StrataRossLAPEm Resource

From: Saxton, John
Sent: Friday, March 28, 2014 8:39 AM
To: StrataRossLA Resource
Subject: FW: Strata Ross ISR Revised Technical Report
Attachments: Ross_TR_Replacement_Pages_February 2014.pdf; Ross_TR_Change_Index_February 2014.pdf

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From: bschiffer [mailto:bschiffer@wwcengineering.com]
Sent: Thursday, March 27, 2014 5:15 PM
To: Saxton, John
Cc: Mike Griffin; Moore, Johari
Subject: Re: Strata Ross ISR Revised Technical Report

John--
On behalf of Strata and pursuant to 10 CFR 2.390 (C)(3) we withdraw the updated Ross Technical Report (TR) received by the NRC Document Control Desk on Tuesday, February 25, 2014. In lieu of providing a complete and updated TR at this time, we are providing via this email attachments that include the Index of Change and replacement pages as Adobe pdf's. Please let Mike or I know if you have any questions. Take care.

Ben

On 3/18/2014 12:43 PM, Saxton, John wrote:

> Ben,
>
> As we discussed, I began our required Sensitive Unclassified Non-Safeguards Information (SUNSI) review of your submittal dated February 19th which contained page changes, change index and an updated complete Technical Report for the Ross ISR project.
>
> I've identified that the document contains the proprietary drawings which Strata had previously requested, and NRC staff formally agreed not to be publicly available. However, an affidavit or redact version of the drawings are not included in this recent submittal. In addition, at the present time, I will not be able to complete my review of the updated complete technical report to ensure its consistency with Strata's initial report and approved changes during NRC's review. I suggest that Strata submits a request to withdraw this submittal pursuant to 10 CFR 2.390 (C)(3) and resubmit the updated complete report at a later date with the appropriate affidavits. This will allow me time to perform a proper review of the report. Strata will still need to submit the individual page changes for the latest change. Please submit the page changes to me directly and I will place them into ADAMS.

John

--

Benjamin J. Schiffer, P.G. | Senior Geologist / Project Manager

1849 Terra Avenue | Sheridan, WY 82801

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Subject: FW: Strata Ross ISR Revised Technical Report
Sent Date: 3/28/2014 8:39:06 AM
Received Date: 3/28/2014 8:39:08 AM
From: Saxton, John

Created By: John.Saxton@nrc.gov

Recipients:
"StrataRossLA Resource" <StrataRossLA.Resource@nrc.gov>
Tracking Status: None

Post Office: HQCLSTR02.nrc.gov

Files	Size	Date & Time
MESSAGE	2135	3/28/2014 8:39:08 AM
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Ross_TR_Replacement_Pages_February 2014.pdf	1939539	
Ross_TR_Change_Index_February 2014.pdf	76961	

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Priority: Standard
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Sensitivity: Normal
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collection will consist of individual injection and recovery rates combined with level readings in both internal baseline wells and perimeter monitor wells. MODFLOW three dimensional simulations (presented in Addendum 2.7-H) indicate that hydraulic anomalies would be quickly detected in the perimeter monitor wells, integration with injection and recovery rates on a well-by-well basis will allow for detailed controls to maintain sufficient bleed. Well efficiency deviations will be measured utilizing data from the injection manifolds.

During operation, a portion of the injection solution will be removed and processed by two phases of reverse osmosis (RO). After treatment, most of the high quality permeate will then be circulated back to the injection stream in order to make up the correct bleed amount, the remainder will be discharged to the lined temporary storage ponds for other uses or disposal. By treating part of the injection stream, Strata hopes to help maintain the water quality of the injection solution. Efforts to maintain the injection stream will reduce the buildup of salts and other dissolved constituents, which will aid in aquifer restoration. The quantity of the injection stream that will be treated will vary throughout the life of the project, depending on operating conditions such as the amount of production bleed being utilized in the wellfields, the waste management capacity, and the water quality of the injection stream.

A three-dimensional groundwater model was developed for the proposed Ross ISR Project using Groundwater Vistas as the pre-processor and the USGS code MODFLOW. As part of the modeling exercise, the calibrated model was used to evaluate an ISR simulation for the ore bodies currently delineated within the permit area. During the simulation, production bleed from ISR, groundwater sweep, and aquifer restoration were removed from the aquifer at currently estimated bleed rates for each respective ISR stage. Simulated flow volumes were based on water balance flow rates presented in Section 3.1.5 and the project schedule as presented in Figure 1.9-1. The primary purpose of this simulation was to evaluate regional impacts from the ISR operations. The simulation was a “one size fits all” simulation that did not adjust flow rates to take into account specific well field changes. For example, where the hydraulic conductivity of the formation is lower than average the production rates may need to be adjusted accordingly. This simulation did not adjust flow rates to account for different conditions. However, the “one size fits all” simulation does conservatively predict maximum impacts to the adjacent aquifer. The

alkalinity, and particularly chloride limits the potential for dilution, as described by Mayo (2010), as the intervals with the mineralization typically have higher horizontal hydraulic conductivities than the overlying and underlying sediments. Chloride concentrations measured in fully penetrating regional baseline wells and discreetly completed observation wells in the ore bearing sandstones correlate very well. In addition, the hydrogeologic system analyzed by Mayo (2010) was highly stratified and lacked the confinement measured at the proposed Ross ISR Project.

Baseline water quality and quantity will be collected from approximately 24 well clusters spaced at 1 cluster per 3-4 acres of wellfield. The baseline wellfield monitoring well clusters, as well as the currently installed regional baseline well clusters are presented in more detail in Sections 2.7 and 5.7.8. Completions for the deep (DM) and shallow (SM) monitoring wells will likely mimic the regional baseline cluster installations, while the ore zone (OZ) baseline wells will likely resemble the observation wells installed for the multi-well aquifer test with more limited, gamma based completions. These wells will be utilized as recovery wells during ISR operations.

Excluding the installation of pressure transducers in the fully penetrating monitor wells, water levels will be routinely measured during sampling in the perimeter, overlying, and underlying monitor wells in order to provide an early warning for impending wellfield problems. An increasing water level in a perimeter monitor well has shown be an indication of a local flow imbalance within the wellfield, which could result in an excursion. An increasing water level in an overlying or underlying monitor well could be caused by the migration of fluid from the production zone or by an injection well casing failure. This monitoring effort will allow corrective action to be immediately taken to locally balance the injection and recovery flows or shut down individual injection wells as necessary.

All previously drilled exploration/delineation holes that can be located on the project and are within a monitor well ring will be re-entered to total depth and sealed with cement slurry. Historic exploration holes are located using a hand-held metal detector that finds a brass cap with the borehole ID. After the holes are located, a small drilling rig sets up over the holes and drills them out to total depth. The holes are then cemented from the bottom to the surface. Details of the plugging each borehole will be recorded on an abandonment record, (examples in Addendum 2.7-F) which will be filed at the Oshoto field

fluctuating water levels with a typical depth to water of 8-12 ft BGL. Two wells indicate water in the shallow bedrock while the northern most well exhibits 15-17 ft of saturation in the unconsolidated materials overlying the Lance Formation. Well logs and completion details for the CPP area piezometers as well as soil laboratory results are included in Addendum 3.1-A. A cross section which uses well and borehole log data from the piezometers and previously drilled exploration boreholes is also included in this addendum. Water quantity and quality monitoring results for the surficial aquifer are detailed in Section 2.7.

Elevated water levels directly beneath the CPP site may create a higher risk of contamination in the event of a spill, as well as create construction and operational issues for the CPP and adjacent facilities. In order to mitigate these risks, a continuous containment barrier wall (CBW) (also known as a soil-bentonite slurry wall) will be constructed hydraulically upgradient of the Ross ISR CPP site as shown on Figure 3.1-16. This structure will serve as a barrier between the shallow groundwater upgradient of the CPP site and the shallow groundwater immediately beneath the plant facilities.

