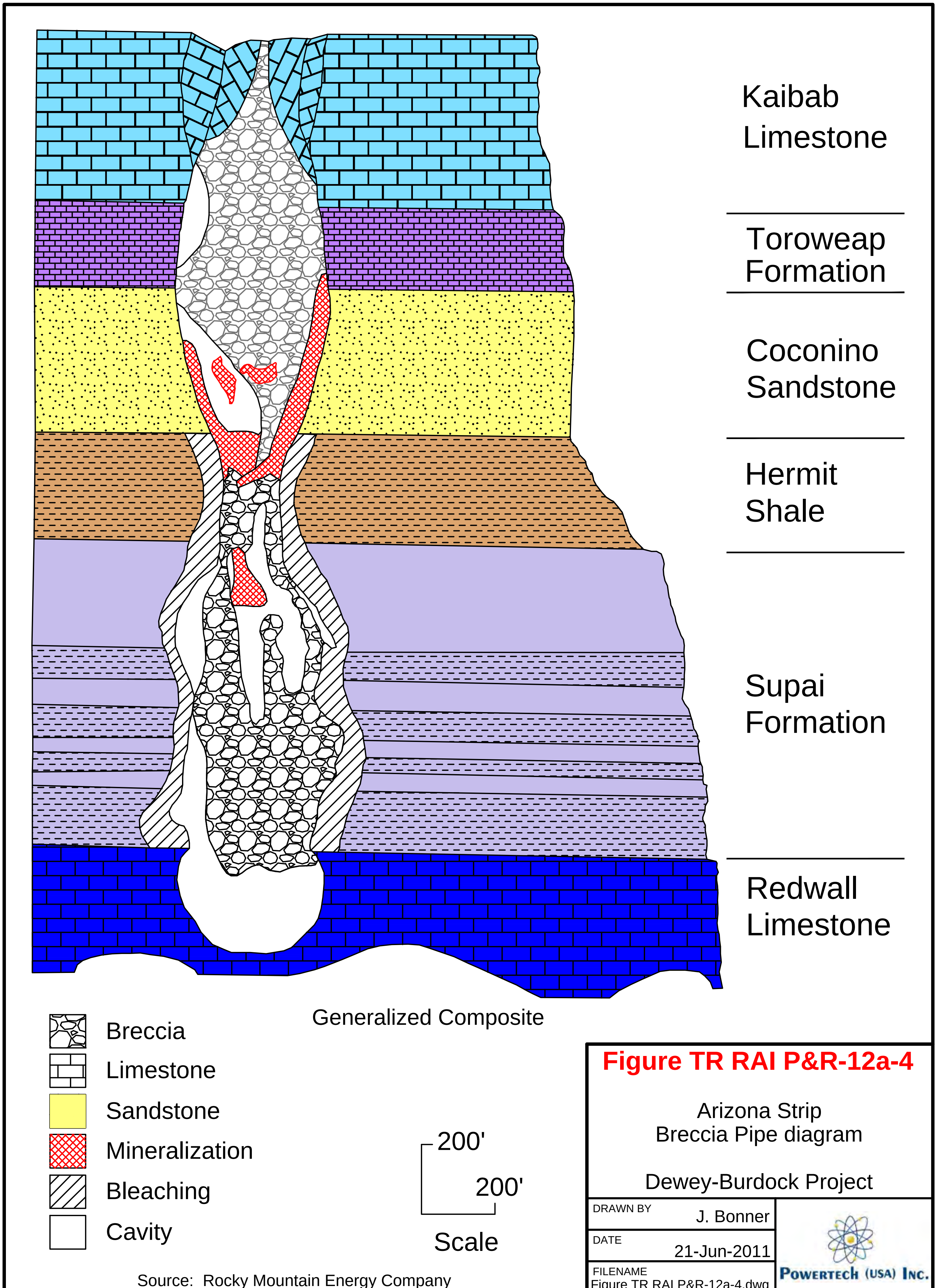
Figure TR RAI P&R-12a-3

Dewey-Burdock
Drill Hole Map

Dewey-Burdock Project

DRAWN BY	Bonner, Hetrick
DATE	10-Jun-2011
FILENAME	Figure TR RAI P&R-12a-3.mxd

POWERTECH (USA) INC.


Kaibab
Limestone
Toroweap
Formation
Coconino
Sandstone
Hermit
Shale
Supai
Formation
Redwall
Limestone
Generalized Composite
Breccia
Limestone
Sandstone
Mineralization
Bleaching
Cavity
200'
200'
Scale
Source: Rocky Mountain Energy Company
Figure TR RAI P&R-12a-4
Arizona Strip
Breccia Pipe diagram
Dewey-Burdock Project
DRAWN BY
J. Bonner
DATE
21-Jun-2011
FILENAME
Figure TR RAI P&R-12a-4.dwg
Powertech (USA) Inc.

Powertech (USA) Inc.

Photo P&R-12a-A: Upper Minnelusa Outcrop (Outside Project Area)

Photo P&R-12a-B: Minnekahta Collapse Breccia (Outside Project Area)

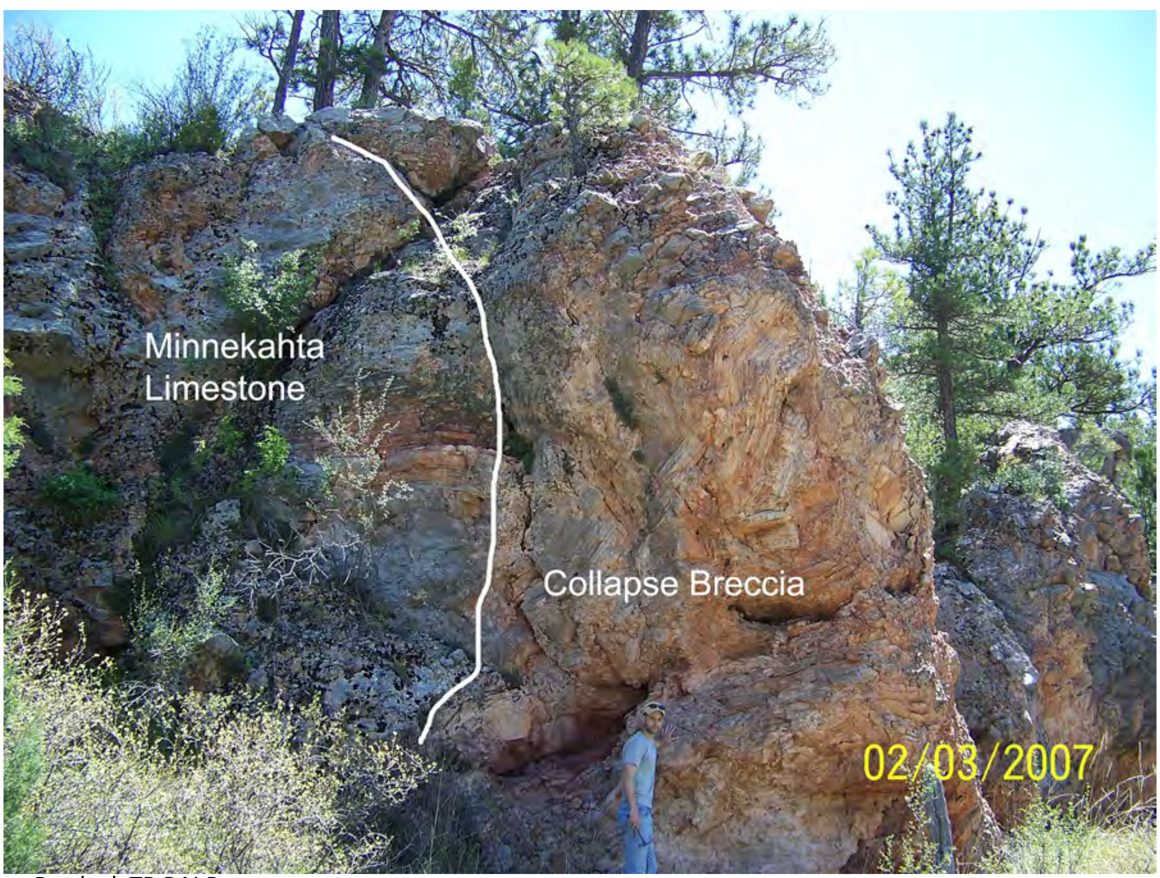


Photo P&R-12a-C: Cascade Springs Breccia Pipe (Outside Project Area)

Photo P&R-12a-D: Cascade Springs Breccia Pipe (Outside Project Area)

Photo P&R-12a-E: Sundance Formation Fault (Outside Project Area)

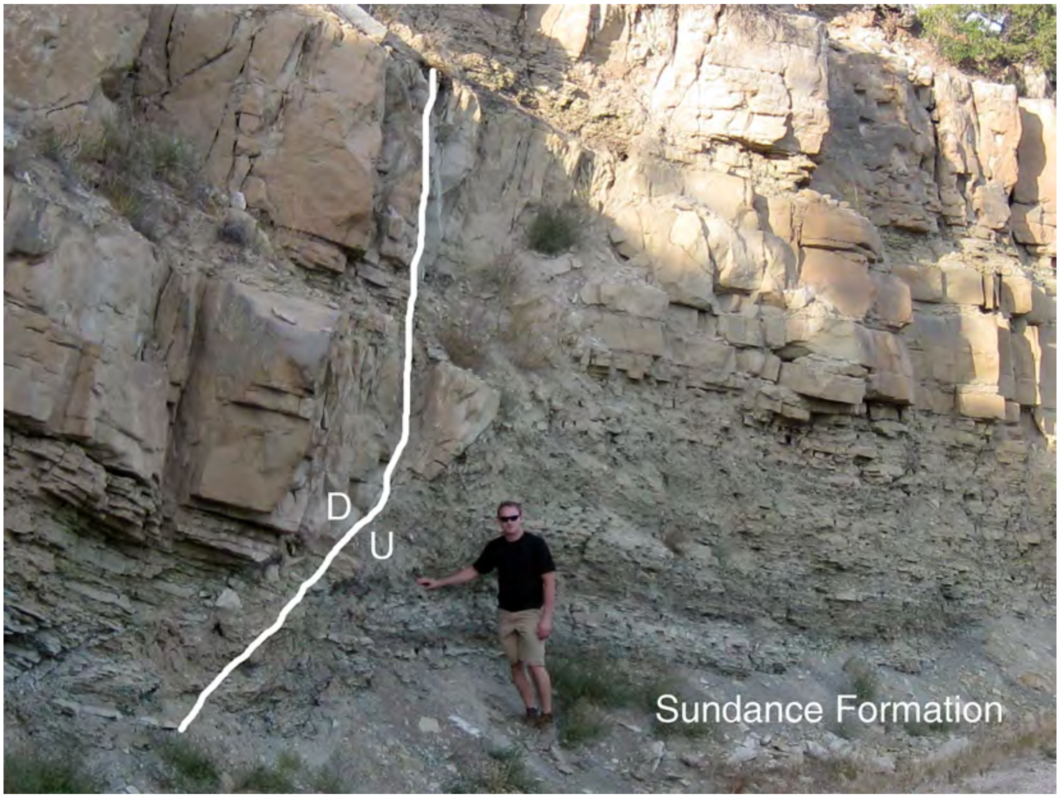


Photo P&R-12a-F: Sundance Formation Fault (Outside Project Area)

Photo P&R-12a-G: Mapped "Breccia Pipes" (Outside Project Area)

Photo P&R-12a-H: Mapped "Breccia Pipes" (Outside Project Area)

TR RAI P&R-12

Clarification of breccia pipes

TR RAI P&R-12(b)

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

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

TR RAI P&R-12(b) Response

The following discussion will be incorporated into Section 2.7 of the revised TR.

The potentiometric surface maps of the Fall River and Chilson within the project area have been revised to include additional data points and to represent water level data collected during a 5-day period, April 25 through April 29, 2011. The prior versions of these maps were prepared from water level measurements taken at different times over a several year period. The revised potentiometric surface maps of the Fall River Formation and the Chilson Member of the Lakota are presented as Figures TR RAI 2.7-5-1 and TR RAI 2.7-5-2, respectively, which are included in the response to TR RAI 2.7-5.

The potentiometric surface map for the Fall River (TR RAI Figure 2.7-5-1) shows a relatively uniform hydraulic gradient across the project area, with heads decreasing to the southwest. Hydraulic gradient is simply the ratio of the change in head divided by the distance between the points of measurement (assuming that the points of measurement are located along a line parallel to the direction of groundwater flow). The potentiometric surface of the Chilson shows a slight flattening of the hydraulic gradient across the northwest portion of the project area but with heads also decreasing to the southwest. Many factors can influence the observed potentiometric surface; most commonly they are due to changes in hydraulic properties or changes in groundwater flux. Increasing groundwater flux

through an area will actually result in a steeper hydraulic gradient, not a flattening, because more water must move through the same cross sectional area of the aquifer.

A more plausible explanation of the flattening of the Chilson potentiometric surface (and therefore the hydraulic gradient) in the northwest portion of the project area is that the transmissivity of the Chilson is higher in that area. Evidence to support this explanation can be found in the pumping tests that were conducted by TVA in 1980 in the Dewey area (Boggs, 1983). The Chilson was pumped at a rate of 495 gpm for 11 days during this test, a much greater production rate than encountered in other pumping tests within the project area in either the Fall River or Chilson. The transmissivity of the Chilson near Dewey was estimated at nearly 600 ft^2/day, more than twice the value determined from the Burdock area pumping tests (Boggs and Jenkins, 1980). The TVA pumping test reports are provided in Appendix 2.7-K.

As previously described in the response to TR RAI P&R-12(a), there is no evidence of the existence of breccia pipes within the project area. Extensive reconnaissance has been conducted to evaluate each potential breccia pipe site within the project area as indicated on the Gott et al. maps (Gott et al., 1974) and no breccia pipes have been confirmed. If a significant discharge were occurring to either the Fall River or Chilson within the project area, the manifestation of that increased flux of groundwater would be a localized steepening of the potentiometric surface, not a flattening thereof.

The regional hydrogeological characterization for the Dewey-Burdock project area is consistent with respect to the understanding of groundwater occurrence and the direction and nature of groundwater flow. Local variations in the configuration of the potentiometric surface do not change this overall regional characterization. Further delineation drilling and well field scale pumping tests after license issuance will be undertaken prior to the development of each well field and will address any differences in local hydrogeological conditions.

TR RAI P&R-13
Proposed operations/infrastructure outside of the license boundary.

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

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

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

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

Clarification: Referring to Exhibit 3.1-4 and using the township range blocks for scale, the mine unit outline of Dewey II and Burdock IV wellfields appear to be located such that one or more of the proposed horizontal excursion monitoring wells will be outside of the license boundary. Additionally, cross referencing the proposed Burdock IV ore body for uranium recovery in Exhibit 3.1-4 to Exhibit 3.2-1, NRC is uncertain of the exact location of the Burdock IV wellfield relative to the license boundary (Exhibit 3.2-1 suggests both monitoring and production wells will be outside of the license boundary).

TR RAI P&R-13 Response
The following response clarifies: 1) that all well fields and associated infrastructure will be located within the proposed license boundary, 2) the materials in the plant-to-plant pipelines, and 3) that all monitor wells will be located within the license boundary. This information will be incorporated into the revised TR.

1. Location of well fields and infrastructure within license boundary
All well fields and infrastructure associated with the Dewey-Burdock Project will be located within the license boundary. This includes all ISR production and injection wells, monitor wells, pipelines, and facilities. Exhibits 3.1-2, 3.1-3, and 3.1-4 have been revised to show clearly the location of all operations/infrastructure within the license boundary. These exhibits are included with this RAI response package and will be incorporated into the revised TR. Exhibit 3.1-2 depicts the proposed facilities in the land application option, Exhibit 3.1-3 depicts the proposed facilities in the deep disposal

well option, and Exhibit 3.1-4 depicts the potential well field areas. Table TR RAI P&R-13-1 describes the exhibit updates.

Table TR RAI P&R-13-1: Obsolete and Replacement Exhibits and Figures Related to Proposed Facilities

Obsolete Figure or Exhibit and Version Date	Purpose	Replacement Exhibit
SR Exhibit 3.1-4 (28-Jun-09)	Potential Well Field Areas	Exhibit 3.1-4 (Jun-11)
SR Exhibit 3.1-2 (05-Aug-09) SR Exhibit 3.1-3 (06-Aug-09) SR Exhibit 3.2-1 (01-Jul-09)	Proposed Initial Well Fields Plant-to-Plant Pipeline Proposed Facilities	Exhibit 3.1-2 (Jun-11) (Land Application Option) Exhibit 3.1-3 (Jun-11) (Deep Disposal Well Option)
TR Figure 3.1-8	Facility Location-Deep Disposal Well Option	Exhibit 3.1-3 (Jun-11)

2. <u>Materials that will flow through the plant-to-plant pipelines</u>

Powertech proposes to install up to eight underground pipelines between the CPP and the Satellite Facility to transport the various fluids present during ISR operations. Conduits for electronic communication and control purposes may also be installed between the CPP and the Satellite Facility. The fluids that will be transported include, but are not limited to: barren and pregnant lixiviant, restoration water, RO reject brines, wastewater resulting from well drilling and maintenance operations, and supply water from the Madison Formation or other aquifers. All infrastructure associated with the proposed project will be located within the license boundary. Liquid waste control and containment is discussed in TR Section 4.2.3 (Potential Pollution Events Involving Liquid Waste).

3. <u>Monitor well ring locations</u>

All well fields and associated perimeter monitor well rings will be located within the license boundary. The potential well field locations with associated monitor wells are depicted in revised Exhibit 3.1-4, which is included with this RAI response package and will be incorporated into the revised TR.

TR RAI P&R-14

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

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

TR RAI P&R-14(a)

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

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

TR RAI P&R-14(a) Response

Powertech has chosen to clarify its response by describing the location of more detailed discussion of each of the issues identified. Powertech believes that this manner of response will reduce the redundancy of the responses and form a cleaner and more organized document as requested.