The CBW will consist of a highly impermeable in situ mixture of soil and bentonite. This wall will be 1.5 ft to 2 ft thick and will extend from the ground surface through the soil and unconsolidated surficial material to a point at a minimum of 2 ft into bedrock. Figure 3.1-17 shows a typical cross section of a CBW. The target permeability of this CBW will be less than the lowest permeability of the soils that lie beneath the CPP site. Preliminary tests indicate that the clays underlying the CPP have a permeability of about 2.8E-07 cm/sec (approximately the same as typical concrete); therefore, target permeability for the CBW will be about 5.0E-08 cm/sec. The target permeability of the CBW will be reached by adjusting the soil-bentonite mixture. A typical soil-bentonite mixture contains 3% by dry weight of bentonite.

The photograph on Figure 3.1-17 shows a typical in situ mixed soil-bentonite slurry wall being constructed. This particular wall serves as a positive cut-off to prevent seepage from passing beneath an earthen dam. These slurry walls are used very successfully in a wide variety of subsurface applications where a relatively impermeable barrier is required, including highly contaminated EPA super-fund sites. These structures have a history of

providing highly effective groundwater barriers with only minimal surface and environmental disturbance.

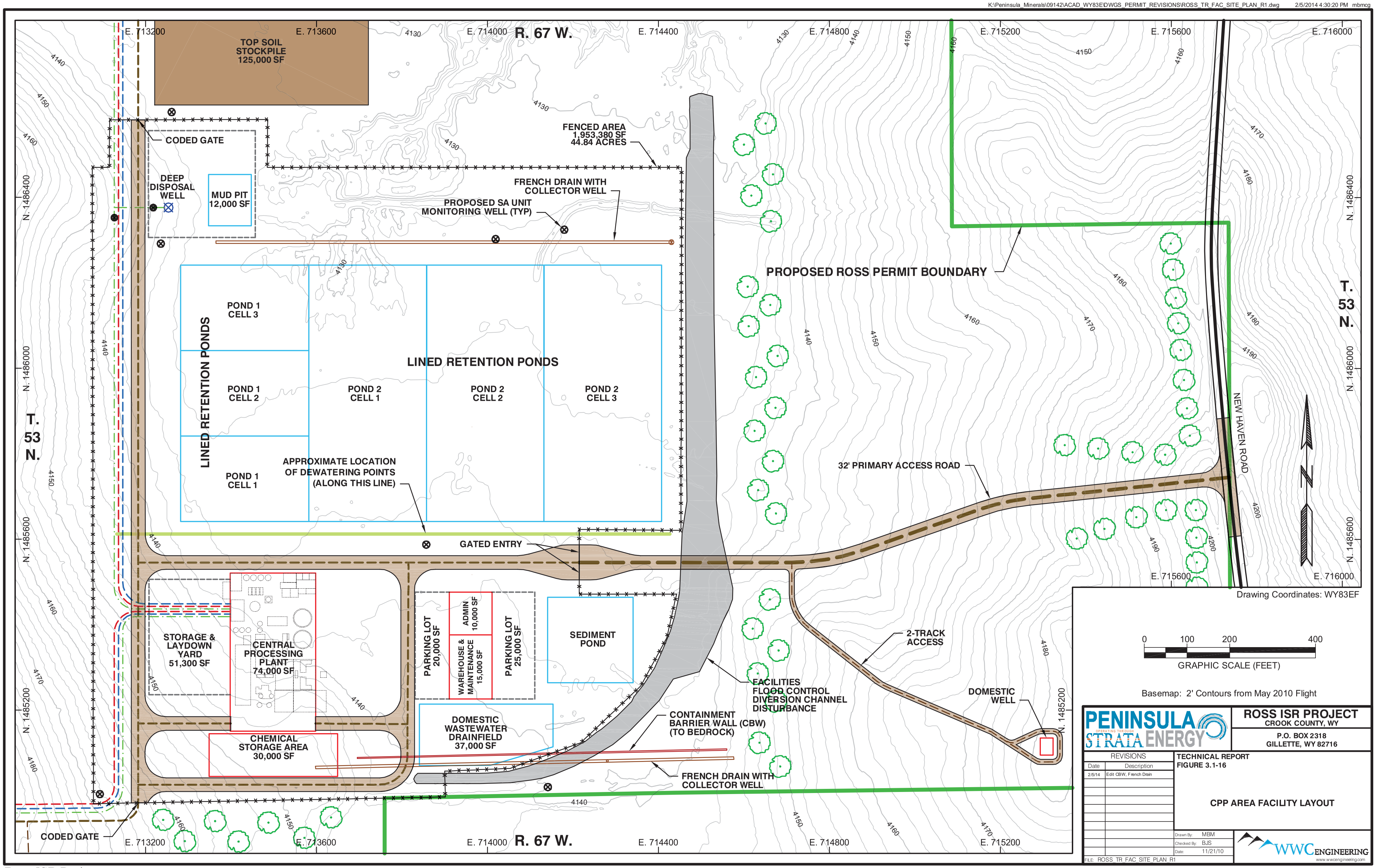
Following construction of the CBW, a matrix of dewatering wells and interceptor trenches and/or underdrains (if required) will be installed and used to dewater the area inside the barrier wall. Dewatering wells will be used as needed throughout the operating life of the CPP to maintain a depressed water level on the inside of the CBW. Monitoring wells will be installed on both sides of the CBW. These wells will be monitored to ensure that there is always a negative gradient for the groundwater to flow from outside the CBW to the inside, and to monitor seepage. Any seepage and/or spillage collected on the inside of the CBW will be discharged to the lined ponds for storage or disposal. In the unlikely event of a process fluid spill, hazardous chemical spill, or failure of the disposal systems, this CBW and associated dewatering system will prevent migration of contaminated liquids from entering and contaminating shallow groundwater outside the facilities area. Approximate locations of dewatering and monitoring infrastructure are shown on Figure 3.1-16.

Dewatering and monitoring wells will be installed and subsequently plugged and abandoned according to WDEQ/WQD standards. In addition all locatable exploration holes within the CPP area fence will be abandoned from bottom to top with cement.

Further details of the CBW and dewatering system including specifications, construction plan, and quality control procedures will be included in the Ross ISR Project Facilities Engineering Report Addendum (3.1-A).

3.1.9 Flood Protection

Protection of equipment and facilities from large runoff events will typically be accomplished by placing the facilities on high ground out of the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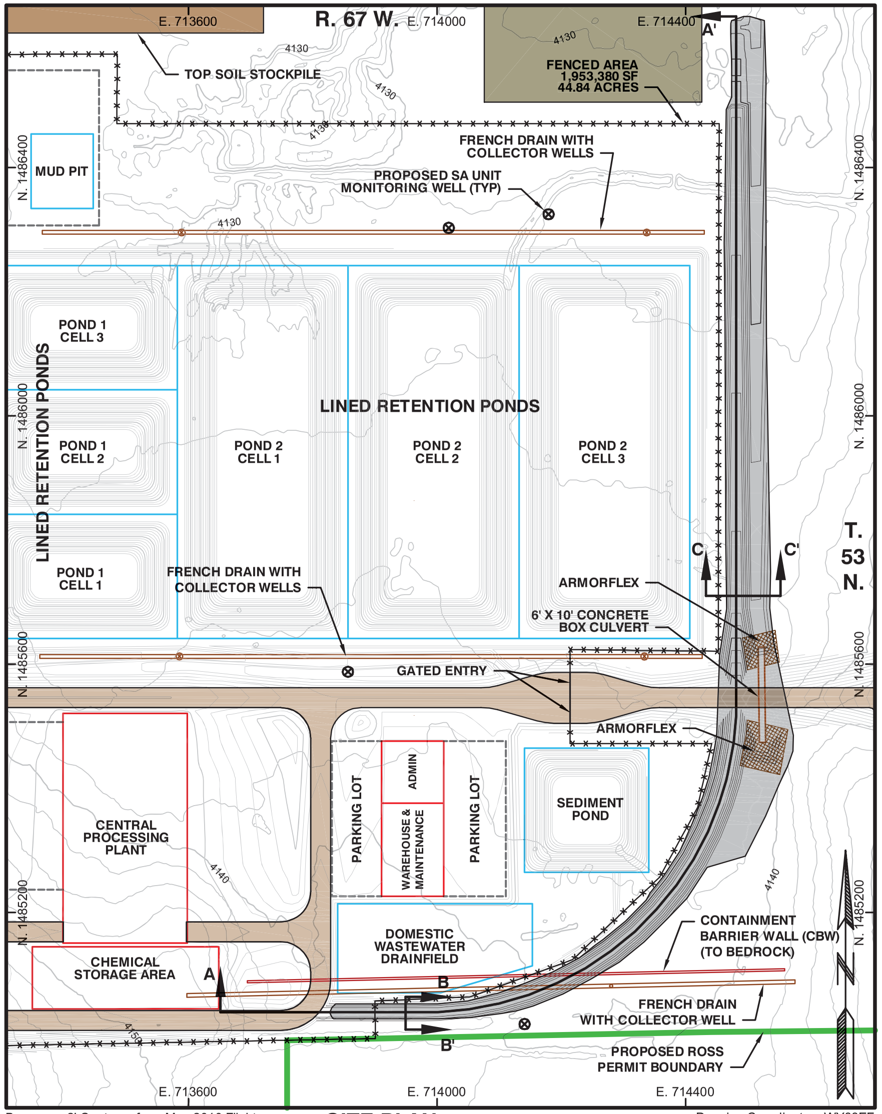
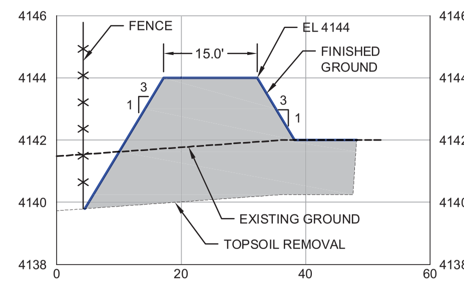
R. 67 W.
T. 53 N.
E. 713200
E. 713600
E. 714000
E. 714400
E. 714800
E. 715200
E. 715600
E. 716000
N. 1486400
N. 1486000
N. 1485600
N. 1485200
TOP SOIL STOCKPILE 125,000 SF
CODED GATE
DEEP DISPOSAL WELL
MUD PIT 12,000 SF
FENCED AREA 1,953,380 SF 44.84 ACRES
FRENCH DRAIN WITH COLLECTOR WELL
PROPOSED SA UNIT MONITORING WELL (TYP)
PROPOSED ROSS PERMIT BOUNDARY
LINED RETENTION PONDS
POND 1 CELL 3
POND 1 CELL 2
POND 1 CELL 1
POND 2 CELL 1
POND 2 CELL 2
POND 2 CELL 3
APPROXIMATE LOCATION OF DEWATERING POINTS (ALONG THIS LINE)
GATED ENTRY
32' PRIMARY ACCESS ROAD
NEW HAVEN ROAD
STORAGE & LAYDOWN YARD 51,300 SF
CENTRAL PROCESSING PLANT 74,000 SF
CHEMICAL STORAGE AREA 30,000 SF
PARKING LOT 20,000 SF
ADMIN 10,000 SF
WAREHOUSE & MAINTENANCE 15,000 SF
PARKING LOT 25,000 SF
SEDIMENT POND
DOMESTIC WASTEWATER DRAINFIELD 37,000 SF
CONTAINMENT BARRIER WALL (CBW) (TO BEDROCK)
FACILITIES FLOOD CONTROL DIVERSION CHANNEL DISTURBANCE
2-TRACK ACCESS
DOMESTIC WELL
N
Drawing Coordinates: WY83EF
0 100 200 400
GRAPHIC SCALE (FEET)
Basemap: 2' Contours from May 2010 Flight
PENINSULA
STRATA ENERGY
ROSS ISR PROJECT
CROOK COUNTY, WY
P.O. BOX 2318
GILLETTE, WY 82716
REVISIONS
Date Description
2/5/14 Edit CBW, French Drain
TECHNICAL REPORT
FIGURE 3.1-16
CPP AREA FACILITY LAYOUT
Drawn By: MBM
Checked By: BJS
Date: 11/21/10
WWC ENGINEERING
FILE: ROSS_TR_FAC_SITE_PLAN_R1



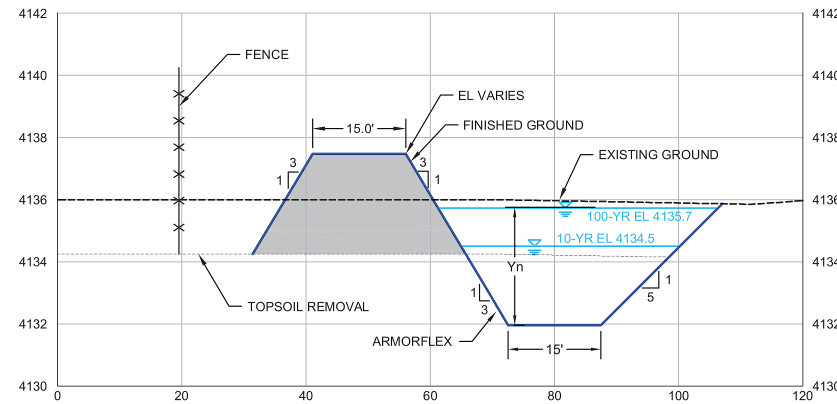
Basemap: 2' Contours from May 2010 Flight

SITE PLAN

Drawing Coordinates: WY83EF



SECTION B-B'
BERM WITHOUT DIVERSION
EXAGGERATION 5H:1V (FT)



SECTION C-C'
BERM WITH DIVERISON
EXAGGERATION 5H:1V (FT)

HYDRAULICS FOR DIVERSION CROSS SECTION

$$Q = \frac{1.49}{n} AR^{2/3} S^{1/2} \quad \text{(Manning's)}$$

10-yr, 24-hr		100-yr, 24-hr	
Q = 311.30 cfs	A = 63.91 ft^2	Q = 681.10 cfs	A = 112.79 ft
n = 0.03	WP = 35.98 ft	n = 0.03	WP = 46.03 ft
S = 0.0045 ft/ft	R = 1.78 ft	S = 0.0045 ft/ft	R = 2.45 ft
b = 15 ft	V = 4.87 fps	b = 15 ft	V = 6.04 fps
	Yn = 2.54 ft		Yn = 3.76 ft

Note: Berm and Diversion will be reseeded with WDEQ/LQD approved seed mixture.

PENINSULA OPERATING THROUGH STRATA ENERGY

ROSS ISR PROJECT
CROOK COUNTY, WY
P.O. BOX 2318
GILLETTE, WY 82716

Date	Description
3/19/12	Update Plan and Profiles
2/5/14	Edit CBW, French Drain

REVISIONS

TECHNICAL REPORT
FIGURE 3.1-18

SHEET 1 OF 2

FLOOD CONTROL
DIVERSION CHANNEL

Drawn By: MBM
Checked By: DEB
Date: 12/18/10

FILE: ROSS_TR_FAC_DIVERSION_R2

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4.2.2 Lined Retention Pond Design

Two ponds are planned as part of the waste storage infrastructure at the proposed project area. Each pond will include three cells and will be built utilizing common containment berms. Interconnected piping within the ponds will allow the transfer of liquids between cells. Ponds will include double liners and leak detection systems as described in Section 4.2.2.1.

Lined retention ponds will be designed to meet the requirements of both NRC Regulatory Guide 3.11 for embankment retention systems and Wyoming Water Quality Rules and Regulations, Chapter 11, for lined wastewater storage ponds. The proposed pond designs will not be covered under the National Dam Safety Program because the proposed impoundments do not meet the criteria listed in NRC Regulatory Guide 3.11. The primary purpose of retention ponds is to manage permeate and brine inflows to optimize disposal techniques and provide for waste storage in the event of upset conditions. Sheet 1 of Figure 4.2-1 shows the location and layout of the proposed ponds.

Pond cells will be rectangular, with maximum internal slopes of 3 horizontal to 1 vertical. Ponds will be 17 feet deep with 3 feet of freeboard and a maximum hydraulic depth of 14 feet. Wherever possible, ponds will be almost entirely incised to minimize embankment fill and minimize the volume of water that could be released during a catastrophic embankment failure. Final pond designs will be prepared following a geotechnical analysis of foundation and borrow soil conditions. Designs will be prepared and submitted to WDEQ and NRC by a licensed professional engineer registered in the State of Wyoming. Typical pond design details are shown on Sheet 2 of Figure 4.2-1. Final pond designs will be included in a separate facilities design report, Addendum 3.1-A, submitted at a later date following further evaluation through geotechnical drilling programs. Final designs for the ponds will include a quality control program for installation, tests to demonstrate liner resistance to chemicals and any other pertinent analysis required to establish that the structures meet all necessary regulatory requirements.