Current designs and descriptions of the liquid waste disposal options for the Dewey-Burdock Project are discussed in detail in the responses to TR RAI P&R-14(b) through TR RAI P&R-14(g) and TR RAI 3.1-7. The response to TR RAI P&R-14(b) contains a detailed description of liquid waste disposal options, the TR RAI P&R-14(c) response presents a typical water balance for the project and discusses liquid waste disposal capacities, the response to TR RAI P&R-14(d) provides an estimate of the expected liquid wastewater quality, the response to TR RAI P&R-14(e) summarizes the Class V DDW information, and the responses to TR RAIs P&R-14(f), P&R-14(g), and 3.1-7 discuss the pond capacities and designs. This information will be incorporated into the revised TR. The Supplemental Report and Pond Design Report (Appendix B to the Supplemental Report) will be revised where necessary. The Supplemental Report will be incorporated into the revised TR and the appendices will be added to the revised TR. The revised TR will include a revision index that indicates the location of previous information contained in the original application as well as the location of the updated information in the revised TR.

TR RAI P&R-14

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

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

TR RAI P&R-14(b)

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

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

TR RAI P&R-14(b) Response

Powertech proposes two options for liquid waste disposal at the Dewey-Burdock Project. Liquid waste 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, and plant wash down water. The preferred disposal option is underground injection of treated liquid waste in non-hazardous Class V deep disposal wells (DDWs). In this disposal option liquid waste will be treated to satisfy EPA non-hazardous waste requirements and injected into the Minnelusa and/or Deadwood Formations in four to eight DDWs being permitted pursuant to the SDWA through the EPA UIC Program. Further details about the proposed DDW liquid waste disposal option are presented below, including information about the pending UIC permit. Powertech will provide updated information regarding its Class V application when appropriate milestones are reached. Class V injection of treated liquid waste is the preferred disposal option. It is anticipated that all liquid waste will be disposed using this option if sufficient capacity is available in DDWs.

The alternate liquid waste disposal option is land application. This option involves treatment in lined settling ponds followed by seasonal application of treated liquid waste through center pivot sprinklers. Land application would be carried out under a Groundwater Discharge Plan (GDP) permit through the SD DENR. Depending on the availability and capacity of DDWs, Powertech may use land application in conjunction with DDWs or by itself. Additional details about the design and permitting status of the land application system are provided below.

The following detailed descriptions of the liquid waste disposal options represent the current engineering designs and information contained in the Class V DDW permit application, submitted to EPA

in March 2010. TR Sections 4.2 (Liquid Waste), 6.1.9 (Restoration Wastewater Disposal), and 3.1.5 (Pond Design and Land Application) will be updated to reflect the information presented below.

Deep Disposal Well Option

Powertech submitted a Class V UIC permit application to EPA Region 8 in March 2010 for authorization to install and operate four to eight DDWs within the project area. A copy of the permit application is provided in Appendix 2.7-L, which is included with this RAI response package. 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 has requested an Area Permit authorizing the installation and operation of four to eight DDWs within the project area. The number of wells required will depend on well capacity. Powertech has requested authorization to inject up to 300 gpm in a maximum of eight wells. Proposed locations for the first four wells are provided in Exhibit 3.1-3, which is provided with this response package. The initial four DDWs are proposed at two sites, one near the Dewey Satellite Facility and one near the Burdock 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, liquid waste will be treated as necessary to comply with non-hazardous Class V UIC requirements. Treatment will typically include removal of uranium and other dissolved species in IX columns followed by radium removal through co-precipitation with barium sulfate in radium settling ponds. Surface facilities near the Burdock CPP and Dewey Satellite Facility related to liquid waste disposal in the DDW option will include radium settling ponds, outlet and surge ponds, a Central Plant Pond located at the Burdock CPP, and surface facilities required for DDW operation such as pretreatment facilities, screen/filters, and high pressure pumps for DDWs. Proposed facilities for the deep disposal option are depicted on Exhibit 3.1-3.

The aquifer restoration method will depend on the liquid waste disposal option. Please refer to the response to TR RAI 6.1-4 for a detailed description of the aquifer restoration methods. 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 liquid waste in DDWs. As described in the water balance

presented in response to TR RAI P&R-14(c), the total liquid waste flow rate will be approximately 47 gpm during uranium recovery without concurrent restoration, approximately 197 gpm during concurrent uranium recovery and restoration, and approximately 150 gpm during aquifer restoration alone. The planned DDW capacity of up to 300 gpm significantly exceeds the anticipated liquid waste flow rate in the DDW option.

Land Application Option

Powertech plans to submit a GDP permit application to SD DENR in 2011 to permit land application of treated liquid waste in the Dewey-Burdock project area. A copy of the SD DENR application will be provided as an appendix to the revised TR. The land application system would consist of irrigation center pivots, associated pumps and piping, radium settling ponds, and outlet and storage ponds.

Two general land application areas are proposed for liquid waste disposal within the project area, one near the Dewey Satellite Facility and one near the Burdock CPP. Each land application area is anticipated to have 315 acres of irrigated area consisting of individual 50-, 25-, and 15-acre center pivots. In addition each site also will have approximately 65 acres of center pivots on standby, which can be used during repairs and maintenance of other center pivots or used on a rotating basis. The total proposed land application area at the project will be 760 acres, with only 630 acres needed for design flow rates. Center pivot irrigation systems will typically operate 24 hours per day during the growing season, which is approximately April through October. During winter months, when land application will not be used, the treated liquid waste stream will be temporarily stored in storage ponds, which will be located near both the Dewey and Burdock processing facilities. The response to TR RAI 3.1-7 contains more specific information concerning pond sizes and functions.

Disposal capacity for the land application system was estimated using the SPAW (Soil-Plant-Atmosphere-Water) model, which was developed by the US Department of Agriculture to simulate the daily hydrologic budget for agricultural landscapes. The inputs to the model include climatic data, soil profile information, and crop growth information. In addition to estimating the water budget for agricultural landscapes, the SPAW model also was used to estimate the water budget for impoundments. Detailed information of the SPAW model inputs and outputs are discussed in Appendix D of the Supplemental Report.

In the land application option, groundwater withdrawn during aquifer restoration would not be treated with RO. Instead, the aquifer restoration water would be disposed directly in land application systems following treatment to remove uranium and radium. The typical liquid waste flows using the land application option are 47 gpm during uranium recovery without concurrent restoration, 547 gpm during

concurrent uranium recovery and aquifer restoration, and about 500 gpm during aquifer restoration only. The SPAW model predicts that each land application area will be able to dispose of approximately 297 gpm from March 29 to May 10, about 653 gpm from May 11 to September 24, and approximately 297 gpm from September 25 to October 31. The combined capacity of both areas will be more than sufficient to dispose of the liquid waste stream during the spring, summer, and fall months. In addition, adequate excess capacity will be present during these months to dispose of stored surplus liquid waste from the winter months.

Combined DDW and Land Application Option

As discussed above, if Class V DDWs are constructed but lack sufficient capacity to dispose of the entire liquid waste stream, Powertech will combine the use of DDWs and land application. In this option land application facilities will be constructed and used on an as-needed basis depending on the DDW capacity.

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

Background: The NRC needs to determine that liquid effluents generated from the process bleed, process solutions (e.g., backwash, resin transfer waters), wash-down water, well development water, pumping test water, and restoration waters are properly controlled.
TR RAI P&R-14(c)

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

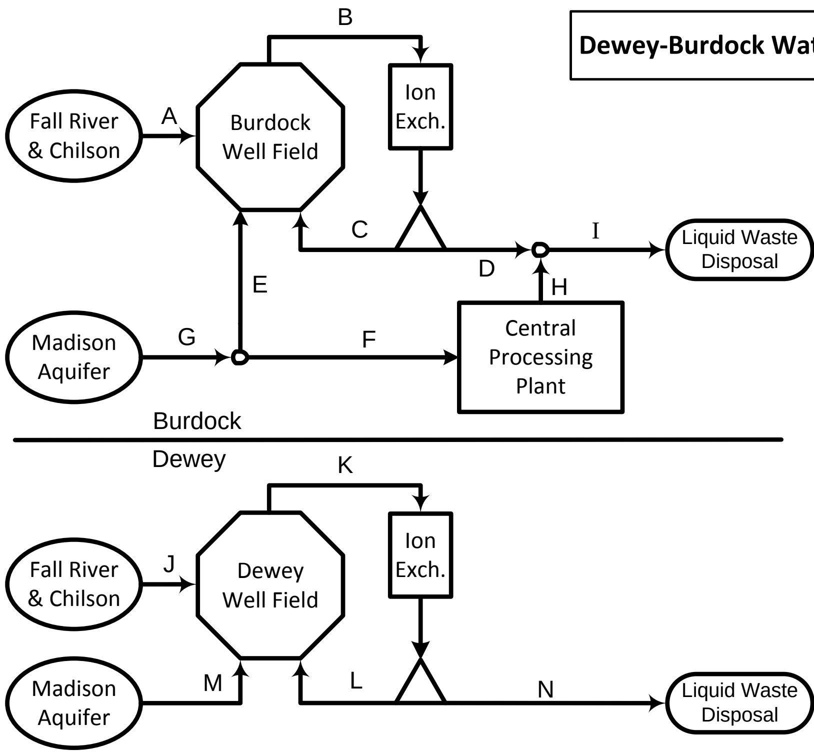
Needed: The applicant needs to provide water balance diagrams for the Dewey and Burdock facilities during normal operation and during restoration.

TR RAI P&R-14(c) Response
Typical water balances during uranium recovery and aquifer restoration are presented in Figure TR RAI P&R-14c-1. The figure depicts typical flow rates during the uranium recovery and aquifer restoration phases. Table TR RAI P&R-14c-1 shows the typical design flow rates during concurrent uranium recovery and aquifer restoration. Detailed descriptions of the water balances for the Dewey-Burdock Project are provided below along with a discussion of liquid waste disposal capacities. TR Section 4.2 (Liquid Waste) and Section 3.1.5 (Pond Design and Land Application) will be updated to reflect this information.

Uranium Recovery Water Balance

During uranium recovery, the flow rates will be the same for either liquid waste disposal option. The typical production bleed will be approximately 0.875%. The typical well field production will be approximately 2,400 gpm (Stream B) from Burdock well fields and 1,600 gpm (Stream K) from Dewey wells fields. Note that these are typical flow rates provided to illustrate the water balance when the Dewey and Burdock well fields are operating simultaneously. An important value is the sum of Streams B and K, which represents the typical project-wide production flow rate. This will be approximately 4,000 gpm, which represents the average annual flow rate proposed at full production for the Dewey-Burdock Project. The proportion of the total flow originating in the Dewey and Burdock well fields will vary depending on the well field development sequence. Multiplying the typical production bleed by the typical production flow rates yields typical production bleed flow rates of 21 gpm (Stream A) at Burdock, and 14 gpm (Stream J) at Dewey. Liquid waste from uranium recovery operations at the Dewey area will consist almost entirely of production bleed. At the Burdock area, liquid waste will also include process solutions (such as resin transfer water and brine generated from the elution and precipitation circuits), affected well development water, laboratory wastewater, laundry water, and plant wash down water. Liquid waste flow rates, which are represented by Streams I and N, will typically be approximately

Dewey-Burdock Water Balance



Stream ID	Description
A	Burdock Aquifer Bleed
B	Burdock Extraction Composite
C	Burdock Reinjection
D	Burdock Well Field Bleed
E	Burdock Madison Make-up
F	Burdock Fresh Brine Make-up
G	Burdock Madison, Total
H	Burdock CPP Brine
I	Burdock Liquid Waste
J	Dewey Aquifer Bleed
K	Dewey Extraction Composite
L	Dewey Reinjection
M	Dewey Madison Make-up
N	Dewey Liquid Waste

Water Balance Flow Rates (gal/min)

Operation phase	Aquifer bleed option	Disposal Option	Burdock Stream ID								
			A	B	C	D	E	F	G	H	I
Recovery	0.875%	DDW	21	2400	2379	21	0	12	12	12	33
		LA	21	2400	2379	21	0	12	12	12	33
Restoration	Without Ground-water Sweep	DDW	2.5	250	175	75	73	0	73	0	75
		LA	2.5	250	0	250	248	0	248	0	250
	With Groundwater Sweep	DDW	42	250	175	75	33	0	33	0	75
		LA	42	250	0	250	208	0	208	0	250

Water Balance Flow Rates (gal/min)

Operation phase	Aquifer bleed	Disposal Option	Dewey Stream ID				
			J	K	L	M	N
Recovery	0.875%	DDW	14	1600	1586	0	14
		LA	14	1600	1586	0	14
Restoration	Without Ground-water Sweep	DDW	2.5	250	175	73	75
		LA	2.5	250	0	248	250
	With Groundwater Sweep	DDW	42	250	175	33	75
		LA	42	250	0	208	250

Figure TR RAI P&R-14c-1: Typical Project-wide Flow Rates During Uranium Recovery and Aquifer Restoration

33 gpm and 14 gpm, respectively. As described in the response to TR RAI P&R-14(b), all liquid waste will be treated prior to disposal via deep disposal wells and/or land application.

Table TR RAI P&R-14c-1: Typical Project-wide Flow Rates During Concurrent Uranium Recovery and Aquifer Restoration

Typical Project-wide Flow Rates		Disposal Option			
		Deep Disposal Well		Land Application	
Restoration Option		Without Groundwater Sweep	With Groundwater Sweep	Without Groundwater Sweep	With Groundwater Sweep
Fall River & Chilson	gal/min	40	118	40	118
Madison Formation	gal/min	157	79	507	429
Wastewater Disposal	gal/min	197	197	547	547

Aquifer Restoration Water Balance

As discussed in the responses to TR RAI P&R-14(b) and TR RAI 6.1-4, Powertech proposes two options for disposal of liquid waste at the Dewey-Burdock Project: (1) injection of treated liquid waste in non-hazardous Class V DDWs and (2) land application of treated liquid waste using center pivots. The disposal option selected will determine the method of aquifer restoration used. RO treatment with permeate injection will be used in the DDW option, and groundwater sweep with injection of clean makeup water from the Madison Formation will be used in the land application option. The aquifer restoration methods are described in detail in the response to TR RAI 6.1-4. Both disposal options are included in the water balance to illustrate the different liquid waste disposal flow rates in each option. In the DDW option, the groundwater withdrawn during aquifer restoration will be treated by RO. The concentrated brine solution will be disposed in the DDWs, while the permeate will be reinjected along with Madison Formation makeup water into the well fields. This will reduce the overall flow rate of liquid waste. Flow rates will be higher if land application is used, because the entire restoration stream will be disposed in the land application system.

Although a 1% restoration bleed will be adequate to maintain hydraulic control of well fields undergoing active aquifer restoration, additional bleed may be required at times. For example, additional restoration bleed may be used to recover flare of lixiviant outside of the well field pattern area. In addition to the restoration methods described above, Powertech may withdraw up to one pore volume of water through groundwater sweep over the course of aquifer restoration. This will result in an average restoration bleed of approximately 17%. The liquid waste disposal systems have been designed to accommodate both options and both options are depicted on the water balance.

The typical restoration extraction flow rate from the Dewey and Burdock well fields will be approximately 250 gpm each for a total of 500 gpm. Again, the total project-wide restoration extraction flow rate will be approximately 500 gpm, while the specific contribution from the Dewey and Burdock well fields will vary. If groundwater sweep is not used, approximately 2.5 gpm less will be injected than is recovered. For the DDW option, RO treatment of the restoration solution typically will result in 175 gpm of permeate returning to each of the Dewey and Burdock well fields (Stream C for Burdock and Stream L for Dewey) and 75 gpm of liquid waste being routed to the DDWs (Stream I for Burdock and Stream N for Dewey). If land application is used for liquid waste disposal, all 250 gpm of the restoration extraction solution will be sent to the land application systems. In this case clean makeup water from the Madison Formation will be injected instead of permeate. Regardless of the disposal option, the balance of any water required to maintain the restoration bleed of 1% will be supplied from the Madison Formation.

If groundwater sweep of one pore volume is used, overall restoration bleed will average approximately 17%, resulting in 42 gpm being removed from the ore zone aquifer under both disposal options. Similar to the aquifer restoration option without groundwater sweep, the resulting liquid waste disposal flow rates will typically be 75 gpm for the DDW option and 250 gpm for the land application option.

Note that Streams F and H, which represent the flows from the Madison Formation to the CPP and from the CPP to liquid waste disposal, are typically zero during aquifer restoration without concurrent uranium recovery. While there will be times during this phase when liquid waste will be generated from the CPP, they will be infrequent due to the small number of resin transfers and elution and precipitation cycles during this phase. During this phase the water supply needs for the CPP will be nearly zero in the typical water balance.

Concurrent Uranium Recovery and Aquifer Restoration

A typical water balance for concurrent uranium recovery and aquifer restoration is shown in Table TR RAI P&R-14c-1. The table shows the typical combined flow from the Fall River Formation and Chilson Member and the flow from the Madison Formation. It also shows the typical liquid waste disposal flow rates under the different restoration options. The typical values for Fall River and Chilson flow rates were obtained by adding the Streams A and J in Figure TR RAI P&R-14c-1 for both uranium recovery and aquifer restoration. The typical Madison Formation makeup water flow rate was obtained by adding Streams G and M in Figure TR RAI P&R-14c-1 for uranium recovery and aquifer restoration. The liquid waste disposal flow rate was obtained by adding the Streams I and N in Figure TR RAI P&R-14c-1 for uranium recovery and aquifer restoration. The typical liquid waste flow rates during concurrent uranium

recovery and aquifer restoration will be approximately 197 gpm for the DDW option and 547 gpm for the land application option.

Liquid Waste Disposal Capacity

In the DDW option, the total liquid waste flow rate during uranium recovery only will be approximately 47 gpm. This will increase to about 197 gpm during concurrent uranium recovery and aquifer restoration, and then decrease to about 150 gpm during aquifer restoration only. If land application is used for liquid waste disposal, the total liquid flow rate during the three phases of operations will be approximately 47 gpm during uranium recovery only, about 547 gpm during concurrent uranium recovery and aquifer restoration, and about 500 gpm during aquifer restoration only.

The DDW option will include four to eight wells completed in the Minnelusa and/or Deadwood Formations. Powertech has requested authorization to inject up to a total of 300 gpm in a maximum of eight wells (see Appendix 2.7-L, which contains the Class V UIC application). If the DDW option is used at the Dewey-Burdock Project, the planned disposal capacity will exceed the expected liquid waste flow rates.