As discussed in Sections 3.1 and 2.7 of this report, preliminary evaluations of the surficial aquifer at the CPP site indicate that shallow groundwater is present at depths ranging from 8-12 feet below grade. Current proposed pond depths extend up to 14 feet below grade. In order to mitigate the effects of the surficial aquifer on the ponds, Strata is proposing to install a containment barrier wall (CBW) hydraulically upgradient of the CPP area as

discussed in Section 3.1.8.2. The area inside the CBW will be dewatered by a series of wells located in the CPP area. Due to the presence of consistent low permeability bedrock below the site, it is expected that maintenance dewatering efforts will be minimal once the water table is initially lowered. Water generated during dewatering of the CPP area will most likely meet surface discharge standards and will therefore be discharged under a temporary WYPDES permit.

Under normal operating conditions, the water levels in the pond cells will be maintained such that the total volume of liquid in any one cell of the pond can be transferred to the other two cells to allow for leak repair. Two water levels will be considered in the pond designs, as indicated on Figure 4.2-1: (1) high water level (HWL), which is the highest water level that will be obtained in any pond while maintaining a minimum of three feet of freeboard, and (2) normal water level (NWL). The NWL is the maximum level that will provide sufficient storage in the event that brine or permeate from a leaking pond cell needs to be transferred to other cells within a pond. The capacity at the NWL is termed the operating capacity and the capacity between the HWL and NWL is termed the auxiliary capacity (see Figure 4.2-1, Sheet 2). Table 4.2-1 shows the anticipated operating capacity, auxiliary capacity, and total capacity for the ponds. The minimum freeboard depth of 3 feet will be sufficient to capture direct precipitation resulting from the 100-year, 24-hour storm and protect the embankment from wave runup. In the Oshoto region, the 100-year, 24-hour precipitation total is about 4.2 inches as discussed in Section 3.1 of the ER. The contributing drainage area of each pond is nearly equal to the HWL area so therefore the 100-year, 24-hour precipitation event is expected to result in a net water level increase of less than 0.5 foot in each pond.

Prevention of overfilling due to abnormal operation, malfunctions in level equipment or human error will be minimized through frequent inspections, maintenance of freeboard and redundant monitoring equipment.

Potential impacts to avian wildlife from liquid waste in the sediment and lined retention ponds will be reduced by using avian specific deterrents such as bird proofing (netting) and/or aversion techniques (sound/visual hazing systems or stretch wire). Best available control technologies (BACT), as determined at the time of construction, will be used.

the foundation material to decrease its permeability. Use of a natural clay or soil-bentonite secondary liner is preferred over the use of synthetic materials due to the self-healing properties of these liners and the proximity of the proposed project to bentonite supplies.

The use of sand and geocomposite drainage material beneath the primary synthetic liner eliminates the need for air vents beneath the liner since gases produced under the liner would be vented through the sand and geocomposite drainage material.

Routine pond inspections and monitoring will be conducted as stated in Section 5.3.2 and consistent with the requirements detailed in Regulatory Guide 3.11. Inspection sheets and monitoring results will be maintained on-site and submitted in annual reports to NRC and WDEQ/LQD. In the event of a confirmed loss of liner integrity a verbal notification to NRC will occur within 48 hours to be followed by a written report to the NRC within 30 days detailing suspected cause of the leak, estimated amount of leaked material, chemical nature of leaked material and mitigation efforts undertaken to repair and re-capture any effluent leaked into the native materials. In addition, the report will provide methods to prevent a similar event in the future.

4.2.3 AEA-Regulated Liquid Waste Disposal Plan

The AEA-regulated liquid waste at the Ross ISR Project will be managed through discharge to the lined retention ponds. Ponds will allow for surge and storage capacity, and provide additional disposal capacity through evaporation in summer months. Regulated flow of liquid waste will be routed from the ponds to the different disposal options that are discussed below.

4.2.3.1 Excess Permeate Disposal and Use

Excess permeate generated during uranium recovery and aquifer restoration activities at the proposed project will be used beneficially through surface discharge, recycling for use as plant make-up water, land application, or disposed of with brine in the Class I deep disposal well. As discussed previously, most permeate generated during RO treatment of the production bleed and aquifer restoration streams will be recycled back to the wellfield. Times when excess permeate is present, such as during the operation only phase, it will be discharged into lined retention ponds, where it will be used or

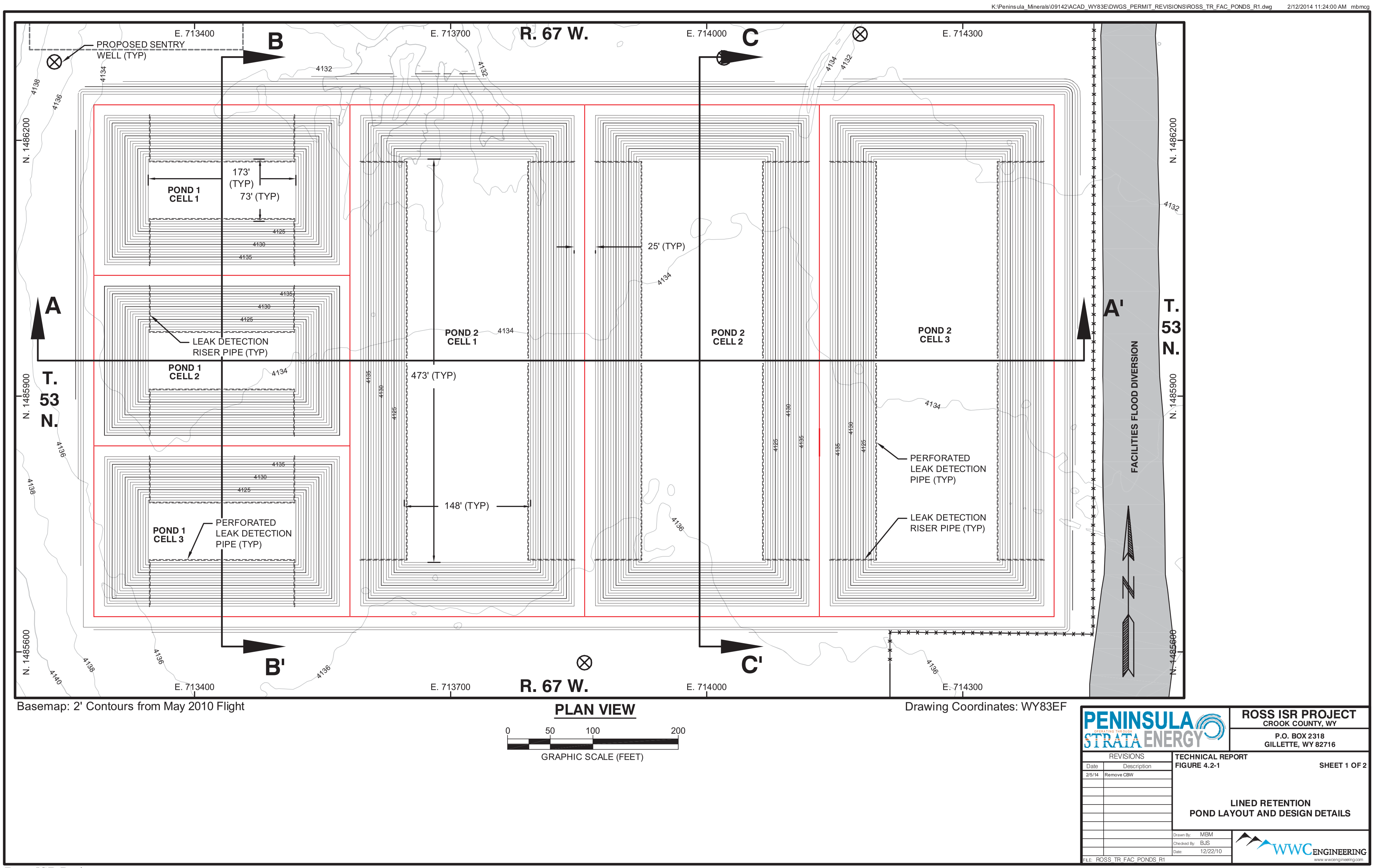
systems, and equipment for injection of treatment chemicals. Well pads will be either asphalt pavement or gravel and will be retained through the life of the disposal well in order to conduct maintenance. Access roads to the sites will be constructed on existing roads where possible and will have widths up to 14 feet. The supply pipelines to the wells will be 6 to 10-inch HDPE. Pressures and flow rates for the piping and the disposal well will be constantly monitored at the CPP.

Instrumentation details for the deep disposal wells are provided in Addendum 4.2-A, and consist of the necessary measures to ensure safe operation of the disposal system. At a minimum, these will include a flow totalizer, flow rate, pressure regulator, pressure indicator, pressure switch, annular tank level indicator and injection pressure chart recorder. Water quality, quantity and rates will be provided to the WDEQ/WQD UIC program as required by the permit.

4.2.3.2.2 Evaporation in Lined Retention Ponds

The secondary method of brine disposal at the proposed Ross ISR Project is evaporation in lined retention ponds. Evaporation will provide additional disposal capacity during normal operations, particularly during summer months. The following is a brief description of the water disposal capacity of the lined retention ponds.

Evaporation was estimated according to methods described in Pochop et al. (1985), which presents evaporation estimates for first-order pan stations in Wyoming. Although the Ross MET station included a Class A evaporation pan, only four months of data was collected. Data collection of pan evaporation rates will continue after application submittal which will provide a better estimate of site specific rates in the future. According to Pochop et al., the mean gross annual lake evaporation rate at the two nearest first-order pan stations varies from 39.1 inches in Sheridan to 42.4 inches in Casper. Pan evaporation rates were measured using relatively clean water, similar to the permeate at the proposed project. The proposed project area gross annual lake evaporation rate is assumed to be the average of these two values or 40.8 inches. The average annual precipitation for the region is approximately 12 inches per year as stated in Section 2.5.1.1.3. The net annual evaporation would be calculated as 40.8 inches, less 12 inches, or 28.8 inches per year. Thus, for each surface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E. 713400
E. 713700
E. 714000
E. 714300
R. 67 W.
T. 53 N.
N. 1486200
N. 1485900
N. 1485600
PROPOSED SENTRY WELL (TYP)
A
A'
B
B'
C
C'
POND 1 CELL 1
POND 1 CELL 2
POND 1 CELL 3
POND 2 CELL 1
POND 2 CELL 2
POND 2 CELL 3
173' (TYP)
73' (TYP)
473' (TYP)
148' (TYP)
25' (TYP)
LEAK DETECTION RISER PIPE (TYP)
PERFORATED LEAK DETECTION PIPE (TYP)
FACILITIES FLOOD DIVERSION
4125
4130
4132
4134
4135
4136
4138
4140
Basemap: 2' Contours from May 2010 Flight
PLAN VIEW
0
50
100
200
GRAPHIC SCALE (FEET)
Drawing Coordinates: WY83EF
PENINSULA
STRATA ENERGY
ROSS ISR PROJECT
CROOK COUNTY, WY
P.O. BOX 2318
GILLETTE, WY 82716
REVISIONS
Date
Description
2/5/14
Remove CBW
TECHNICAL REPORT
FIGURE 4.2-1
SHEET 1 OF 2
LINED RETENTION
POND LAYOUT AND DESIGN DETAILS
Drawn By: MBM
Checked By: BJS
Date: 12/22/10
FILE: ROSS_TR_FAC_PONDS_R1
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However, it should be recognized that there is no aspect of the ISR process that would separate beta emitters Th-234 or Pa-234 from their alpha emitting uranium parents and therefore, there cannot be "beta contamination" associated with spills or maintenance activities in the absence of detectable alpha. In the event that there was a spill on a complex matrix (carpet, wood, etc) alpha surveys may not indicate the presence of contamination due to self absorption effects; however it is unlikely that a spill would occur on this type of surface in an ISR plant since only in office areas would there be carpeted and/or wood floors. Special care will be taken to survey for beta emitters in the unlikely event that a spill occurs on such a complex material. (Maximum beta possible would be when Th-234/Pa-234 are at equilibrium with the uranium at approximately 4 months post mining). Strata will typically transport offsite all yellowcake as soon as a full shipment is accumulated. Accordingly no aged yellowcake is stored on site.

It is therefore highly unlikely that under conditions of routine operations or as a result of spills or maintenance activities, beta exposure rates to which workers could be exposed could result in shallow dose equivalents to the skin or the skin of extremities ≥10% of the limits at 10 CFR 20.1201 (a)(2) requiring individual beta monitoring per 10 CFR 20.1502 (10% of 50 Rem/yr = 5 Rem /yr). For any maintenance work and/or spill clean up activities (typically not covered by existing standard operating procedures) a radiation work permit will be prepared which will define specific radiological monitoring and controls for the task. These will include beta exposure rate monitoring if it is suspected that the material in question may be aged yellowcake.

However, if these circumstances were to be identified, an ALARA analysis will be performed to evaluate needs for additional surveys and controls, including provisions for personnel beta monitoring (e.g., ring and/or wrist badges).

It is of interest to note that Cameco Resources Corporation has performed extensive beta surveys at both the Smith Ranch and Crow Butte ISRs in 2010 throughout their plants. These surveys were performed with GM detectors in the open vs. closed shield modes and indicated no difference at any location surveyed (including proximate to products in yellowcake areas) between measured exposure rates in the open (beta plus gamma) vs. closed (gamma only) configurations. That is, the beta exposure rates were zero (Brown 2010a).

All exit doors without a permanent or temporary scanning station will be designated and labeled as emergency exits only. A temporary scanning station may be set up for a limited period using an alpha detector/meter system approved by the RSO. Unannounced quarterly spot surveys of personnel will be performed by the RSO or RST as recommended by NRC Regulatory Guide 8.30, Section 2.6. The spot surveys will also take place in non-restricted areas and will include personnel who work in the wellfield and other areas external to the CPP. Spot checks will ensure that employees perform self survey before leaving the restricted areas.

5.7.6.2.1 Response to Identification of Personnel Contamination in Excess of Background

Upon determination by any employee that contamination on his/her person, clothing or other personal effects exceeds background, the affected area(s) will be washed with water and soap and resurveyed. A second washing using modest abrasive methods may be required (soft brush or cloth). If the contamination remains above background, the RSO or RST will be contacted. More aggressive methods, e.g., use of detergents may be used, but abrasion of the skin should be avoided. If the ALARA objective of background cannot be achieved without more extensive and potentially abrasive methods, the methods and release limits specified in Regulatory Guide 8.30, Section 2.6 will be used and all detected activity would be assumed to be removable. If these limits cannot be achieved without abrasion of the skin or other potentially harmful impact to the employee, the RSO may need to refer the employee for medical intervention.

Since any beta–gamma contamination at an ISR (or uranium mill) must be associated with alpha emitting nuclides, no special monitoring or survey for beta–gamma emitters are required. The lack of detectable alpha contamination assures no beta–gamma contamination. For example, the immediate short-lived beta-gamma emitting progeny Pa-234 and Th-234 take approximately 4 months to reach equilibrium and little would be associated with fresh product. The fact that the radionuclide composition of material in an ISR plant would be almost exclusively natural uranium and/or radium 226 is discussed in Section 5.7.3.1.1. The very small amount of in growth of other progeny during the brief life cycle of the material through the plant will be associated with its alpha emitting parents, i.e. the natural uranium isotopes and radium 226, all alpha emitters. These beta – gamma emitting progeny must be associated with their uranium parent; Ra-226 emits alpha particles at >94% yield. However, surveys

Operational Monitoring – CPP Area

The surficial aquifer, also known as the SA monitoring unit, is monitored in the wellfield areas by the SA cluster wells, and in the CPP area by the SA monitoring wells and piezometers. Monitoring efforts on the SA unit will be to demonstrate water level contrasts across the containment barrier wall (CBW) and measure and record the extent of surficial contamination from potential spills resulting from piping, tank, and pond failures as well as other accidents relating to the handling of the various solutions used in the CPP. Because of a relatively higher potential for contamination of the SA unit in the CPP area, the majority of the SA monitoring wells and piezometers will be located in this immediate area. Figure 5.7-13 depicts the locations of the proposed SA wells in the CPP area.