In the land application option, land application of liquid waste will occur at two areas, one near the Dewey Satellite Facility, and one near the Burdock CPP. Each site will have approximately 315 acres of center pivots with approximately 65 additional acres available on standby. The disposal capacity of the land application system was estimated using the SPAW (Soil-Plant-Atmosphere-Water) model developed by the USDA. The SPAW model is capable of performing daily water budgets for farm land, ponds, and inundated wetlands. Powertech used the SPAW model to estimate both the disposal capacity of the center pivots as well as the evaporation capacity of the storage ponds.

In the land application option, pumping will occur 24 hours a day. The estimated daily water budgets obtained from SPAW modeling indicate that each land application area will be capable of disposing approximately 297 gpm from March 29 to May 10, about 653 gpm from May 11 to September 24, and approximately 297 gpm from September 25 to October 31. Normally there will not be land application disposal from approximately October 31 to March 29. Detailed information regarding the SPAW model inputs and outputs are discussed in Appendix D of the Supplemental Report and will be incorporated into the revised TR. The land application system will be capable of handling all of the expected liquid waste throughout each phase of the project. During the winter months liquid waste will be stored in ponds, which are described in more detail in the response to TR RAI 3.1-7. The capacity required to store the liquid waste throughout the winter months was calculated using the SPAW model to be

approximately 216 acre-feet. By comparison, the total storage pond capacity under the land application option will be approximately 510 acre-feet, not including spare storage ponds.

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

Background: The NRC needs to determine that liquid effluents generated from the process bleed, process solutions (e.g., backwash, resin transfer waters), wash-down water, well development water, pumping test water, and restoration waters are properly controlled.
TR RAI P&R-14 (d)

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

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

TR RAI P&R-14(d) Response
The anticipated liquid waste quality at the Dewey-Burdock Project is presented in Table TR RAI P&R-14d-1. A discussion of the anticipated liquid waste quality in relation to Class V DDW regulations is presented below. This information will be incorporated into the revised TR.

Table TR RAI P&R-14d-1: Estimated Liquid Waste Water 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

Table TR RAI P&R-14d-1 shows the estimated water quality of various liquid waste streams for the Highland ISR Facility. The water quality of liquid waste 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. In the land application disposal option, the final liquid waste disposal stream is expected to have similar water quality to the range shown under "Restoration Wastes" in Table TR RAI P&R-14d-1, except that radium-226 and gross alpha will be reduced by treatment in the radium settling ponds. 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 more closely resemble the first four columns in Table TR RAI P&R-14d-1 depending on the specific contribution from each of the liquid waste sources.

EPA issued a final rulemaking in December 1999 that revised the Class V Underground Injection Control (UIC) regulations. The revisions reclassified all wells which dispose of radioactive waste as Class I wells (40 CFR 144.6(a) and 146.5(a)). Since South Dakota law prohibits Class I DDWs, the liquid waste stream will be treated to remove radioactive constituents. It will then be disposed in Class V DDWs or a land application system. In order to meet the Class V UIC or land application requirements, Powertech proposes to treat the liquid waste to reduce radionuclide activities below the established limits for discharge of radionuclides to the environment, which are listed in 10 CFR Part 20, Appendix B, Table 2, Column 2. These limits are presented in Table TR RAI P&R-14d-2. These limits are based on Annual Limits on Intake (ALI) of radionuclides for occupational exposure. Waste streams containing radionuclides below these regulatory limits are not classified as radioactive waste.

Table TR RAI P&R-14d-2: Anticipated Effluent Limits for Class V DDWs

Radionuclide	Anticipated Effluent Limits	
Units	μCi/ml	pCi/L
Lead-210	1E-8	10
Radium-226	6E-8	60
Uranium-nat.	3E-7	300
Thorium-230	1E-7	100

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

Liquid wastes will be treated to achieve uranium effluent limits in the IX columns. It is not anticipated that thorium-230 and lead-210 will be present at concentrations above the limits; however, if

concentrations are above the limits, the effluent will be treated as necessary to satisfy the Appendix B limits. Radium-226 will be treated in radium settling ponds by adding barium chloride to the liquid waste to co-precipitate radium-226 with barium sulfate. Additional information about the radium settling pond design can be found in the Pond Design Report (Supplemental Report, Appendix B). The technology for radium removal by barium chloride is well developed (e.g., Kirby and Salutsky, 1964).

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

Background: The NRC needs to determine that liquid effluents generated from the process bleed, process solutions (e.g., backwash, resin transfer waters), wash-down water, well development water, pumping test water, and restoration waters are properly controlled.
TR RAI P&R-14 (e)

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

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

TR RAI P&R-14(e) Response
The following information will be incorporated into the revised TR.

The Class V UIC Permit Application for disposal of non-hazardous liquid wastes was submitted by Powertech to EPA in March 2010. The Application is included as Appendix 2.7-L to this RAI response package and will be included as an appendix to the revised TR. An analysis of potential target disposal zones is included in the Class V application and is summarized below.

(1) Synopsis of Analyses to Determine Target Disposal Zone(s)

The Class V application is for an Area Permit and authorization to install and operate four to eight Class V non-hazardous disposal wells for underground injection of fluids from Powertech's proposed Dewey-Burdock uranium ISR project.

Within the Black Hills area, both groundwater quality and use are highly variable and dependent on location. Regionally, the major bedrock aquifers in the Black Hills area include the Deadwood Formation, Madison Limestone, Minnelusa, Minnekahta, and Inyan Kara Group. These aquifers are regionally extensive in areas surrounding the Black Hills. Based on TDS concentrations, only the Madison and Inyan Kara are considered to be Underground Sources of Drinking Water (USDWs) in the Dewey-Burdock area. The Deadwood, Minnelusa, and Minnekahta are not used as a water supply and are not USDWs in the Dewey-Burdock area. As summarized below, the Deadwood and Minnelusa appear to have suitably high TDS and porosity to be considered as injection zones for deep disposal wells.

Minor aquifers include the Sundance Formation and Unkpapa sandstone which may be USDWs in the Dewey-Burdock area.

Deadwood Formation - The Cambrian Deadwood Formation consists of massive to thinly-bedded, brown to light-gray sandstone, greenish glauconitic shale, dolomite, and flat-pebble limestone conglomerate and ranges from 0 to 500 feet thick. Because of its depth and stratigraphic position immediately overlying the Precambrian basement, the Deadwood is not a USDW in the project area. There are no known water wells completed in the Deadwood in the project area. Although water-quality data are not available for the Deadwood Formation locally, it is likely that TDS concentrations are in excess of 10,000 mg/L.

Madison Formation - The Mississippian Madison aquifer is contained within the limestones, siltstones, sandstones and dolomites of the Madison Limestone Group. Generally, water in the Madison is confined except in outcrop areas and frequently exists under artesian pressure. Water in the Madison is typically fresh only near the recharge areas, becoming slightly saline to saline as it moves down-gradient. In the deeper parts of the Williston Basin, the water is a brine with TDS concentrations larger than 300,000 mg/L. Locally, the Madison is used as a water supply for the City of Edgemont, approximately 12 miles southeast of the project area.

Minnelusa Formation - The Pennsylvanian/Permian Minnelusa Formation consists of yellow to red, cross-stratified sandstone, limestone, dolomite, and shale. The Minnelusa aquifer occurs primarily in the sandstone and anhydrite beds in the upper part of the formation. The Minnelusa is confined above by the Opeche Shale and below by layers of lower permeability within the Minnelusa.

The Minnelusa is an oil and gas producer in the vicinity of the project area. TDS concentrations locally are in excess of 10,000 mg/L. The Minnelusa is not used locally as a source of water supply. As such, the Minnelusa is not considered to be a USDW in the project area.

Minnekahta Formation - The Permian Minnekahta Limestone is a thin to medium-bedded, fine-grained, purple to gray, laminated limestone, which ranges in thickness from 25 to 65 feet. The Minnekahta is considered a major aquifer in parts of the Black Hills area but does not supply any known water wells in the project area.

Sundance - The Sundance Formation consists of greenish-gray shale with thin limestone lenses, glauconitic sandstone, with red sandstone near the middle of the formation. The Sundance ranges from 250 to 450 feet thick.

Unkpapa - The Unkpapa Sandstone is a massive fine-grained sandstone, 0 to 225 feet thick.

Inyan Kara Group - The Inyan Kara Group includes the Lakota and Fall River Formations; the Lakota Formation is divided into the Chilson, Minnewaste, and Fuson Members. The Inyan Kara is confined by thick shales of the Graneros Group except in outcrop areas around the Black Hills Uplift. Although the Inyan Kara aquifer is widespread, it contains little fresh water except in small areas in central and south-central Montana and north and east of the Black Hills Uplift. In the project area, the Inyan Kara is used as a source of water supply.

Conclusions

Through its submittal of a UIC permit application for Class V non-hazardous injection wells, Powertech requested an Area Permit and authorization from EPA to install and operate four to eight non-hazardous Class V disposal wells at its Dewey-Burdock Project in Fall River and Custer Counties, South Dakota.

Injected fluids will be delivered to the Minnelusa and Deadwood Formations in separate wells under positive pressure injection through tubing and a packer. Fresh water aquifers will be protected by casing and cement. The wells will have one cemented long string protective casing extending into the injection interval and the wellbores will be perforated over the injection interval. The annulus area between the protective casing and injection tubing strings will be filled with inhibited fresh water. Annulus pressure will be continuously monitored to detect potential leaks in the tubing and casing strings.

(2) Basis for Conclusion Only One Well Needed at Each Site

During development of The Class V UIC Permit Application, it was estimated that four to eight deep disposal wells, not one, will be necessary to handle the volume of liquid wastes for disposal from the Dewey-Burdock Project. The number of wells that may be required will be determined following drilling of a test well and is dependent upon well capacity. Redundancy with regard to deep well disposal of liquid waste is provided by multiple wells interconnected via pipeline to the plant. Because of this redundancy, shut down of a single disposal well would not adversely impact production operations or restoration.

The use of surface impoundments provides an additional layer of redundancy for disposal of liquid wastes during ISR operations. Please refer to the following RAI responses for additional information regarding pond capacity: TR RAI P&R-14(a), 14(b), 14(c), 14(f) and 14(g).

(3) Status of Application for Class V UIC Permit

The Class V Application was submitted to EPA on March 20, 2010 and deemed complete on April 28, 2010. EPA's review of the Application is in progress.

(4) Compliance with Requirements of 20.2002

For information on the anticipated treated liquid waste water quality and the anticipated effluent limits for Class V deep disposal wells, refer to the response to TR RAI P&R-14(d), specifically Tables TR RAI P&R-14d-1 and TR RAI P&R-14-d-2.

<u>TR RAI P&R-14</u>
Provide revised and additional information on plans for the disposal of liquid wastes.

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

<u>TR RAI P&R-14 (f)</u>

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

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

<u>TR RAI P&R-14(f) Response</u>

Powertech has revised the storage volume calculations for the radium settling ponds for a project life extending well beyond 10 years. The radium settling ponds have been sized conservatively in that each pond has been designed to process the entire project-wide liquid waste stream with a minimum retention time of approximately 13 days at the maximum production bleed rate of 3%. In actual practice, the production bleed will typically be about 0.875% and the liquid waste will typically be divided between the Dewey and Burdock radium settling ponds. Higher bleed rates, up to 3%, will only be used for relatively short time periods as needed to control the sub-surface movement of lixiviant.

The revised inputs to the radium settling pond retention times and sludge accumulation rate calculations are presented in Table TR RAI P&R-14f-1 along with the values previously submitted in the TR and Supplemental Report. The current values listed in the table supersede all values previously presented in TR Section 4 and in Appendix B of the Supplement Report. Section 4 of the TR and Appendix B will be updated with the discussion below. The revised Appendix B will be incorporated into the revised TR.

The Dewey-Burdock Project is expected to produce liquid waste from project year 2 through the first quarter of project year 10, for a total of 8.25 years. Table TR RAI P&R-14f-2 shows estimates of the production bleed and liquid waste produced from uranium recovery, aquifer restoration and CPP operations. The estimated production bleed and CPP wastewater volume were calculated based on estimates of the volume of barren lixiviant required to recover U_3O_8 at the Dewey-Burdock Project. The restoration waste volumes were calculated assuming 6 pore volumes of restoration composite. This table also shows the design values for the total volume of sludge accumulated and the computed mean pond retention times for both the deep disposal well and land application disposal options at the typical production bleed rate of 0.875%. The pond retention times were computed both for initial ISR

Table TR RAI P&R-14f-1: Revisions to Radium Settling Pond Sludge Accumulation Rates and Retention Times

Radium Settling Pond Parameter	Disposal Option	Original Value and Reference		Current Value
		Report/Section or Page	Value	
Pond Sludge Accumulation Rate	Unspecified	TR/4.4.1.1	100 yd^3/yr (sludge + misc.)	See note
	DDW	SR/App. B, pg. 4-2	321 ft^3/yr	795 ft^3/yr
	Land App.	SR/App. B, pg. 3-4	790 ft^3/yr	1,780 ft^3/yr
Single Pond Retention Time	DDW	SR/App. B, pg. 4-2	14 d @ 252 gpm	12.7 d @ 282 gpm
	Land App.	SR/App. B, pg. 3-4	14 d @ 620 gpm	14.1 d @ 632 gpm
Pond Life/ Project Life	DDW	SR/App. B, pg. 4-3	"10-year Project life"	Pond life is greater than 10 years as described below.
	Land App.	SR/App. B, pg. 3-4	"10-year Project life"	

Note: Unspecified waste disposal option is not currently being evaluated for the Dewey-Burdock Project.

Table TR RAI P&R-14f-2: Estimated Sludge Accumulation and Effect on Pond Retention Times for Typical Production Bleed of 0.875%

Radium Settling Pond Parameters	Units*	Liquid Waste Disposal Option	
		DDW	LA
Production Bleed	Mgal	127	127
Restoration Wastewater	Mgal	162	539
CPP Wastewater	Mgal	43	43
Total Project Wastewater	Mgal	332	709
Volume of Sludge @ Project End	ac-ft	0.04	0.09
Volume of Sludge @ 10 Years	ac-ft	0.13	0.35
Volume of Sludge @ 20 Years	ac-ft	0.25	0.71
Operating Capacity of 1 Radium Settling Pond	ac-ft	15.9	39.4
Retention Time, Initial	d	18.3	16.3
Retention Time, Project End	d	18.2	16.3
Retention Time @ 10 Years	d	18.1	16.2
Retention Time @ 20 Years	d	18.0	16.0

* Mgal = million gallons
DDW = deep disposal well
LA = land application
ac-ft = acre-feet
d = days

operations, when no sludge will have accumulated, and at project end, when the liquid retention time will be reduced due to accumulated sludge, which will reduce the available pond volume. Additionally, pond retention times were computed for extended periods of operation, including 10 and 20 years of ISR operation. In order to calculate the volumes of liquid waste for computing the sludge accumulation and retention times after 10 and 20 years of operations, the typical liquid waste flow rates for uranium recovery with concurrent aquifer restoration were used. These values are 197 gpm for the deep disposal well option and 547 gpm for the land application option (see liquid waste disposal values in Table TR RAI P&R-14c). This results in a very conservative estimate of the volume of sludge accumulation and subsequent reduction in retention pond capacity because it is very unlikely that these flow rates would be sustained for 10- or 20-year periods. The volumes of sludge presented in this response were computed based on the addition of barium chloride at a rate of 20 mg/L of wastewater and assuming the pond sludge is comprised of the resultant barium sulfate, with a solids content of 40 percent by weight and a specific gravity of 1.4. These values are considered to be conservative.

As shown in Table TR RAI P&R-14f-2, the volume of sludge which will accumulate over 10- and 20-year periods is relatively small compared to the overall pond volume. For example, after 20 years of pond operation at the typical production bleed of 0.875%, the estimated volume of accumulated sludge is 0.25 ac-ft for the deep disposal well option and 0.71 ac-ft for the land application option, which reduces the liquid retention time in the ponds by approximately 0.3 day, a reduction of less than 2% of the initial pond retention time. The resulting retention time after 20 years is estimated to be 16 to 18 days, depending on the liquid waste disposal option. As stated in the Pond Design Report (Supplemental Report Appendix B), "a literature survey of radium settling ponds has indicated that typical retention times range from 8 to 14 days." Therefore, radium settling ponds at the Dewey-Burdock Project will have adequate retention times even after 20 years of service, which is significantly longer than the anticipated service life of 8.25 years. In addition, the Satellite Facility and CPP will each have a spare pond suitable for use as a settling pond if the primary ponds need to be temporarily removed from service for sludge removal or repair.

Radium settling pond sludge accumulation and retention times were also evaluated for the maximum production bleed of 3%. These values are presented in Table TR RAI P&R-14f-3. The volumes of production bleed and CPP and restoration wastewater were calculated as described above for Table TR RAI P&R-14f-2. This table shows that even at the maximum production bleed, pond retention times will still be within the acceptable range of 8 to 14 days for typical radium settling ponds.

Table TR RAI P&R-14f-3: Estimated Sludge Accumulation and Effect on Pond Retention Times for a Maximum Production Bleed of 3%

Radium Settling Pond Parameters	Units*	Liquid Waste Disposal Option	
		DDW	LA
Production Bleed	Mgal	436	436
Restoration Wastewater	Mgal	162	539
CPP Wastewater	Mgal	43	43
Total Project Wastewater	Mgal	641	1018
Volume of Sludge @ Project End	ac-ft	0.08	0.13
Volume of Sludge @ 10 Years	ac-ft	0.18	0.41
Volume of Sludge @ 20 Years	ac-ft	0.36	0.82
Operating Capacity of 1 Radium Settling Pond	ac-ft	15.9	39.4
Retention Time, Initial	d	12.8	14.1
Retention Time, Project End	d	12.7	14.1
Retention Time @ 10 Years	d	12.6	14.0
Retention Time @ 20 Years	d	12.5	13.8

* Mgal = million gallons
DDW = deep disposal well
LA = land application
ac-ft = acre-feet
d = days

<u>TR RAI P&R-14</u>
Provide revised and additional information on plans for the disposal of liquid wastes.