As discussed in Section 3.1.8.2, due to a relatively high groundwater table in the CPP area, a continuous containment barrier wall (CBW) will be constructed hydraulically upgradient of the CPP. Monitoring wells will be completed in the SA unit to monitor water levels on both sides of the CBW. It will be necessary to dewater the CPP area prior to construction, and a groundwater control system will be used to manage groundwater levels over the life of the project.

The SA unit monitoring wells depicted on Figure 5.7-13 will monitor both the hydraulic gradient and groundwater quality across the CBW. Water level differentials adjacent to the CBW will serve to demonstrate the ability of the CBW to isolate the CPP area from the background groundwater flow regime of the SA unit, and to indicate adjustments that may be necessary in the dewatering system. In the event of a large spill at the CPP, samples collected at the monitor wells outside of the CBW will allow Strata to determine if contaminated groundwater was contained within the CBW.

In the vicinity of the CPP, groundwater levels within the SA unit monitoring wells will be monitored continuously with dedicated data logging pressure transducers (note: wellfield baseline SA wells will be monitored manually). In conjunction with the monitoring wells, the dewatering french drain/collector well will also be monitored. Samples will be collected monthly at three down-gradient monitoring wells and at least one up-gradient monitor well. Analytes are presented in Table 5.7-2.

entail repair of the recovery well and turning down the injection rate at the wells proximal to the excursion well.

5) Follow-up sampling for water quality is proposed to occur on a weekly basis with additional information derived from the dedicated pressure transducer/datalogging system on hydraulic conditions following implementation of mitigation measures. If after 30 days, UCL's are still in exceedance, the well on excursion status will be sampled for a full Guideline 8 parameter suite.

Impacts to financial assurance estimates from a lateral excursion will be significantly aided through the use of a groundwater model or aquifer management software platform. The regional groundwater model utilized for pre-license characterization appears to accurately predict where an excursion might take place and more importantly, the magnitude of the excursion in terms of volume of aquifer impacted. Based on the pore volume impacted, the financial assurance estimates will be increased and included within both the quarterly NRC reporting as well as in the annual reports for NRC and WDEQ/LQD.

Financial assurance estimates in the unlikely event of a vertical excursion will again utilize a modeling platform along with aquifer specific hydraulic and physical characteristics to determine the magnitude of the incident. In situ measurements of hydraulic conductivity will be provided for both the SM and DM systems to aid in surety updates.

<u>Excursion Monitoring and Upper Control Limits</u>

After baseline water quality is established for the monitor wells for a particular production unit, UCLs are set for chemical constituents that would be indicative of a migration of lixiviant from the wellfield and provide an "early warning" of a potential excursion. Consistent with the ISR-GEIS, the constituents proposed for indicators of lixiviant migration and for which UCLs are set are <u>chloride</u>, <u>conductivity</u>, and <u>total alkalinity</u>. Chloride was chosen due to its low natural levels in the native groundwater and because chloride is introduced into the lixiviant from the IX process (uranium is exchanged for chloride on the IX resin). Chloride is also a very mobile constituent in groundwater and will show up very quickly in the case of a lixiviant migration to a monitor well. Conductivity was chosen because it is an excellent general indicator of overall groundwater quality. Total alkalinity concentrations should be affected during an excursion as bicarbonate is the major constituent added

will be available to calculate UCLs. The Mine Unit 1 monitoring well network will not be installed without both NRC and LQD approval.

As discussed previously, the proposed Ross ISR Project may use an early warning system of pressure transducers to detect hydraulic anomalies in the form of hydrostatic pressure increases (beyond those caused by changes in barometric pressure) in the perimeter monitoring wells. Due to the high confining pressures in the OZ unit (Section 2.7.3.2), pressure transients propagate very quickly through the aquifer. Additionally, modeling indicates that local wellfield imbalances would be detected in perimeter monitoring wells spaced 400 to 600 feet from the wellfield as well as offset from one another by 400 to 600 feet within days, considerably before any geochemical evolution would be noted. Not only would the detection of a hydraulic anomaly potentially prevent a chemical excursion, the operational control of wellfields with pressure head data, both inside the wellfields as well as adjacent to the wellfields, would result in improvements in recovery efficiency, particularly in maintaining wellfield balance and minimizing interference. Strata may utilize internal ore zone trend wells to monitor wellfield head data and to provide a comprehensive hydraulic assessment to further aid recovery efficiency. Beyond the public perception and regulatory challenges posed by excursions, they are a significant distraction to the effectiveness of solution extraction and therefore an economic concern. The enriched lixiviants only produce uranium when they are focused within an ore body, hence there is reagent waste, electrical costs and manpower considerations any time recovery fluids migrate beyond the mineralized target.

Excursion Verification and Corrective Action

Through the use of continuous water level measurements, operational data capture and integration with a suitable reservoir engineering software platform, Strata plans to minimize the potential for local wellfield imbalances to impact adjacent non-exempt aquifers. However, in the unlikely event that water level data indicate this potential the following procedures will be initiated in accordance with NRC and LQD regulations.

During routine sampling, if two of the three UCL values for excursion indicators are exceeded in a monitor well, or if one UCL value is exceeded by 20%, the well will be re-sampled within 24 hours and analyzed for the excursion indicators. If the second sample does not exceed the UCLs, a third

sample will be taken within 48 hours. If neither the second nor third sample results exceeded the UCLs, the first analysis is considered in error.

If the second or third sample verifies an exceedance, the well in question will be placed on excursion status. Upon verification of the excursion, the NRC Project Manager will be notified by telephone or email within 24 hours and notified in writing within 7 days. A written report describing the excursion event, corrective actions, and corrective action results will be submitted to the NRC within 60 days of the excursion confirmation. If wells are still on excursion status when the report is submitted, the report will also contain a schedule for submittal of future reports describing the excursion event, corrective actions taken, and results obtained. In the case of a vertical excursion to an overlying or underlying aquifer, the report will contain a projected date when characterization of the extent of the vertical excursion would be completed.

If an excursion is verified, the following methods of corrective action will be instituted depending upon the circumstances:

- A preliminary investigation is completed to determine the probable cause;
- Adjustment of production and/or injection rates in the vicinity of the monitor well to increase the net over-recovery, thus inducing a hydraulic gradient toward the production zone; and
- Pumping of individual wells to enhance solution recovery.
- Injection into the wellfield area adjacent to the monitor well may be suspended. Recovery operations would continue, thus increasing the overall bleed rate and the recovery of wellfield solutions.

In addition to the above corrective actions, the monitor well on excursion status will be sampled weekly. An excursion will be considered concluded when the concentrations of excursion indicators do not exceed the criteria defining an excursion for three consecutive samples.

If an excursion is not corrected within 60 days of confirmation, injection of lixiviant into the wellfield will be terminated until the excursion is controlled, or the reclamation surety will be increased an amount that is agreeable to the NRC, which would cover the expected full cost of correcting and cleaning up the excursion. The surety increase will remain in force until the excursion is

controlled. The written 60-day report will explain and justify the course of corrective action that be followed.

5.7.8.3 Lined Retention Pond Leak Detection Monitoring

The lined retention ponds will be equipped with leak detection system consisting of perforated subsurface pipes along the pond floor. Perforated pipes will drain to riser standpipes that can be accessed from the pond embankments. The presence and depth of water in the riser pipes will be checked as part of the daily inspections conducted for the ponds. These inspections are detailed in Section 5.3.2. Condensate will often be present in the leak detection systems; therefore, ponds will only be sampled if more than 6 inches of water is detected in the piping. The fluid from the riser pipe will be tested and compared to the water quality of the contents of the ponds. Strata will use common constituents such as conductivity and chloride to determine if the leakage is from the pond. If the sample is verified, the NRC will be notified within 48 hours and the contents of the pond will be transferred to the other two pond cells or into the deep disposal well. The liner will then be thoroughly inspected and leak tested to determine the source of the leak. After the leak has been repaired and the pond is back in operation, any fluid detected in the riser pipes will be sampled at least once every 7 days for at least 14 days. NRC will be provided a written report that explains the details of the leak investigation and mitigation, and the analytical results from the samples. This leak detection and mitigation report will be sent to NRC within 30 days of the initial notification of the leak.