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

<u>TR RAI P&R-14 (g)</u>

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

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

<u>TR RAI P&R-14(g) Response</u>
The purpose of the Central Plant Pond is to temporarily store liquid waste originating from the CPP during uranium recovery and aquifer restoration operations until the CPP liquid waste can be blended with other sources of liquid waste and treated to meet discharge standards.

The CPP liquid waste stream will consist of process solutions (such as resin transfer water and brine generated from the elution and precipitation circuits), and may also contain laboratory wastewater, laundry water, plant washdown water, plant sump water, and other minor sources of liquid waste excluding domestic sewage. The CPP liquid waste will be blended with well field production bleed and aquifer restoration bleed prior to final treatment to applicable standards for removal of uranium and other radionuclides.

Central Plant Pond Size and Capacity

The Central Plant Pond storage capacity for the land application option has been revised from 2 years, which is stated on page 3-5 in the Pond Design Report (Supplemental Report, Appendix B), to 660 days. The change in storage capacity is based on the revised CPP liquid waste flow rate of 12 gpm, which supersedes the value of 10.81 gpm that is stated on page 3-5 of the Pond Design Report. The Pond Design Report will be revised and included as an appendix to the revised TR.

A summary of the Central Plant Pond size and storage capacity under each disposal option is presented in Table TR RAI P&R-14g-1.

The Central Plant Pond has been designed to accommodate the CPP liquid waste design flow plus direct precipitation from the 100-year storm event, while maintaining 3 feet of freeboard. As shown in Table TR RAI P&R-14g-1, the Central Plant Pond capacity will depend on the liquid waste disposal option. The active waste storage capacity, excluding freeboard and reserve capacity for precipitation, will be 15.2 ac-ft for the DDW option, which is sufficient storage for approximately 287 days at the typical CPP

Table TR RAI P&R-14g-1: Central Plant Pond Size and Capacity

Parameters	Units	Deep Disposal Well Option	Land Application Option
Central Plant Pond Total Capacity	ac-ft	15.9	36.2
100-year Precipitation Volume	ac-ft	0.7	1.2
Central Plant Pond Waste Storage Capacity	ac-ft	15.2	35.0
CPP Liquid Waste Flow Rate	gpm	12	12
Liquid Waste Storage Capacity in Time of Operation[1]	yr	0.79	1.81
	d	287	660

[1] During uranium recovery and concurrent uranium recovery and aquifer restoration. Refer to the water balance presented in the response to TR RAI P&R-14(c).

liquid waste production rate of 12 gpm. The Central Plant Pond active waste storage capacity for the land application disposal option will be 35.0 ac-ft. This capacity will allow storage of up to 660 days of CPP liquid waste production at 12 gpm. 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. In addition, the larger capacity will also provide more flexibility for blending the liquid wastes during normal operation. This will be necessary because the land application disposal option will be more sensitive to higher dissolved solids concentrations in the waste stream. A larger Central Plant Pond will also allow for additional excess storage during the winter months when no land application will occur.

The flow rate of the CPP liquid waste from the Central Plant Pond to the radium settling pond will be adjusted according to the concentration of dissolved solids in the CPP liquid water stream. When well field liquid waste has relatively lower concentrations of dissolved solids, for example when restoration is near completion in a particular well field, the percentage of CPP liquid waste in the waste disposal stream can be higher, or when well field liquid waste has a relatively higher concentration of dissolved solids (e.g., near the end of uranium recovery in a particular well field), the percentage of CPP liquid waste in the waste disposal stream can be lower.

<u>TR RAI P&R-14</u>

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

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

<u>TR RAI P&R-14 (h)</u>

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

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

<u>TR RAI P&R-14(h) Response</u>

Detailed construction specifications, testing, and QA/QC procedures for the ponds are attached in Appendix 3.1-A of this response. This appendix also will be included with the revised TR. The following is a summary of the construction specifications and testing and inspection program for pond construction. In the following specifications "engineer" refers to a professional engineer licensed in South Dakota.

Construction specifications include the following:

i) Clearing, grubbing and stripping: The natural ground surface shall be cleared and stripped and/or grubbed of all organic and objectionable materials. The limits of stripping shall generally be 10.0 feet outside of the work activity areas.

ii) Excavation and fill placement: Excavation shall be to the lines and grades shown on the pond drawings. Excavations shall not exceed a vertical tolerance of plus or minus 0.1 foot, and a horizontal tolerance of 0.5 foot. Fill and backfill shall be placed within a vertical tolerance of plus or minus 0.1 foot, and a horizontal tolerance of 0.5 foot, unless otherwise approved by the Engineer. All precautions necessary to preserve, in an undisturbed condition, all areas outside the lines and grades shown on the drawings, will be taken. Fill will be constructed in near horizontal layers with each layer being completed over the full length and breadth of the zone before placement of subsequent layers. Each zone will be constructed with materials meeting the specified requirements, and shall be free from lenses, pockets and layers of materials, which are substantially different in gradation from the surrounding material in the same zone. All over-sized material shall be removed from the fill material either prior to being placed, or after it is dumped and spread but prior to compaction. The Engineer will conduct testing, as discussed below, to establish suitability of all fill materials used. No fill material shall be placed until the Engineer has inspected and approved the foundation or in-place lift.

iii) Rolling: Compaction of each layer of fill shall proceed in a systematic, orderly and continuous manner that has been approved by the Engineer, to ensure that each layer receives the compaction specified. Compaction equipment shall be routed parallel to the

embankment axis or the long axis of the fill zone, and overlap between roll patterns shall be a minimum of 12 inches. The rolling pattern for compaction of all zone boundaries or construction joints shall be such that the full number of passes required in one of the adjacent zones, or on one side of the construction joint, extends completely across the boundary or joint. Compaction equipment shall be of the types and sizes specified in Section 4.6 of Appendix 3.1-A.

iv) Compaction and moisture control: All material, after placing, spreading and leveling to the appropriate layer thickness shall be uniformly compacted in accordance with the requirements for each type of fill as indicated in the following table:

Table TR RAI P&R-14h-1: Compaction Requirements

Material	Compaction Specifications	Moisture Content
Prepared Subgrade	92% of Maximum Dry Density by ASTM D1557	+/- 3% of Optimum
Random Fill	92% of Maximum Dry Density by ASTM D1557	+/- 3% of Optimum
Soil Liner	92% of Maximum Dry Density by ASTM D1557	0 to +5% of Optimum

v) Finishing: Finished grades shall slope uniformly between given spot and contour elevations. All grades shall provide for natural runoff of water without low spots or pockets.

Subgrade sterilization and liner sub-drainage and gas venting do not apply to the pond designs presented in Appendix 3.1-A.

Testing and Inspection Program

Inspection of earthwork will involve testing and visual examination of all materials being used for construction to establish compliance with the material requirements, moisture conditioning, spreading procedures, layer thicknesses, and compaction requirements. To ensure that satisfactory quality control is maintained and that the design objectives are achieved, specific testing requirements will be implemented for all materials placed within the Work area. Tests to be carried out will be divided into two categories; control tests and record tests. Control tests will be used to verify whether the materials comply with the specifications prior to placement. Record tests will be used during placement and after completion of the work to assess whether the work and materials meet the requirements of the specifications.

Control tests will include: i) particle size distribution for fill materials, soil liner, filter sand and riprap; ii) moisture content of fill materials and the soil liner; iii) Modified Proctor compaction tests (ASTM D1557) of fill materials and the soil liner: iv) Atterberg limits of fill materials and soil liner; v) and other tests of fill materials taken from borrow areas and on the fill, as necessary to assess whether the fill material is in compliance with the technical specifications.

The record tests will include: i) particle size distribution for fill materials, soil liner and filter sand; ii) field density test on fill materials and the soil liner; iii) moisture content of the fill materials and soil liner; iv)

laboratory compaction and particle size distribution of materials recovered from select field density test locations; v) in-situ laboratory permeability tests on fill materials and the soil liner; vi) Atterberg limit tests on fill materials and the soil liner; vii) other tests on fill compacted in place as necessary to assess whether the compacted fill is in full compliance with the technical specifications.

Testing Frequencies

Geotechnical tests will be conducted to establish compliance of the work with the technical specifications. Standard procedures will be used for all tests. The following tables from Appendix 3.1-A show the test methods and frequency of testing for various materials.

Table TR RAI P&R-14h-2: Test Methods

Test Designation[(1),(2)]	Type of Test	Test Methods (ASTM)
C1, R1	Atterberg Limits	D4318
R2a C2, R2b	Nuclear Method Moisture Content Laboratory Moisture Content	D6938 D2216
C3, R3	Particle Size Distribution	D422[(3)]
C4, R4	Laboratory Compaction	D1557
R5a R5b R5c	Nuclear Method Field Density Sand Cone Field Density Water Replacement Field Density	D6938 D1556 D5030
C6, R6	Laboratory Permeability Test	D5084
C7, R7	Riprap Particle Size Distribution	Pebble Count

Notes:

1. C- Denotes Control Tests
2. R- Denotes Record Tests
3. Hydrometer tests down to the 2-micron size will be carried out as directed by the Engineer but will generally not be required. All samples are to be wash graded over a #200 sieve.

Table TR RAI P&R-14h-3: Test Frequency- Prepared Subgrade

Test Designation	Type of Test	Frequency (1 per)
R1	Atterberg Limits	2,000 yd^2
C2, R2a, R2b	Moisture Content	1,000 yd^2
C3, R3	Particle Size Distribution	2,000 yd^2
C4, R4	Laboratory Compaction	2,000 yd^2
R5a	Nuclear Density	1,000 yd^2
R5b	Sand Cone Density	5,000 yd^2

Table TR RAI P&R-14h-4: Test Frequency- Random Fill

Test Designation	Type of Test	Frequency (1 per)
R1	Atterberg Limits	5,000 yd^3
C2, R2a, R2b	Moisture Content	2,500 yd^3
C3, R3	Particle Size Distribution	5,000 yd^3
C4, R4	Laboratory Compaction (Modified Proctor)	5,000 yd^3
R5a	Nuclear Density	1,000 yd^3
R5b	Sand Cone Density	10,000 yd^3
C6, R6	Laboratory Permeability Test	5,000 yd^3

Table TR RAI P&R-14h-5: Test Frequency - Soil Liner

Test Designation	Type of Test	Frequency (1 per)
R1	Atterberg Limits	1,000 yd^3
C2, R2a, R2b	Moisture Content	500 yd^3
C3, R3	Particle Size Distribution	1,000 yd^3
C4a, R4a	Laboratory Compaction	1,000 yd^3
R5a	Nuclear Density	1,000 yd^3
R5b	Sand Cone Density	2,500 yd^3
C6, R6	Laboratory Permeability Test	1,000 yd^3

Table TR RAI P&R-14h-6: Test Frequency - Filter Sand

Test Designation	Type of Test	Frequency (1 per)
C3, R3	Particle Size Distribution	250 yd^3

Table TR RAI P&R-14h-7: Test Frequency - Riprap

Test Designation	Type of Test	Frequency (1 per)
C7, R7	Riprap Particle Size Distribution	1,000 yd^3

<u>TR RAI P&R-14</u>
Provide revised and additional information on plans for the disposal of liquid wastes.

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

<u>TR RAI P&R-14 (i)</u>

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

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

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

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

<u>TR RAI P&R-14(i) Response</u>
The TR will be revised to include the following information.

An inspection program based on Regulatory Guide 3.11 will be implemented for all ponds. A detailed checklist will be developed and followed to document the observations of each significant geotechnical, structural, and hydraulic feature, including control equipment. Inspections will be conducted by trained personnel who are knowledgeable of the pond construction and safety features. Inspections will be documented and the reports retained on site for reference and inspection by regulatory authorities. Inspections will include but are not limited to the following:

- Daily inspections of the liner, liner slopes, and other earthwork features
- Daily inspections of pond freeboard
- Monthly inspection of leak detection systems or
- Daily checks for water accumulation in leak detection systems
- Quarterly inspections of embankment settlement and slope stability. Unscheduled inspections will be performed after occurrence of significant earthquakes, tornadoes, intense local rainfall, or other unusual events

If these inspections reveal any damage or defects that could result in leakage, this information will be reported to the NRC within 24 hours, and appropriate repairs will be implemented as soon as possible.

If significant water is found in the leak detection system, the water in the standpipes will be sampled immediately for indicator parameters to confirm that the water in the detection system is from the pond. The indicator parameters which are proposed to be used are chloride and conductivity. If the analysis confirms a leak, a secondary sample shall be collected and analyzed within 24 hours. Upon confirmation of a leak by the second analysis, the pond will be taken out of service until repairs can be completed. The leak will be reported to the NRC within 24 hours of the confirmation. A pond removed from service because of a confirmed leak will be dewatered by transferring the contents to a spare pond. Regardless of the disposal option used at the project, the Dewey and Burdock areas will each have a spare pond of identical capacity, construction, and dimensions as the primary radium settling ponds. At the Burdock area, the spare pond may also serve as a spare for the Central Plant Pond. A spare storage pond will also be included at each area in the land application disposal option. Refer to the response to TR RAI 3.1-7 for a discussion of pond capacities for each liquid waste disposal option.

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

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

TR RAI P&R-14 (j)

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

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

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

TR RAI P&R-14(j) Response

TR Sections 5.7.1 and 7.5.1 will be revised to present this discussion of the likelihood of and measures for preventing and containing a multiple tank failure. Both the CPP and the Satellite Facility will be equipped with trench drains and sumps with pumps to collect spills of process fluids from leaks or tank failures. Sump and curb locations have been added to Figures TR 3.2-4 and 3.2-5, which are provided in the response to TR RAI MI-1(b).

Potential surface releases could result from a tank failure, pipe rupture, or transportation incident. Failure of a process vessel will be contained within the CPP via concrete containment curbs and directed into a sump (equipped with a level alarm) that will transport the solution to the appropriate tank or disposal system.

Measures for Preventing Tank Failures

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

- routine inspection
- installation of devices to avoid over pressurization or excessive level
- use of tanks and vessels that meet applicable ASME and/or ASTM codes appropriate to their function and operating conditions.
- proper engineering design of tanks and supporting structures, foundations, and footings.

Methods of Containing Tank Failures

The facility floors will be surrounded by 6-inch containment curbs and sloped toward the trench drains and sumps. Spilled or leaked fluid will be transferred to the waste tanks, from which it can be directed to liquid waste treatment and disposal. If a spill occurs in the recovery area, the spilled fluid could also be returned to the process circuit for processing, or stored temporarily in the Central Plant Pond.

Capacity of the Curbed Areas

The CPP and the Satellite Facility buildings will be designed with concrete containment curbs around the building perimeters. The largest liquid-containing vessel in the CPP is the yellowcake thickener with a capacity of 37,500 gallons (5,000 ft^3). Two vessels are currently planned for a combined capacity of 75,000 gallons (10,000 ft^3). A 6-inch high containment curb around the entire perimeter of the CPP floor would contain 10,750 ft^3. This would be more than enough to contain the entire contents of both thickeners in the extremely unlikely event that both thickeners should fail simultaneously and spill their entire contents onto the floor of the CPP before any of the contents flowed into the sump. The sumps will provide additional temporary containment capacity such that the total containment capacity of curbs and sumps is above 200% of the largest liquid-containing tank or vessel in the CPP. The thickeners will be separated by sufficient distance that collapse of the support footing for one thickener could not cause that thickener to fall into the second thickener. Standard operating procedures and employee training will be in place for emergency situations including spills in the CPP and Satellite Facility.

For the Satellite Facility, the largest liquid-containing vessel will be the utility water tank, with a volume of 16,000 gallons (2,139 ft^3). The Satellite Facility will include a 6-inch high containment curb around the perimeter wall of the building slab. The containment curb capacity will be at least 7,680 ft^3, or more than 350% of the volume of the utility water tank. Sumps will provide additional incremental containment capacity. Sump pumps will direct the spill to the radium settling pond for treatment and disposal. Depending on the nature of the spilled fluid, the sump pumps may be used to pump the spilled fluid through the ion exchange system for removal of uranium and other dissolved constituents prior to disposal.

Spilled fluids will be removed from the sumps by pumps and transported to the appropriate disposal system or recycled back to the appropriate process component. The primary contingency for spills within the elution and thickening area of the CPP is placement of the spilled liquid in the Central Plant Pond. This pond will have minimum capacity of 15.2 ac-ft (662,112 ft^3) not including allowance for storm water, or over 66 times the combined volume of both thickeners. At full level there is 3 ft of freeboard, which amounts to over 174,000 ft^3, or over 17 times the combined volume of both thickeners. Stated another way, with the Central Plant Pond full to its normal capacity, the addition of 10,000 ft^3 of liquid would increase the liquid depth in the pond by less than 0.2 ft.

Likely Consequences of Leak or Spill Events

The design of the process buildings (CPP and Satellite Facility) will include curbed foundations as noted previously, such that any spill will be contained within the building, regardless of sump pump operation. In the event of a total electrical failure, such that no pumps would be operational, a spill due to a vessel failure would be contained within the building in which the vessel failure occurred.

<u>TR RAI P&R-14</u>
Provide revised and additional information on plans for the disposal of liquid wastes.

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

<u>TR RAI P&R-14 (k)</u>
The applicant needs to describe the controls for shut down of the deep well injection system.
Needed: Provide information as requested.

<u>TR RAI P&R-14(k) Response</u>
The following information will be incorporated in Section 4.2 (Liquid Waste) of the revised TR. A detailed description of the deep disposal wells operation and control is included in Section 2.K, "Injection Procedures," of Appendix 2.7-L (attached). Appendix 2.7-L includes the Class V UIC permit application. This appendix will also be included with the revised TR.

The automated control system on the Class V deep disposal wells will include control switches to alert the operator if certain operating conditions are encountered. A high injection pressure switch (set below the permitted maximum) and a low annulus differential pressure switch (set above the permitted minimum) will shut off injection pump power and will alert the operator so that the well can be fully isolated and secured. The alarm will sound in the central control room of the CPP and/or Satellite Facility, whichever is nearer. In the event that any of the permit condition related set points are exceeded, injection operations will cease immediately until the problem is identified and corrected. The system will then be manually restarted by an operator when operating parameter compliance is verified.