Water levels in the CPP area SA monitoring network and collector well would also be monitored to determine if any of the leaked substance reached the isolated environment underlying the facility. Capture of any leaked fluids would be conducted through the french drain/collector well system and dewatering well points.

5.7.9 Quality Assurance Program

Strata will establish a quality assurance (QA) program at the facility consistent with the recommendations contained in NRC Regulatory Guide 4.14 Sections 3 and 6 and Regulatory Guide 4.15 (NRC 1979) following issuance of the license but no later than 60 days prior to the pre-operational inspection.

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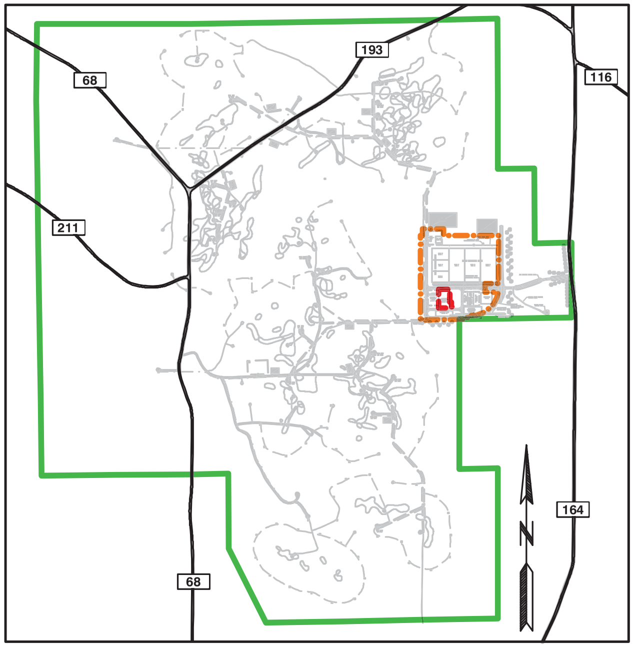
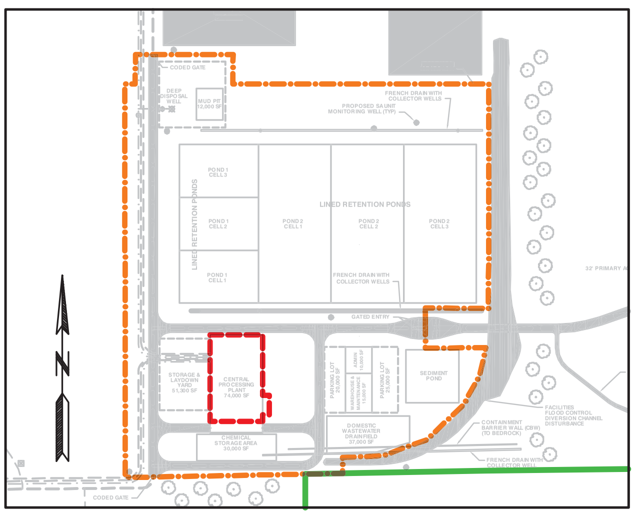
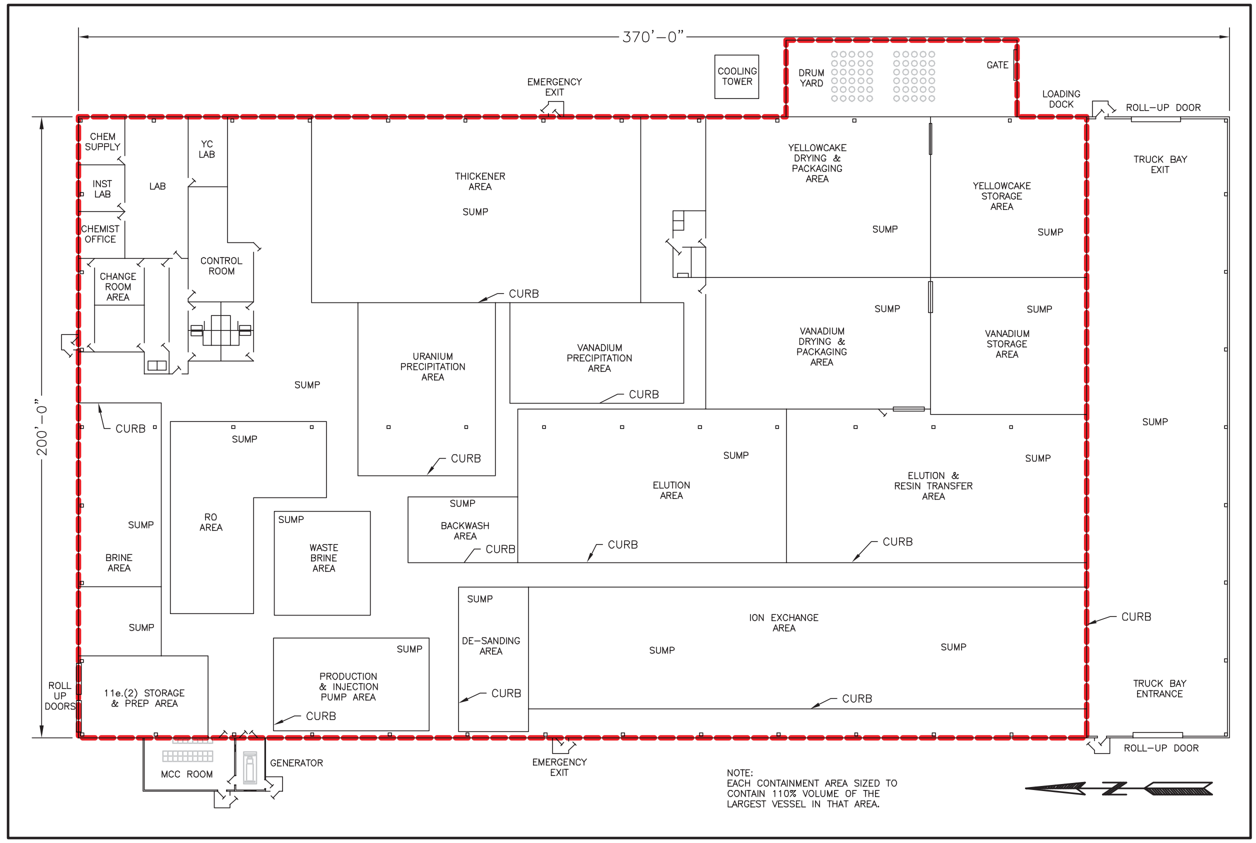