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

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

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

TR RAI P&R-15 Response
TR Section 4.4 and 6.3 will be revised to incorporate the following information.

Powertech will provide an approved waste disposal agreement for 11e.(2) byproduct material prior to beginning operations. Powertech understands that without such an agreement operations cannot begin. Powertech, therefore, acknowledges that without an approved 11e.(2) byproduct material disposal agreement in place prior to issuance of a license, NRC will include a license condition requiring verification of an approved 11e.(2) byproduct material disposal agreement at an NRC or NRC Agreement State licensed disposal facility prior to the start of operations.

Powertech based the financial assurance estimate and transportation analysis on disposal of 11e.(2) byproduct material at the White Mesa facility near Blanding, Utah. However, as described in the response to TR RAI MI-4(c), the transportation distance is similar or less to several alternative NRC or NRC Agreement State licensed facilities.

TR RAI P&R-16
Additional discussion of the land clean up program needs to be provided.

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

TR RAI P&R-16 Response
TR Sections 6.4 and 5.7.9 will be revised to include the following information.

(1) The post-operation (pre-decommissioning) radiological survey will consist of an integrated area gamma survey and confirmation soil sampling and analysis to verify that the required cleanup standard(s) are met. The areas that will receive particular attention are those that are expected to have higher readings than surrounding areas and include diversion ditches, surface impoundment areas, well fields (particularly those areas where spills or leaks may have occurred), process structures, storage areas, and on-site transportation routes for contaminated material and equipment. Areas associated with liquid waste disposal will also receive close attention.

(2) Powertech will conduct land cleanup in accordance with 10 CFR Part 40, Appendix A, Criterion 6(6) and South Dakota DENR regulations. Powertech commits to removal of all 11e.(2) byproduct material for disposal in a licensed 11e.(2) disposal facility (including all affected soils, liners, equipment, filters, etc.) or, if liquid, using an appropriately permitted deep disposal well and/or land application. Any non-11e.(2) byproduct material will be disposed off-site in an appropriately permitted solid or hazardous waste disposal facility.

(3) Prior to operations, Powertech will prepare a Quality Assurance Project Plan (QAPP) in accordance with Regulatory Guide 4.15. The outline for the QAPP is provided in Figure TR RAI P&R-16-1 and will be provided in the revised TR.

Dewey-Burdock Project
Quality Assurance Project Plan – Outline

1. Policy
2. Table of Contents
3. Introduction
    - 3.1 Purpose
    - 3.2 Scope
    - 3.3 Relationship to Other Plans
    - 3.4 Reference Documents
4. Regulatory Requirements
    - 4.1 Regulations
    - 4.2 Regulatory Guidance
5. Organization and Personnel
    - 5.1 Organizational Structure
    - 5.2 Personnel Responsibilities
    - 5.3 Personnel Qualifications
    - 5.4 Personnel Training and Certifications
6. Procedures and Instructions
7. Records and Recordkeeping
    - 7.1 Records Management Plan
    - 7.2 Record Retention Requirements
8. Sampling and Analysis
    - 8.1 Environmental Media
        - 8.1.1 Sampling Methods and Procedures
        - 8.1.2 Sample Containers, Preservation and Holding Times
        - 8.1.3 Field Measurements
        - 8.1.4 Decontamination Procedures and Materials
    - 8.2 Occupational Health and Safety Monitoring
9. Radionuclide Analysis
    - 9.1. Onsite Laboratory
    - 9.2. Contract Laboratory
10. Instruments and Equipment
    - 10.1 Calibration
    - 10.2 Maintenance
11. Data Management
    - 11.1 Data Validation
    - 11.2 Qualification of Data
    - 11.3 Anomalous Data
12. Assessment and Oversight
    - 12.1 Review and Improvement
    - 12.2 Assessment and Corrective Actions

Figure TR RAI P&R-16-1: Quality Assurance Project Plan Outline

TR RAI P&R-17

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

TR RAI P&R-17 Response
TR Section 6.3 will be revised to include the following information.

(1) Powertech commits to prepare procedures for performing radioactivity measurements on the interior surfaces of pipes, drain lines, and ductwork, and include the procedures in the Decommissioning Plan. Such plans will include measurements at all traps and other access points where contamination is likely to be representative of system-wide contamination.

(2) In the Decommissioning Plan, Powertech will assume that all premises, equipment, or scrap likely to be contaminated in excess of limits, but that cannot be measured, is contaminated in excess of limits and will be treated accordingly.

Radiological Issues

TR RAI RI-1

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

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

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

TR RAI RI-1 Response

TR Section 5.1.5 will be revised to include the following information.

The Radiation Safety Officer (RSO) will possess the authority to enforce regulations and administrative policies that may affect any aspect of the radiological protection program. The RSO will have the authority to suspend, postpone, or modify any activity that the RSO determines is not in compliance with regulations and administrative policy. Powertech no longer uses the term “mine manager.” This position will be called the “facility manager.” The facility manager will not possess the authority to unilaterally override the RSO’s decision to suspend, postpone, or modify an activity.

<u>TR RAI RI-2</u>

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

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

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

<u>TR RAI RI-2 Response</u>

TR Section 5.2.2 (Non-Routine Activities) will be revised to include the following information. The RSO designee will not review and approve RWPs.

The RSO or a Radiation Safety Technician (RST) will review and sign RWPs. The RST will perform this function when the RSO is not available, e.g., during off shifts. Please refer to the response to TR RAI RI-3, which describes that the RST will meet the minimum training requirements of the RSO. The RST will meet the Regulatory Guide 8.31 requirement as a member of the radiation safety staff who has specialized radiation protection training and will be authorized to review and sign RWPs when the RSO is not available.

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

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

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

TR RAI RI-3 Response
TR Sections 5.3.1 and 5.4 will be revised to include the following information. Powertech will utilize Radiation Safety Technicians (also referred to as Health Physics Technicians in Regulatory Guide 8.31). Powertech will not have RSO designees other than Radiation Safety Technicians performing inspections. Since the RST will meet the minimum training requirements of the RSO, Powertech does not propose to limit the frequency of inspections performed by the RST.

The criteria used to determine who is a qualified RST to replace the RSO in daily visual inspections of all work and storage areas in the facility to determine if SOPs are being followed properly and good radiation practices are being implemented are: A) satisfy one of the alternative requirements for education, training and experience as described in Regulatory Guide 8.31 and summarized below, and B) demonstrate a working knowledge of: i) the proper operation of health physics instruments used at the facility, ii) surveying and sampling techniques, iii) personnel dosimetry requirements, iv) which locations, operations and jobs are associated with the highest exposures, and v) why exposures may increase or decrease during work execution. The criteria are consistent with Section 2.4.2 of Regulatory Guide 8.31.

Minimum qualifications will include:

- Training equal to the minimum qualifications of the appointed RSO as specified in Section 2.4 of Regulatory Guide 8.31.
- Must pass a test with an 80 percent score or better regarding the minimum training of the RSO.
- The level of experience required will be commensurate with the type, form and the anticipated radiation hazards to be encountered while acting as a designee for the appointed RSO.

On-the job training overseen by the RSO will provide expertise regarding implementation of site-specific radiological safety protocols and any necessary specialized radiation safety training concerning a specific RWP. For more information see Section 5.2.2. The minimum combination of education, training and experience for a Radiation Safety Technician includes the following:

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

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

<u>TR RAI RI-4</u>
Sampling and analysis results

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

<u>TR RAI RI-4(a)</u>

a. ***In the Technical Report, no LLD or error values for fish are given in Tables 2.8-23 and 2.8-30 or in the lab report in Appendix 2.8-H.***

Needed: For all radiological data reported, the applicant should address Regulatory Guide 4.14, Section 7.0 (Recording and Reporting Results), recommendations regarding LLD, error, and other quality assurance provisions.

<u>TR RAI RI-4(a) Response</u>

To meet the recommendations of Regulatory Guide 4.14, Section 7.0, Powertech has combined Tables 2.8-23 and 2.8-30 into revised Table 2.8-23, which includes the LLDs and error values associated with each concentration. The only exception is uranium, which does not include an error value, since uranium was analyzed using ICP-MS. Error estimates for other parameters are expressed as precision (+/-). This estimate is a two sigma (two times the standard deviation) error estimate. This table is provided with this response and also will be included in the revised TR.

Table 2.8-23: Baseline Radiological Analysis of Whole Fish

Site	Species	Number	Length[a] mm	Sample Weight[b] (g)	U				Po-210			Pb-210			Th-230			Ra-226		
					Conc.[c] mg/kg	RL (LLD) mg/kg	Conc.[c] uCi/kg	RL (LLD) uCi/kg	Conc. uCi/Kg	Precision (±) uCi/Kg	RL (LLD)	Conc. uCi/Kg	Precision (±) uCi/Kg	RL (LLD)	Conc. uCi/Kg	Precision (±) uCi/Kg	RL (LLD)	Conc. uCi/Kg	Preci-ion (±) uCi/Kg	RL (LLD)
BVC 01 April	GRS	1	120	22.96	<MDC	0.02	<MDC	2.0E-05	0.0E+00	6.0E-05	6.0E-05	0.0E+00	2.0E-04	5.0E-05	0.0E+00	2.0E-05	1.0E-05	3.0E-04	9.0E-05	1.0E-04
	PLK	1	48	1.77	<MDC	0.3	<MDC	2.0E-04	0.0E+00	8.0E-04	5.0E-04	2.0E-02	2.0E-02	5.0E-04	2.0E-04	3.0E-04	1.0E-04	-4.0E-04	4.0E-04	9.0E-04
	LND	1	48	0.64	<MDC	0.9	<MDC	6.0E-04	2.0E-03	3.0E-03	1.0E-03	0.0E+00	7.0E-03	1.0E-03	1.0E-03	1.0E-03	3.0E-04	-2.0E-03	1.0E-03	3.0E.-03
	FHM	1	30-60	4	<MDC	0.1	<MDC	1.0E-04	4.0E-04	5.0E-04	2.0E-04	0.0E+00	1.0E-03	2.0E-04	0.0E+00	7.0E-05	5.0E-05	-1.0E-04	2.0E-04	5.0E-04
BVC 04 April	PLK	1	40-60	0.72	<MDC	0.8	<MDC	5.0E-04	0.0E+00	1.0E-03	1.0E-03	0.0E+00	8.0E-03	1.0E-03	0.0E+00	4.0E-04	3.0E-04	-1.0E-03	1.0E-03	2.0E-03
	RIC	1	111	18.79	<MDC	0.03	<MDC	2.0E-05	4.0E-04	2.0E-04	5.0E-05	0.0E+00	3.0E-04	5.0E-05	2.0E-05	3.0E-05	1.0E-05	-2.0E-05	6.0E-05	1.0E-04
	GRS	1	50	2.16	<MDC	0.3	<MDC	2.0E-04	6.0E-04	7.0E-04	4.0E-04	0.0E+00	3.0E-03	4.0E-04	8.0E-04	6.0E-04	4.0E-04	-3.0E-04	4.0E-04	9.0E-04
	FHM	1	30-70	~1.2	<MDC	0.02	<MDC	1.0E-05	0.0E+00	2.0E-05	5.0E-05	0.0E+00	9.0E-05	5.0E-05	1.0E-05	1.0E-05	1.0E-05	1.0E-04	3.0E-05	3.0E-05
	CHC	1	215	72	0.05	0.05	3.0E-05	3.0E-05	9.0E-04	3.0E-04	8.0E-05	0.0E+00	5.0E-04	8.0E-05	2.0E-05	3.0E-05	2.0E-05	-8.0E-05	6.0E-05	1.0E-04
CHR 05 April	RIC	1	97	13.73	<MDC	0.04	<MDC	3.0E-05	8.0E-04	3.0E-04	7.0E-05	0.0E+00	4.0E-04	7.0E-05	0.0E+00	5.0E-05	1.0E-05	-9.0E-05	5.0E-05	1.0E-04
	GRS	1	98	13.67	<MDC	0.04	<MDC	3.0E-05	8.0E-05	1.0E-04	7.0E-05	0.0E+00	4.0E-04	7.0E-05	1.0E-05	5.0E-05	1.0E-05	-6.0E-05	7.0E-05	1.0E-04
	SRS	1	169	55.05	<MDC	0.02	<MDC	1.0E-05	2.0E-04	1.0E-04	5.0E-05	0.0E+00	1.0E-04	5.0E-05	2.0E-05	2.0E-05	1.0E-05	-1.0E-05	2.0E-05	3.0E-05
	CRC	1	30-70	2.92	<MDC	0.2	<MDC	1.0E-04	0.0E+00	3.0E-04	3.0E-04	0.0E+00	2.0E-03	3.0E-04	0.0E+00	2.0E-04	7.0E-05	-2.0E-04	3.0E-04	6.0E-04
	PLK	1	32-74	1.51	<MDC	0.4	<MDC	3.0E-04	0.0E+00	1.0E-03	6.0E-04	0.0E+00	3.0E-03	6.0E-04	1.0E-03	8.0E-04	1.0E-04	-5.0E-04	5.0E-04	1.0E-03
	SAS	1	30-60	1.51	<MDC	0.4	<MDC	3.0E-04	0.0E+00	5.0E-04	6.0E-04	0.0E+00	3.0E-03	6.0E-04	1.0E-03	7.0E-04	1.0E-04	-3.0E-04	6.0E-04	1.0E-03

Table 2.8-23: Baseline Radiological Analysis of Whole Fish (Continued)

Site	Species	Number	Length[a] mm	Sample Weight[b] (g)	U				Po-210			Pb-210			Th-230			Ra-226		
					Conc.[c] mg/kg	RL (LLD) mg/kg	Conc.[c] uCi/kg	RL (LLD) uCi/kg	Conc. uCi/Kg	Precision (±) uCi/Kg	RL (LLD)	Conc. uCi/Kg	Precision (±) uCi/Kg	RL (LLD)	Conc. uCi/Kg	Precision (±) uCi/Kg	RL (LLD)	Conc. uCi/Kg	Preci-ion (±) uCi/Kg	RL (LLD)
BVC 01 July	FHM	5	42-67	~8	0.026	0.0050	1.8E-05	3.4E-06	4.0E-04	2.3E-04	9.3E-05	1.4E-03	3.6E-03	6.0E-03	-1.2E-05	6.2E-05	1.9E-05	-2.2E-04	1.2E-04	2.9E-04
	PLT	5	48-71	12	0.021	0.0050	1.4E-05	3.4E-06	3.5E-04	2.8E-04	1.1E-04	-2.0E-03	4.2E-03	7.1 E-03	1.0E-04	1.0E-04	2.2E-05	-2.0E-04	1.1E-04	2.7E-04
	PLK	5	57-71	9	0.035	0.0050	2.4E-05	3.4E-06	4.7E-04	3.1E-04	1.1E-04	1.2E-03	4.2E-03	7.1E-03	5.7E-06	1.0E-04	2.2E-05	-2.0E-04	1.lE-04	2.8E-04
	SAS	5	46-62	7	0.031	0.0050	2.1E-05	3.4E-06	2.3E-04	2.6E-04	1.6E-04	3.8E-03	6.1E-03	1.0E-02	9.8E-05	1.6E-04	3.2E-05	-3.0E-04	1.6E-04	4.0E-04
	CAP	1	171	73	0.0098	0.0050	6.7E-06	3.4E-06	7.8E-04	1.9E-04	5.0E-05	7.6E-05	5.0E-04	8.4E-04	-7.4E-07	9.2E-06	2.6E-06	-2.3E-05	1.6E-05	3.6E-05
BVC 04 July	SAS	5	45-58	~6.7	0.024	0.0050	1.6E-05	3.4E-06	5.4E-04	5.4E-04	1.1E-04	6.4E-04	4.4E-03	7.3E-03	2.7E-05	1.0E-04	2.3E-05	-7.7E-05	1.3E-04	2.5E-04
	SRS	1	136	130	0.0072	0.0050	4.9E-06	3.4E-06	1.7E-04	1.0E-04	5.0E-05	I.2E-04	1.2E-03	2.0E-03	1.9E-06	2.3E-05	6,3E-06	-3.7E-05	3.2E-05	6.9E-05
	FHM	5	42-61	~3.7	0.031	0.0050	2. 1E-05	3.4E-06	1.8E-04	3. 1E-04	1.2E-04	7.9E-04	4.7E-03	7.9E-03	-1.2E-05	6.9E-05	2.5E.05	-1.2E-04	1.6E-04	3.2E-04
	PLK	5	48-68	~7.2	0.019	0.0050	1.3E-05	3.4E-06	8.5E-05	1.3E-04	1.2E-04	3.2E-03	4.7E-03	7.8E-03	9.4E-05	9.1E-05	2.4E-05	-2.1E-04	1.1E-04	2.8E-04
	CAP	1	260	237	0.014	0.0050	9.4E-06	3.4E-06	1.6E-04	7.1E-05	4.0E-06	9.2E-05	1.5E-04	2.6E-04	2.3E-06	3.7E-06	8.0E-07	-4.8E-06	4.2E-06	9.1E-06
CHR 05 July	SAS	5	42-60	~1.5	0.04	0.0050	2.7E-05	3.4E-06	4.9E-04	3.2E-04	1.4E-04	4.5E-03	5.3E-03	8.8E-03	1.4E-04	1.1E-04	2.7E-05	-2.8E-04	1.5E-04	3.8E-04
	FHM	5	38-60	~0.7	0.024	0.0050	1.6E-05	3.4E-06	4.2E-04	2.8E-04	1.1E-04	1.5E-03	4.3E-03	7.2E-03	1.3E-05	4.5E-05	2.2E-05	-2.1 E-04	1.3E-04	3.0E-04
	PLK	4	46-68	~7.4	0.017	0.0050	1.2E-05	3.4E-06	4.7E-04	3.5E-04	1.7E-04	-1.8E-03	6.5E-03	1.lE-02	1.6E-05	8.9E-05	3.4E-05	-2.2E-04	1.9E-04	4. 1E-04
	SRS	2	146-160	78	0.0066	0.0050	4.4E-06	3.4E-06	5.0E-04	1.3E-04	1.3E-05	2.3E-04	4.9E-04	8.1 E-04	3.2E-06	5.3E-06	2.5E-06	-8.7E-05	1.8E-05	3.4E-05
	CAP	1	135	31	0.01	0.0050	6.9E-06	3.4E-06	7.4E-04	2.2E-04	3.1E-05	1.5E-04	1.2E-03	2.0E-03	1.7E-05	2.7E-05	6.1E-06	-6.4E-05	4.4E-05	1.0E-04
	CHC	3	181-290	265	0.017	0.0050	1.2E-05	3.4E-06	1.6E-04	5.2E-05	3.5E-06	3.2E-05	1.4E-04	2.3E-04	9.0E-06	2.6E-05	7.0E-07	-1.6E-06	4.4E-06	8.4E-06
	RIC	4	381-415	5150	0.031	0.0050	2.1E-05	3.4E-06	6.6E-07	3.2E-06	2.7E-06	1.1E-05	1.0E-04	1.7E-04	-1.3E-05	2.3E-05	5.3E-07	8.0E-06	5.4E-06	7.3E-06

Notes:

GRS = Green Sunfish, PLK = Plains Killifish; LND = Longnosed Dace; RIC = River Carpsucker; FHM = Fathead Minnow; CHC = Channel Catfish; SRS = Shorthead Redhorse Sucker; CRC = Creek Chub; SAS = Sand Shiner. U = Uranium; Po = Polonium; Pb = Lead; Th = Thorium; Ra = Radium. [a]Lengths reported as a range when multiple specimens were combined as a composite sample, or when the individual processed for radiology was not recorded separately. [b]Approximate sample weights from field average weights for the species measured in the field. [c]MDC = minimum detectable concentration = RL (reporting limit) in this case.

TR RAI RI-4
Sampling and analysis results

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

TR RAI RI-4(b)

b. In Table 2.9-16 and 2.9-17 of the Technical Report, no LLD or error values are given for ground water.

Needed: For all radiological data reported, the applicant should address Regulatory Guide 4.14, Section 7.0 (Recording and Reporting Results), recommendations regarding LLD, error, and other quality assurance provisions.

TR RAI RI-4(b) Response

Tables 2.9-16 and 2.9-17 have been replaced with the tables provided in Appendix 2.9-J to this RAI response package. The revised tables will be incorporated into the revised TR. The revised tables include the value, precision and MDC format, where available (see discussion below), and other information to meet the format detailed in Table 2.9.3-1 of NUREG-1569. Where the earlier reporting format was used by the laboratory and where a result was reported as non-detect, a less than sign and the reporting limit are provided in the summary tables.

Analytical data provided by the contracting laboratory during the early part of Powertech's baseline study were reported in a "not detected (ND) at reporting limit (RL)" format. During the course of the baseline study, the contracting laboratory, Energy Laboratories, Inc., implemented the Multi-Agency Radiological Laboratory Analytical Protocols (MARLAP) process. Analytical data derived from the MARLAP process are reported in a "value, precision and minimum detectable concentration (MDC)" format. Energy Laboratories, Inc. has advised Powertech that it is not possible to reprocess earlier ND/RL data into the value/precision/MDC format (value/error/LLD format) referenced in Regulatory Guide 4.14. As a result, both reporting formats, the earlier ND/RL and the later value/precision/MDC format, appear in Powertech's water quality radiological summary tables and laboratory analytical data packages.

Laboratory data packages for groundwater samples are provided in Appendix 2.7-H to this response package.

TR RAI RI-4
Sampling and analysis results

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

TR RAI RI-4(c)
In Table 2.9-5 of the Technical Report, LLD values for soil samples are not provided.

Needed: For all radiological data reported, the applicant should address Regulatory Guide 4.14, Section 7.0 (Recording and Reporting Results), recommendations regarding LLD, error, and other quality assurance provisions.

TR RAI RI-4(c) Response
Powertech will revise Table 2.9-5 in the revised TR to include the LLDs for radionuclide concentrations in soil. The LLD values for data presented in Table 2.9-5 are summarized in Section 2.9.3.2.1 of the TR.

TR RAI RI-4
Sampling and analysis results

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

TR RAI RI-4(d)

d. The results for sediment samples in Tables 2.9.8 and 2.9.9 of the Technical Report do not fully address reporting recommendations for LLD, error and quality assurance.

Needed: For all radiological data reported, the applicant should address Regulatory Guide 4.14, Section 7.0 (Recording and Reporting Results), recommendations regarding LLD, error, and other quality assurance provisions.

TR RAI RI-4(d) Response

Tables 2.9-8 and 2.9-9 provide the radionuclide concentrations measured in stream sediment samples collected during the baseline monitoring program and by TVA between 1975 and 1977, respectively. Analytical reports for the baseline monitoring results included in Appendix 2.9-A included the error and LLD associated with each concentration. To meet the recommendations of Regulatory Guide 4.14, Section 7.0, Table 2.9-8 has been replaced with the summary table provided in Appendix 2.9-K to this response package. The revised table includes the error and LLDs associated with each concentration. The revised table and analytical reports will be included in the revised TR. Historical TVA data will be reviewed after submittal of this response package to determine if error estimates and LLDs are available. If so, Table 2.9-9 will be updated in the revised TR.

TR RAI RI-4
Sampling and analysis results

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

TR RAI RI-4(e)

e. ***In Table 2.9-12 of the Technical Report, LLD values for the radionuclide concentrations in air are reported. However, the LLD values are not reported on the corresponding laboratory report and NRC staff cannot locate the method of deriving these LLD values in the Technical Report.***

Needed: For all radiological data reported, the applicant should address Regulatory Guide 4.14, Section 7.0 (Recording and Reporting Results), recommendations regarding LLD, error, and other quality assurance provisions.

TR RAI RI-4(e) Response

The LLDs reported in Table 2.9-12 of the TR were derived by dividing the reported MDC or RL on the analytical report in units of activity per filter composite by the total volume of air in milliliters that was sampled for that period. For natural uranium, the mass per filter composite was converted to activity per filter composite by multiplying the mass result from the laboratory by 677 (pCi/mg), the specific activity for natural uranium. As described and provided in the response to TR RAI 2.9-5, Powertech has revised Table 2.9-12 to reflect the correct collection periods. The updated table will also be included in the revised TR.

<u>TR RAI RI-5</u>
Reporting format of radiological sample results.

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

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

<u>TR RAI RI-5 Response</u>

Please refer to the response to TR RAI RI-4(a-e). Powertech has revised the tables presenting radionuclide concentrations and included the revised tables in this response package. The revised tables also will be incorporated into the revised TR. All revised tables report measured values, error estimates, and LLDs for radionuclides, where these data are available (please refer to the response to TR RAI RI-4(b)). The only exception is the analysis of natural uranium, which was performed by the laboratory using an ICP-MS. Because of the method of measurement, some uranium concentrations are reported as less than the reporting limit (RL) or minimum detectable concentration (MDC).

Miscellaneous Issues

TR RAI MI-1

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

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

Needed: Provide information as requested.

TR RAI MI-1(a)

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

TR RAI MI-1(a) Response

This response identifies those chemicals used in uranium processing that have the potential to impact radiological safety. The information provided with this response will be incorporated into the revised TR.

The chemicals to be utilized in uranium processing at the project are listed in Table TR RAI MI-1a-1. The potential for any of these chemicals to impact radiological safety is variable in likelihood and consequence. Chemicals that have the potential to impact radiological safety include hydrochloric acid, sulfuric acid, hydrogen peroxide, and sodium hydroxide. Oxygen, because of its ability to support combustion, also requires special handling. In all instances, process controls and preventative safety measures minimize the risk of increased radiological exposure or release. Each chemical storage and feeding system will be designed to safely store and accurately deliver process chemicals to the process delivery points. All chemical storage tanks will be clearly labeled to identify contents. Design criteria for chemical storage and feeding systems include applicable regulations of the International Building Code (IBC), National Fire Protection Association (NFPA), Compressed Gas Association (CGA), Occupational Safety and Health Administration (OSHA), Resource Conservation and Recovery Act (RCRA), and the Department of Homeland Security (DHS). Designing, constructing, and maintaining chemical storage facilities in accordance with applicable regulations will help ensure the safety of Powertech employees and members of the public, both with regard to the specific chemicals and with regard to the potential release of radioactive materials in the event of an accident.

Any negative impact to radiological safety from use of these chemicals would be due to accidents, improper use, or human error. Nevertheless, these chemicals would only indirectly cause a radiological hazard as they do not contain radiological materials themselves. Chemicals that have the potential to impact radiological safety and that are stored at each location are as follows:

- At the CPP, the chemicals include sulfuric and/or hydrochloric acid, hydrogen peroxide, and sodium hydroxide. Of these, only hydrogen peroxide presents a fire hazard if it comes in contact with combustible materials. These chemicals are corrosive and reactive. Areas within the CPP and chemical storage areas will be provided with secondary containment consisting of concrete curbs around the floor perimeters. Curbs will also divide areas to prevent mixing of incompatible fluids in the event of a leak or spill. Concrete floors, secondary containment, and sumps in areas where corrosive fluids could be spilled will be coated with corrosion resistant materials as recommended by the manufacturer. Thickeners will be plain carbon steel construction lined with chlorobutyl or bromobutyl rubber and capable of operating at 175° F in a highly acidic environment. Elastomeric linings will also be used to resist abrasion from the slurries in these tanks. All slurry piping will use materials that are abrasion and corrosion resistant and solution piping will be appropriately corrosion resistant. Tanks holding process solutions will be constructed from FRP using resins and liners appropriate to the conditions as recommended by the manufacturers.
  - The hydrogen peroxide system will include a storage tank and delivery pump. The hydrogen peroxide storage tank will be located in the chemical storage area outside the CPP and will be isolated from acid storage areas. The site will have storage facilities for 7,000 gallons (70,000 pounds) of 50% H_2O_2. The hydrogen peroxide storage tank will be in a concrete secondary containment basin designed to contain at least 110% of the tank volume. Hydrogen peroxide is a strong oxidizer, can be very reactive and is easily decomposable. Its hazardous decomposition products include oxygen, heat, and steam.
  - Sulfuric acid and/or hydrochloric acid will be used in the precipitation circuit of the CPP to break down the uranium carbonate complexes. The hazards associated with use and storage of these acids include corrosiveness, toxicity to tissue, and reactivity with other chemicals at the project such as sodium carbonate and water. Acid storage tanks will be isolated from the above listed chemicals to reduce the risk of reactions. The acid storage and feeding system will include one or more storage tanks and delivery pumps. The storage tank will be located adjacent to the CPP in the chemical storage area. The chemical storage area will include a lined concrete secondary containment basin designed to contain at least 110% of the largest tank volume. This secondary containment basin for acid storage will be separate from the containment basins for other chemical systems. Sulfuric acid will be purchased and stored as standard commercial grade concentrated acid (approximately 93% H_2SO_4 by weight). The storage tank will be made either of carbon steel or ultra-high-molecular-weight, cross linked polyethylene. Piping and pump material will be chosen based on compatibility. The freezing point of 93% sulfuric acid is approximately -28.9°C (-20°F); therefore, freeze protection of the storage tank and outside piping (insulation and heat tracing) will be used. Powertech will develop and implement an emergency response plan and emergency notification procedures in the event of an accidental release.
  - The sodium hydroxide system will include a storage tank and delivery pump. The storage tank will be located adjacent to the CPP in the chemical storage area in a concrete secondary containment basin designed to contain at least 110% of the tank volume. This secondary containment basin will be separate from the containment basins for other chemical systems. Sodium hydroxide will be purchased as aqueous caustic soda and will be pumped directly into the storage tank from the supplier's tanker trucks.

- At the Dewey Satellite Facility, none of the chemicals listed above will be present. The only chemicals to be stored and used at the Satellite Facility will be relatively small quantities of RO pretreatment chemicals such as antiscalant.
- Liquid oxygen will be present within the well fields. The primary hazard associated with oxygen is fire since it is a strong oxidizer in the presence of combustible materials. To reduce the risk of an accident that could potentially affect other processes or storage facilities and radiological safety, oxygen will be stored near the well fields, so that in the event of an accidental release the gas would disperse and not cause a fire hazard to project equipment or infrastructure. Where above-ground oxygen storage or conveyance facilities exist, barriers will be used to prevent impacts from mobile equipment. Oxygen conveyance pipelines will be surveyed and marked with tracer wire to make them locatable by field personnel during excavation activities. A fire within a header house, where the oxygen is metered into separate injection lines, could damage equipment and instrumentation within the header house but would be unlikely to result in a spill of injection or recovery fluids. If a spill of lixiviant were to occur, well field personnel will have been trained in emergency procedures for responding to well field spills containing radiological materials. Oxygen will be stored in storage vessels designed, fabricated, tested, and inspected in accordance with the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code. Oxygen storage vessels will be equipped with safety relief devices and will be located at least 25 feet from buildings or as required by applicable NFPA and OSHA standards. Oxygen will be delivered and stored as a cryogenic liquid and then conveyed to the injection point (either upstream of the injection manifold within the header house or at each well head) as a gas through piping made from appropriate materials. Oxygen storage and delivery systems will be designed and fabricated in accordance with NFPA 55 and OSHA standards for the installation of bulk oxygen systems on industrial premises (29 CFR 1910.104). To reduce the risk of an accident which could potentially affect other processes or storage facilities and radiological safety, oxygen will be stored a sufficient distance from other infrastructure and storage areas. Facilities used to store oxygen will conform to standards detailed in NFPA 55. Typically, oxygen storage and dispensing systems will be leased from the bulk oxygen vendor. Conveyance systems for oxygen will be clean of oil and grease because these substances will burn violently if ignited in the presence of oxygen. The proper pressure relief devices, component isolation and barriers will also be employed. Cleaning of equipment used for delivering and storing oxygen will be done in accordance with CGA G4.1. The design and installation of the oxygen piping system will be done according to the requirements of CGA G4.4. Powertech will develop procedures that implement emergency response instructions for a spill or fire involving oxygen systems.
- The storage facilities for liquid phase chemicals will be within or adjacent to the CPP. The storage site for oxygen, as a cryogenic liquid, will be in the vicinity of the operating well fields. Refer to the response to TR RAI MI-1(b).

Potential non-radiological accident impacts include high consequence chemical release events for both workers and nearby populations. The likelihood of such release events would be low based on historical operating experience at NRC-licensed facilities, primarily due to operators following commonly-applied chemical safety and handling protocols. The overall potential impact to public and occupational health

and safety of ISR operations that utilize these chemicals has been determined to be SMALL to MODERATE (NUREG-1910, v2, p. xliii).

Table TR RAI MI-1a-1: Process-related Chemicals and Quantities Stored On-site

Burdock CPP and Well Fields					
Chemical Name	**No. Tanks**	**Unit Storage Capacity**	**Units**	**Usage Rate ton/yr**	**Hazard Classification**
Sodium Chloride (NaCl)	2	20,000	gal	2,250	Non-flammable
Sodium Carbonate (Na_2CO_3) i.e., Soda Ash	1	20,000	gal	450	Non-flammable
Hydrochloric Acid (HCl, 32%, or Sulfuric Acid (H_2SO_4 93%)	1	7,000	gal	487	Toxic, reactive, corrosive
Sodium Hydroxide (NaOH 50%)	1	7,000	gal	446	Toxic, reactive, corrosive
Hydrogen Peroxide (H_2O_2 50%)	1	7,000	gal	177	Oxidizer, irritant, corrosive
Oxygen (O_2, liquid)	1	11,000	gal	979	Cryogenic, oxidizer
Carbon Dioxide (CO_2)	1	6,000	gal	245	Asphyxiant, freezing hazard
Barium Chloride ($BaCl_2$)	1	275	50-kg sacks	7	Toxic, non-flammable
Dewey Satellite Facility and Well Fields					
Oxygen (O_2, liquid)	1	11,000	gal	653	Cryogenic, oxidizer
Carbon Dioxide	1	6,000	gal	163	Asphyxiant, freezing hazard
Barium Chloride	1	138	50-kg sacks	7	Toxic, non-flammable

<u>TR RAI MI-1</u>

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

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

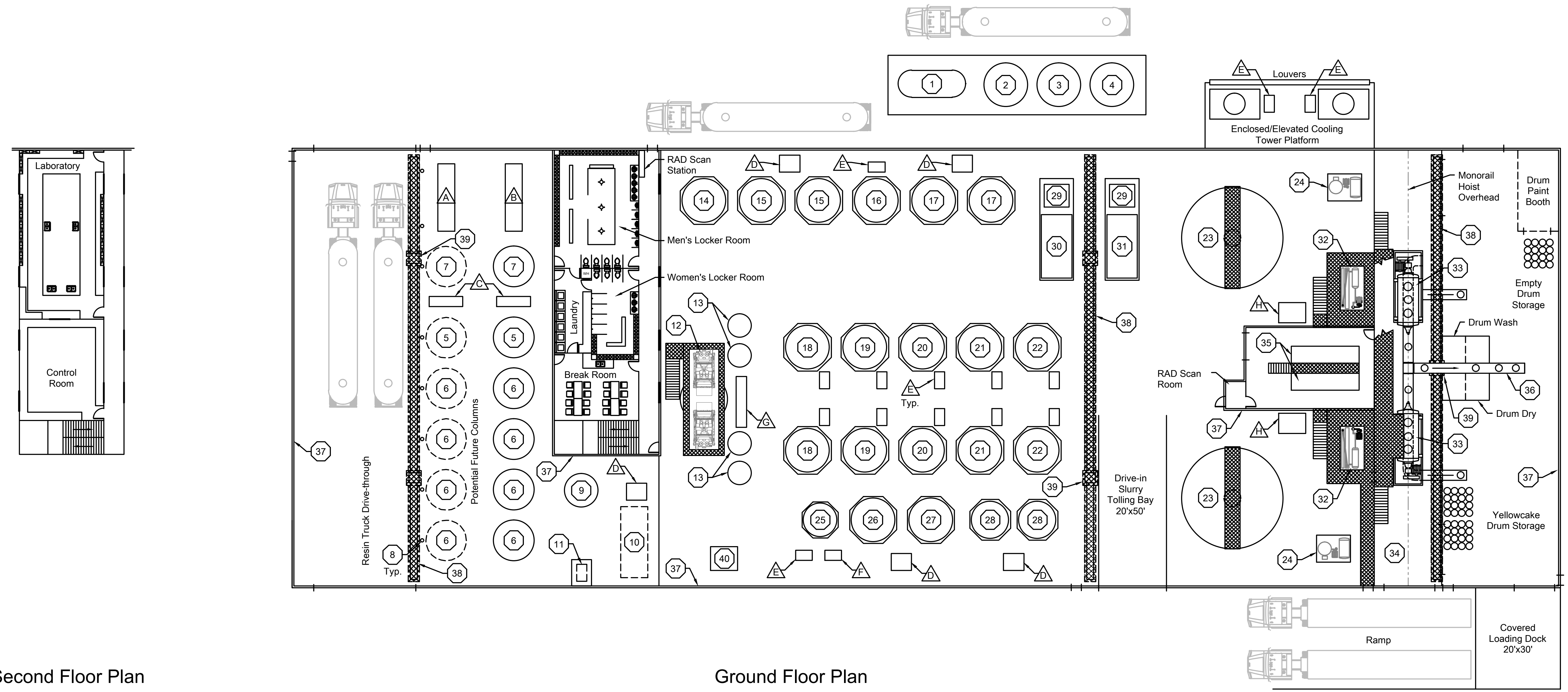
<u>TR RAI MI-1(b)</u>

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

Needed: Provide information as requested.

<u>TR RAI MI-1(b) Response</u>

TR Figures 3.2-4 and 3.2-5 have been revised and enlarged to show the storage locations of all chemicals used in uranium processing, with the exception of oxygen. The revised figures are included with this response package and also will be included in the revised TR. For a list of chemicals, refer to Table TR RAI MI-1a-1 provided in the response to TR RAI MI-1(a). Barium chloride will be stored as palletized sacks at the locations shown on Figures 3.2-4 and 3.2-5. Oxygen will be stored as cryogenic liquid in tanks located in the well field areas. Oxygen storage tanks will be located near but at a safe distance from header houses as required by NFPA and OSHA standards. Figures TR RAI MI-1b-1 and TR RAI MI-1b-2 depict the potential oxygen storage tank locations for the Burdock and Dewey initial well fields, respectively. Please refer to the response to TR RAI MI-1(a) for additional information about the safe storage of oxygen.



Second Floor Plan

Ground Floor Plan

Key Notes

1. CO_2
2. NaOH
3. H_2SO_4
4. H_2O_2
5. Reclamation IX Column 12'Ø
6. Process IX Column 12'Ø
7. Bleed IX Column 12'Ø
8. Pipe Bollard Guard Post
9. Resin Transfer Water 10'Ø
10. Resin Supersack Storage
11. Standby Generator in Sound Insulated Room
12. Shaker Screens with Shaker Overflow Collection Tank Below
13. Elution Column 7'Ø
14. Reclamation Make-up Water 13'Ø
15. NaCl 13'Ø
16. Na_2CO_3 13'Ø
17. Utility Water 13'Ø
18. Fresh Eluant 13'Ø
19. Lean Eluant 13'Ø
20. Intermediate Eluant 13'Ø
21. Rich Eluant 13'Ø
22. Precipitation 13'Ø
23. 30'Ø Thickener, 5'Ø Shear Tank Below
24. Hot Oil Boiler
25. Potable Water 10'Ø
26. High TDS Wastewater Tank 13'Ø
27. Low TDS Wastewater Tank 13'Ø
28. Solids Removal Tank 11'Ø
29. RO Pre-treatment
30. Recovery RO Unit
31. Restoration RO Unit
32. Elevated Condenser/Vacuum Pump Skid 7'x13'
33. Vacuum Dryer 8'x24'
34. Dryer Room 20'x130'
35. Filter Press and Transfer Pump 5'x20'
36. Drum Conveyor
37. 6" Curb Off All Walls, Typ.
38. 2'-0" Trench Drain, Typ.
39. 3'-0" Sump, Typ.
40. Barium Chloride Storage

Housekeeping Pads

- A 5'x20' - PC Booster Pumps
- B 5'x20' - IC Booster Pumps
- C 3'x10' - Pump
- D 6'x5' - Pump
- E 3'x5' - Pump
- F 3'x5' - Disinfectant
- G 3'x15' - Pump
- H 6'x8' - Pump

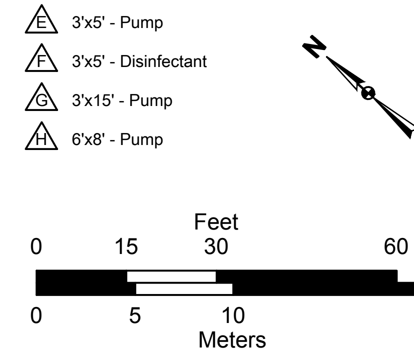


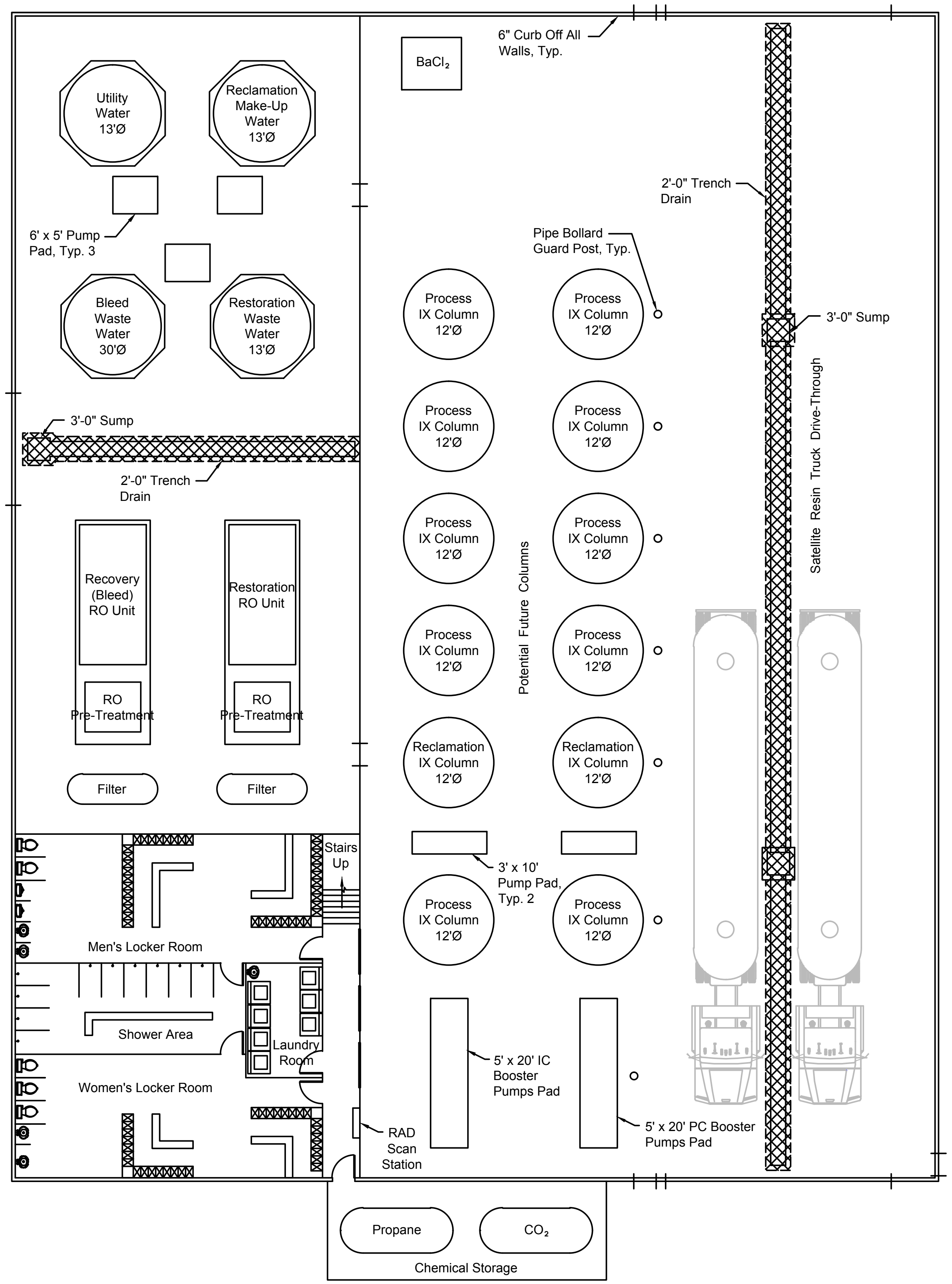
Figure 3.2-4

Central Processing Plant Detail

Dewey-Burdock Project

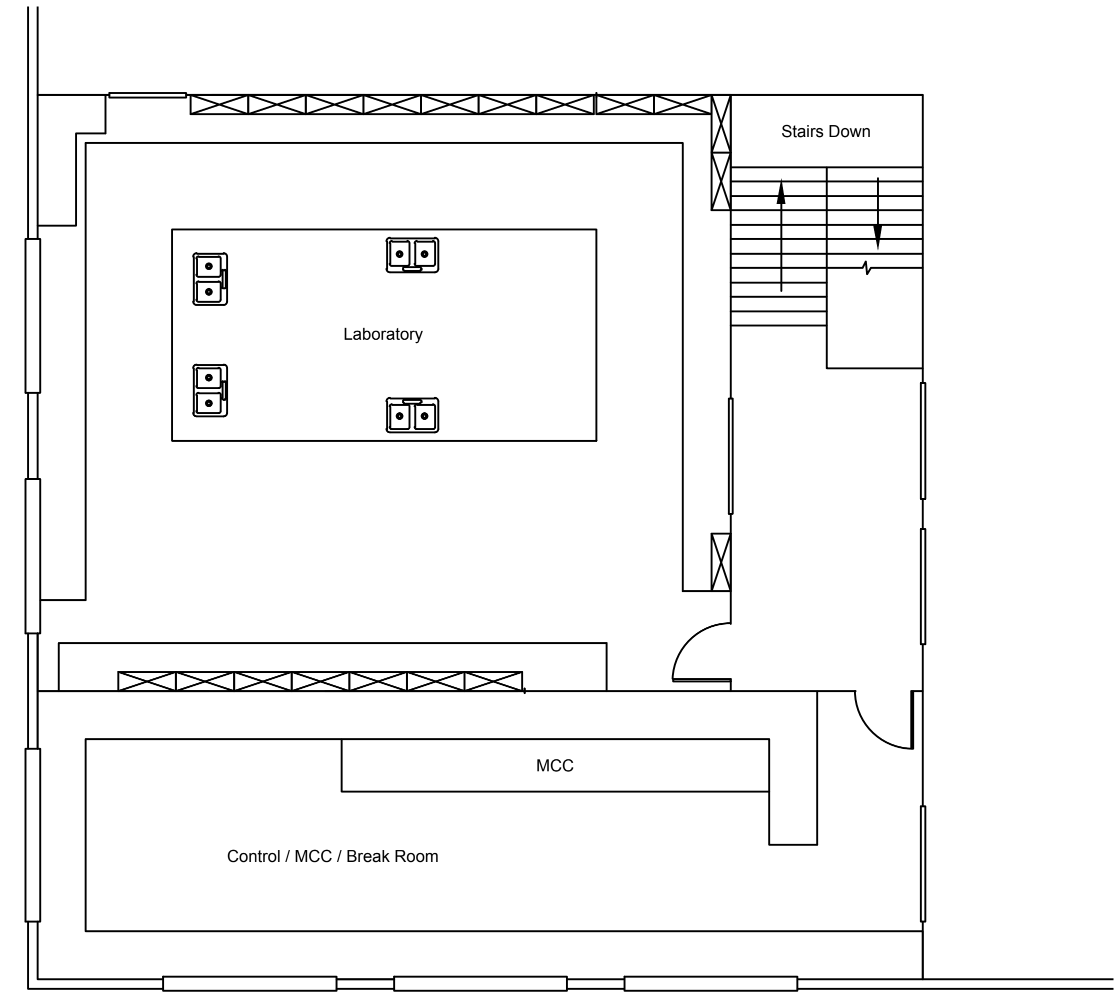
DRAWN BY	Cadd Svcs, Hetrick
DATE	10-Jun-2011
FILENAME	Figure 3.2-4.dwg

POWERTECH (USA) INC.



Ground Floor Plan

Feet: 0 10 20 40
Meters: 0 5 10



Second Floor Plan

Feet: 0 5 10 20
Meters: 0 2 4 6

N

Figure 3.2-5

Satellite Processing Plant Detail

Dewey-Burdock Project

DRAWN BY	Cadd Svcs, Hetrick
DATE	10-Jun-2011
FILENAME	Figure 3.2-5.dwg

POWERTECH (USA) INC.

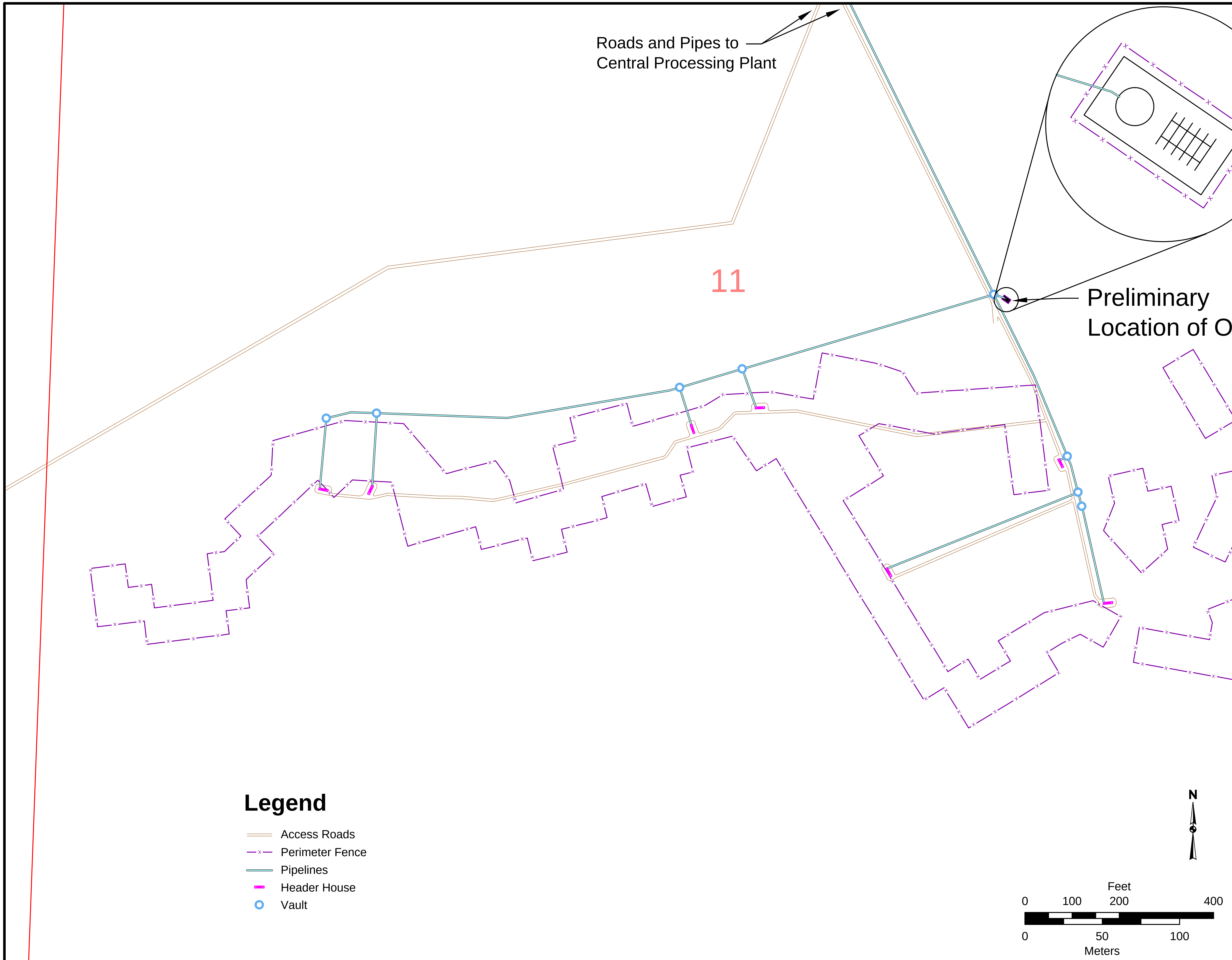


Figure TR RAI MI-1b-1

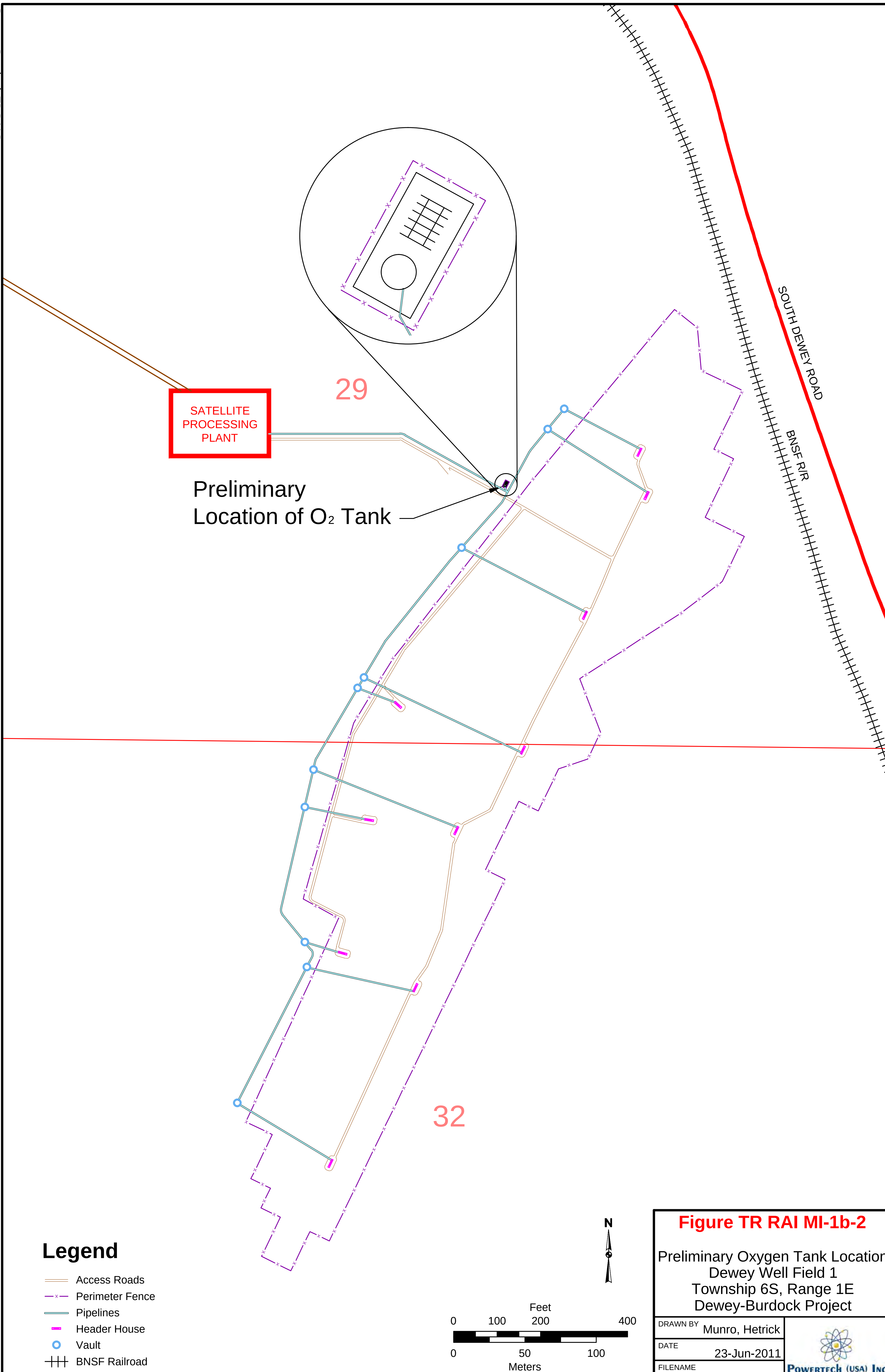
Preliminary Oxygen Tank Location
Burdock Well Field 1
Township 7S, Range 1E
Dewey-Burdock Project

DRAWN BY Munro, Hetrick

DATE 23-Jun-2011

FILENAME Figure TR RAI MI-1b-1.dwg

POWERTECH (USA) INC.


SOUTH DEWEY ROAD
BNSF R/R
29
SATELLITE PROCESSING PLANT
Preliminary Location of O2 Tank
32
Legend
Access Roads
Perimeter Fence
Pipelines
Header House
Vault
BNSF Railroad
N
Feet
0 100 200 400
0 50 100
Meters
Figure TR RAI MI-1b-2
Preliminary Oxygen Tank Location
Dewey Well Field 1
Township 6S, Range 1E
Dewey-Burdock Project
DRAWN BY Munro, Hetrick
DATE 23-Jun-2011
FILENAME Figure TR RAI MI-1b-2.dwg
POWERTECH (USA) INC.

<u>TR RAI MI-1</u>

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

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

<u>TR RAI MI-1(c)</u>

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

Needed: Provide information as requested.

<u>TR RAI MI-1(c) Response</u>

The acid storage tank will be located outside the CPP as shown in updated Figure 3.2-4, which has been revised and enlarged to indicate clearly the acid storage tank location. This figure is provided with the response to TR RAI MI-1(b). The acid storage tank will be vented directly to the atmosphere and not through the roof of the CPP. TR Section 3.2.8 will be revised to correct this inconsistency by noting that the acid tank will be vented directly to the atmosphere.

<u>TR RAI MI-2</u>

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

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

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

<u>TR RAI MI-2 Response</u>

TR Section 3.2.6 will be revised to reflect the following discussion.

Powertech will operate in conformance with 10 CFR Part 40, Appendix A, Criterion 8 to assure that all airborne effluent releases are ALARA. Powertech proposes use of a non-emissions vacuum dryer, which has no exhaustible effluent and therefore no stack or stack emissions. According to NUREG-1910 (Table 7.4-1), use of vacuum dryers is a listed Best Management Practice.

The principles of Criterion 8 regarding hourly monitoring and logging to ensure the vacuum dryer is operating near or at peak efficiency will be followed. Also, the principles in Regulatory Guide 3.56 regarding routine equipment inspections on the ventilation and effluent control equipment will be implemented to ensure redundant safety protocol.

Powertech staff will perform a manual check of the vacuum alarm before each packaging event. Efficiency monitoring instrumentation will be installed that activates an audible alarm at the dryer and in the CPP control room if the air pressure (i.e., vacuum level) falls below the specified threshold. The vacuum level will be monitored hourly or more frequently during dryer operations.

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

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

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

TR RAI MI-3 Response
The TR will be revised to incorporate the following discussion.

Loss of power to the project site will cause production wells to stop operating, resulting in shutdown of all production and injection flows. This condition avoids flow imbalance within the well fields, but a well field bleed would not be maintained during the power failure. The time span for the aquifer to recover from operational drawdown back to its natural groundwater gradient is much longer than the duration of a typical power outage. Since lixiviant would not begin to travel to the monitoring ring until the cone of depression caused by the bleed had recovered and groundwater had returned to its natural gradient, excursions are very unlikely within the short time period of a typical power outage.

The likelihood of a long-duration regional power outage has been considerably reduced by passage of the Energy Policy Act of 2005. This act created the North American Electric Reliability Corporation (NERC) to develop and enforce compliance with mandatory reliability standards in the U.S. NERC's standards are mandatory and enforceable throughout the 50 United States and several provinces in Canada. The major interconnections which cover most of the continental U.S. and Canada include the Eastern Interconnection (most of eastern North America) and the Western Interconnection (Rocky Mountains to the Pacific Coast). The Eastern Interconnection is tied to the Western Interconnection via high voltage DC transmission facilities.

The Dewey-Burdock project area is in the Western Interconnection, but very close to the boundary between the Eastern and Western Interconnections. Because of the reliability added since NERC was created, it is difficult to conceive of a natural event that would cause loss of electric power for an extended period of time. Tornadoes, blizzards or freezing rain can knock out power generating or transmitting facilities. Transmission facilities can be replaced fairly quickly (relative to groundwater flow rates) and power sources can be substituted through the NERC interconnection.

Thus, power outages in the project area would not be likely to last more than a few days or weeks under most conceivable scenarios. The project area is in fairly close proximity to the Powder River Basin area in northeastern Wyoming, home to several coal-fired and gas turbine generating facilities and industrial

activities including oil and gas production and very large surface coal mines. Proximity to this region would facilitate acquisition of portable generators to keep the CPP and well field facilities operating until normal power supplies could be restored. Powertech would contract for temporary generators to operate well field pumps sufficient to maintain a cone of depression within the well field if unforeseen power outages occur with expected duration of more than a few weeks. Two or more small portable generators would provide sufficient energy to maintain a bleed sufficient to prevent excursions.

Backup generators will be installed to maintain continuous instrumentation monitoring and alarms in the CPP, Satellite Facility, and well fields. Backup power will also be provided for lights and emergency exits.

Shutdown due to power failure during winter months is not expected to be problematic because well field pipelines will be buried below the frost line. Heating of the Satellite Facility and CPP will use propane or natural gas and will require little or no power to operate.

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

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

TR RAI MI-4(a)

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

Needed: Provide information related to financial assurance as requested.

TR RAI MI-4(a) Response
TR Section 1.12 will be revised to incorporate the following discussion.

By this response, Powertech commits to supplying a financial assurance mechanism in a form and in an amount approved by NRC staff in accordance with 10 CFR Part 40, Appendix A, Criterion 9 prior to the commencement of operations. Powertech is required to supply financial assurance cost estimates for NRC staff approval for construction and the first year of operations based on best available information, including contractor and material costs, using standard industry practices (Hydro Resources, Inc., 51 NRC 227, May 25, 2000). However, based on the Commission's decision, Powertech is not required to commit to a specific financial assurance instrument during the license application review process, nor is it required to supply the actual financial assurance instrument for the proposed cost estimates prior to the commencement of licensed activities. Thus, while Powertech is planning on using an irrevocable letter of credit, it is premature to commit to a specific financial assurance instrument at this time.

<u>TR RAI MI-4</u>
Additional financial assurance information needs to be provided.

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

<u>TR RAI MI-4(b)</u>

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

Needed: Provide information related to financial assurance as requested.

<u>TR RAI MI-4(b) Response</u>
Powertech submitted detailed financial assurance cost estimates in its initial license application in 2009. Powertech commits to updating these cost estimates prior to commencement of licensed activities at the Dewey-Burdock Project. The financial assurance cost estimates in the application are based on best available information and standard industry practices in the year of license application and are included for license review. To clarify the information provided in the TR, Powertech is providing revised Table 6.6-1, which summarizes the financial assurance cost estimates for the Dewey-Burdock Project based on 2009 information.

Revised Table 6.6-1 will be included in the revised TR as a replacement for previously submitted Tables 6.6-1 and 6.6-2. Revised Table 6.6-1 summarizes the revised financial assurance cost estimates provided in revised TR Appendix 6.6-A, which is also included with this RAI response package and will be included with the revised TR.

All of the financial assurance information contained in the license application as well as the information in revised Table 6.6-1 and Appendix 6.6-A will be consolidated into a restoration action plan (RAP), which will be submitted as part of the revised TR.

Powertech will revise these financial assurance cost estimates after license issuance based on NRC approval of the methodologies for cost estimate calculations. In the event that additional factors are utilized for adding or subtracting from NRC-approved cost estimates, Powertech will provide a written explanation of such factors when submitting revised cost estimates after license issuance.

Table 6.6-1: Summary of Financial Assurance Amounts

No.		Financial Assurance Estimate - Dewey-Burdock Project Description	Table Referenced in App. 6.6-A	Disposal Option	
				Disposal wells	Land application
1		Facility Decommissioning			
	A	Salvageable equipment	9	$ 242,000	$ 242,000
	B	Non-salvageable building & equipment disposal	9,13	$ 710,080	$ 1,123,580
	C	11e.(2) byproduct material disposal	6	$ 466,609	$ 527,831
	D	Restore contaminated areas	9	$ 570,300	$ 1,429,100
2		O&M - Aquifer Restoration and Stability Monitoring			
	A	Method: RO treatment with permeate injection	O&M	$ 897,873	
	B	Method: Groundwater sweep with Madison injection	O&M		$ 555,700
3		Well Field Reclamation			
	A	Well plugging & closure	8, 14	$ 751,300	$ 751,300
	B	Remove surface equipment & reclaim	9	$ 975,050	$ 975,050
4		Radiological Survey and Environmental Monitoring	10	$ 10,300	$ 24,400
5		Project Management Costs & Miscellaneous	12	$ 968,700	$ 968,700
6		Labor, 35% overhead + 10% contactor profit	11	$ 1,337,000	$ 1,337,000
7		Contingency @ 15%		$ 1,039,382	$ 1,190,199
Total Financial Assurance Amount				$ 7,968,594	$ 9,124,861

<u>TR RAI MI-4</u>
Additional financial assurance information needs to be provided.

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

<u>TR RAI MI-4(c)</u>

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

Needed: Provide information related to financial assurance as requested.

<u>TR RAI MI-4(c) Response</u>
The following information will be incorporated into the revised TR.

The requested detailed cost factors and tables are provided in a revised TR Appendix 6.6-A, which is included in this RAI response package. Pages 3 and 4 of this appendix provide a summary of costs by year for the deep disposal well option and the land application option, respectively. The financial assurance model is based on the Dewey-Burdock Project being in operation for one full year prior to a third party taking over reclamation of the facility. Reclamation would include facility decommissioning, groundwater restoration, stability monitoring, well field reclamation, soil reclamation, and radiological surveys. The by-year costs are based on year 1 being the pre-operational construction phase, year 2 the full year of ISR operations, and year 3 the beginning of the financial assurance-funded reclamation activities. Groundwater restoration and stability monitoring would be conducted in years 3-4. Final decommissioning, including building demolition and soil reclamation, would be conducted during years 5-6.

The table references in the remainder of this response refer to the tables within revised Appendix 6.6-A. The financial assurance cost estimate reflects costs as of 2009. The cost factors found in Table 2 and elsewhere were obtained from vendor quotes, from the 2009 RS Means cost estimating handbooks, from recent ISR license applications, and from calculations as described. All electrical power costs are conservatively based on a per kWh hour cost of \$0.07; the results of a power study (Lyntek, 2010) showed estimated 2013 power costs of \$0.0595 to \$0.0691 per kWh, depending on the supplier. The costs of 11e.(2) byproduct material disposal, as listed Table 2 and as utilized in Table 6, are based on the assumption that Powertech will secure a byproduct disposal contract with Denison Mines Corporation

for disposal at their byproduct disposal facility at White Mesa, UT. The cost estimate is based on a transportation distance of 785 miles from the project area to the White Mesa facility near Blanding, UT. Transportation costs to alternate 11e.(2) byproduct material disposal facilities will be similar or less. For example, the Pathfinder Mines Corporation Shirley Basin Facility is approximately 250 miles away, the Energy Solutions LLC Clive Disposal Site near Clive, UT is approximately 700 miles away, and the Waste Control Specialists LLC facility near Andrews, TX is approximately 900 miles away.

While it is likely that the facility buildings will have a salvage value, the demolition cost estimate assumes that all buildings will be shredded and disposed at an appropriate landfill. Decommissioning costs include a final gamma survey.

Labor costs associated with the reclamation operations will be a combination of contract labor and direct hires, listed in Table 11. A full-time Radiation Safety Officer will be employed through final decommissioning.

TR RAI MI-4

Additional financial assurance information needs to be provided.

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

TR RAI MI-4(d)

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

Needed: Provide information related to financial assurance as requested.

TR RAI MI-4(d) Response

The following discussion will be incorporated into the revised TR.

Powertech proposes use of a flare factor of 1.44 and the restoration estimate of 6 pore volumes of groundwater for its financial assurance. Basis for the flare factor is found in TR Appendix 6.6-B, "Numerical Modeling of Groundwater Conditions Related to In Situ Recovery at the Dewey-Burdock Uranium Project, South Dakota," which is attached to this RAI response package and which will accompany the revised TR. Please refer to the response to TR RAI 6.1-7 for justification of the flare factor and total number of restoration pore volumes. As explained in more detail in the response to TR RAI 6.1-7, the flare factor is based on experience gained from ISR operations in Wyoming and on numerical groundwater modeling. The number of PVs necessary for restoration is also based on experience from other ISR operations after allowing for improvements in technology, including reduced groundwater sweep, which was found to be ineffective at some other operations, and elimination of long delays, sometimes up to several years, which proved to be less effective than completing restoration soon after uranium recovery was completed.

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

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

TR RAI MI-4(e)

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

Needed: Provide information related to financial assurance as requested.

TR RAI MI-4(e) Response
The requested commitments will be incorporated into Section 6.6 of the revised TR as described below.

Powertech commits to providing annual financial assurance updates to NRC staff, including any revisions to financial assurance cost estimates based on a series of factors including, but not limited to: (1) inflation; (2) changes in contractor costs; (3) changes in material costs; and (4) changes in restoration elements such as pore volumes. Pursuant to NUREG-1757, Volume 3, Powertech also commits to (i) automatically extend the financial assurance instrument for the previously approved financial assurance amount until NRC approves the revised financial assurance cost estimates if NRC staff has not approved its proposed revisions thirty (30) days prior to the expiration date of the existing financial assurance instrument; (ii) revise the financial assurance instrument within ninety (90) days of NRC approval of any revised decommissioning plan if the revised cost estimate exceeds the amount of existing financial assurance costs; (iii) submit for NRC staff review an updated financial assurance package to cover any planned expansion or operational change not included in the previous annual financial assurance update at least ninety (90) days prior to beginning such associated construction; and (iv) provide NRC staff with copies of financial assurance-related information submitted to the State of South Dakota and/or EPA, including a copy of the financial assurance review or final financial assurance package.

TR RAI MI-5

Provide additional information and analyses related to site flooding.

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

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

TR RAI MI-5 Response

Powertech has evaluated flood inundation boundaries and will construct facilities outside of these boundaries to avoid potential impacts to facilities from flooding and potential impacts to Beaver Creek and Pass Creek in the event of any potential spills or leaks.

Estimates of peak flood discharges and water levels produced by floods on Pass Creek, Beaver Creek and local small drainages are provided in TR Section 2.7.3 and TR Appendix 2.7-M, which is included with this submittal in response to this RAI and TR RAI 2.7-3. This information will be incorporated into the revised TR.

As described in Appendix 2.7-M, HEC-HMS models were used to calculate peak discharges, and HEC-RAS models were used to compute water-surface profiles and inundated areas for the respective runoff events.

Where possible, facilities will be located out of the 100-yr flood inundation boundary. Facilities which must be located within such boundaries will be protected from flood damage by the use of straw bales, collector ditches, and/or berms. Diversion channel designs for the plant sites and ponds are provided in Appendix 3.1-A. Diversion channels for the CPP facilities are depicted on Drawing No. 101 (pg. 3.1-A-33), and diversion channels for the Satellite Facility are depicted on Drawing No. 102 (pg. 3.1-A-34). If it is necessary to place a well head within the inundation boundary, diversions or erosion control structures will be constructed to divert flow and protect the well head. The well head also will be sealed to withstand brief periods of submergence (see response TR RAI 2.7-3). Pipelines will be buried below the frost line and will not be subject to flooding. Pipeline valve stations will be located outside of the 100-year flood inundation boundary.

TR RAI MI-6

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

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

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

TR RAI MI-6 Response

Please also see response to TR RAI MI-5, which discusses flood analysis and inundation.

Site drawings showing detailed topography and pond construction features as well as erosion protection design features are included in Appendix 3.1-A. As shown on these drawings, control structures (collector ditches and berms) will be used to prevent surface runoff for events up to and including the 100-yr, 24-hr rainfall event from entering the ponds. Collector ditches will be designed to have velocities less than 5 feet per second or appropriate erosion control measures, such as fabric mats or riprap, will be constructed to minimize the potential for erosion. Appendix 3.1-A is included with this response package and will be included as part of the revised TR.