ROSS PROJECT AREA



CPP AREA



ROSS CPP AND LIQUID CONTAINMENT

LEGEND

- PROPOSED LICENSE BOUNDARY
- CONTROLLED AREA BOUNDARY
- RESTRICTED AREA BOUNDARY
- PROPOSED INFRASTRUCTURE

PENINSULA — OPERATING THROUGH STRATA ENERGY

ROSS ISR PROJECT
CROOK COUNTY, WY
P.O. BOX 2318
GILLETTE, WY 82716

REVISIONS

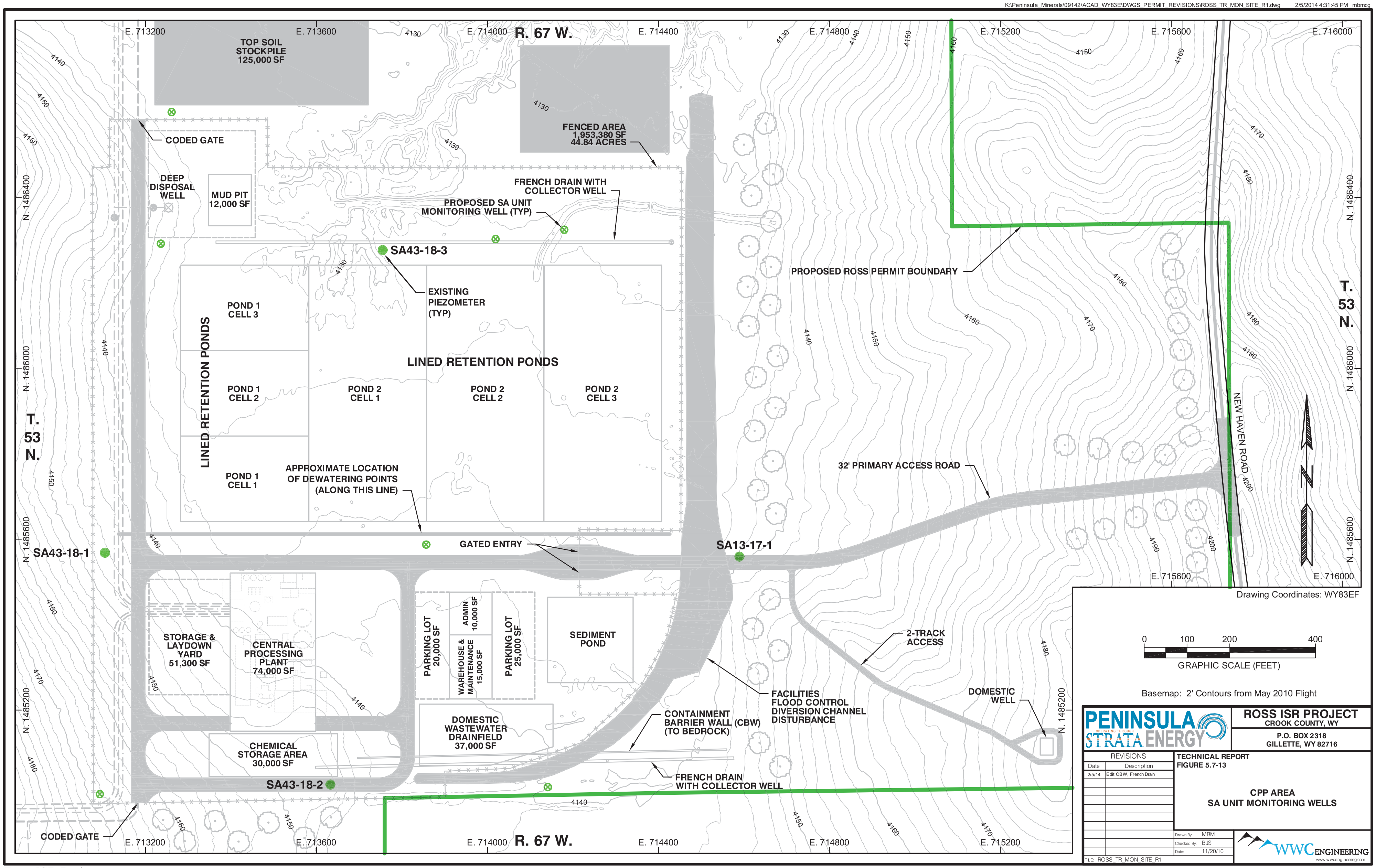
Date	Description
4/2/12	Update Boundaries, Views
2/5/14	Edit CBW, French Drain

TECHNICAL REPORT
FIGURE 5.7-4

RESTRICTED & CONTROLLED AREA SHOWING LIQUID CONTAINMENT DESIGN FEATURES

Drawn By: MBM
Checked By: BJS
Date: 3/19/12
FILE: ROSS RAI RESTRICTED CONTROLLED R2

WWC ENGINEERING
www.wwcengineering.com


K:\Peninsula_Minerals\09142\ACAD_WY83E\DWGS_PERMIT_REVISIONS\ROSS_TR_MON_SITE_R1.dwg 2/5/2014 4:31:45 PM mbmcg
R. 67 W.
T. 53 N.
TOP SOIL STOCKPILE 125,000 SF
FENCED AREA 1,953,380 SF 44.84 ACRES
CODED GATE
DEEP DISPOSAL WELL
MUD PIT 12,000 SF
FRENCH DRAIN WITH COLLECTOR WELL
PROPOSED SA UNIT MONITORING WELL (TYP)
SA43-18-3
EXISTING PIEZOMETER (TYP)
PROPOSED ROSS PERMIT BOUNDARY
LINED RETENTION PONDS
POND 1 CELL 3
POND 1 CELL 2
POND 1 CELL 1
POND 2 CELL 1
POND 2 CELL 2
POND 2 CELL 3
APPROXIMATE LOCATION OF DEWATERING POINTS (ALONG THIS LINE)
32' PRIMARY ACCESS ROAD
NEW HAVEN ROAD
SA43-18-1
GATED ENTRY
SA13-17-1
STORAGE & LAYDOWN YARD 51,300 SF
CENTRAL PROCESSING PLANT 74,000 SF
PARKING LOT 20,000 SF
ADMIN 10,000 SF
WAREHOUSE & MAINTENANCE 15,000 SF
PARKING LOT 25,000 SF
SEDIMENT POND
2-TRACK ACCESS
DOMESTIC WASTEWATER DRAINFIELD 37,000 SF
CHEMICAL STORAGE AREA 30,000 SF
CONTAINMENT BARRIER WALL (CBW) (TO BEDROCK)
FACILITIES FLOOD CONTROL DIVERSION CHANNEL DISTURBANCE
DOMESTIC WELL
SA43-18-2
FRENCH DRAIN WITH COLLECTOR WELL
CODED GATE
E. 713200
E. 713600
E. 714000
E. 714400
E. 714800
E. 715200
E. 715600
E. 716000
N. 1486400
N. 1486000
N. 1485600
N. 1485200
Drawing Coordinates: WY83EF
0 100 200 400
GRAPHIC SCALE (FEET)
Basemap: 2' Contours from May 2010 Flight
PENINSULA
STRATA ENERGY
ROSS ISR PROJECT
CROOK COUNTY, WY
P.O. BOX 2318
GILLETTE, WY 82716
REVISIONS
Date Description
2/5/14 Edit CBW, French Drain
TECHNICAL REPORT
FIGURE 5.7-13
CPP AREA
SA UNIT MONITORING WELLS
Drawn By: MBM
Checked By: BJS
Date: 11/20/10
FILE: ROSS_TR_MON_SITE_R1
WWC ENGINEERING
www.wwcengineering.com

that Strata is proposing a two-stage RO system, which will reduce the amount of wastewater but also concentrate the salts in the brine stream compared to a single-stage RO system. The two-stage RO system decreases the amount of consumptive use of water by returning more permeate to the exempted aquifer.

6.1.5 Groundwater Restoration Schedule

Strata will adhere to the timelines in decommissioning regulations of 10 CFR 40.42. When groundwater restoration begins in a given wellfield module, NRC and LQD will be notified and a plan submitted for regulatory review and approval. If, at that time, groundwater restoration is estimated to take longer than 24 months, Strata will provide an explanation and request approval for an alternate schedule through a license amendment as allowed under 10 CFR 40.42(i).

6.1.5.1 Transition from Production to Restoration

Strata will monitor uranium concentrations in the recovery wells and trunk lines from producing wellfield modules to determine when a wellfield module will be taken out of production and started in restoration. The criteria used to determine when this will occur may include, but will not be limited to:

- An adequate recovery of uranium
- Uranium recovery grade below 10 mg/l
- Available production plant capacity.

The NRC and WDEQ/LQD will be informed when a transition from production to restoration occurs in a wellfield module. In addition to the typical transition criteria listed above, the following four conditions will trigger NRC notification of decommissioning (restoration) activities:

- The license has expired
- The licensee has decided to permanently cease principal activities (defined as the last date of lixiviant injection)
- No principal activities have been conducted for 24 months under the license
- No principal activities have been conducted in a specific wellfield.

The proposed production plant has been designed with a capacity of 7,500 gpm to permit simultaneous production in multiple wellfield modules.

sand units, separate recovery and injection wells will be installed to address the ore in each sand. In this situation there would be multiple wells at each location. The stacked roll fronts would be produced and restored together, and the restoration processes and PVDs would be unchanged in the case of restoring stacked roll fronts.

6.1.8 Potential Environmental Impacts from Groundwater Restoration

Potential environmental impacts from groundwater restoration are discussed in Chapter 4.0 of the ER.

There are two primary categories of potential environmental impacts from the proposed groundwater restoration activities. The first is potential surface and groundwater quality impacts and the second is potential water consumption impacts. Other potential environmental impacts such as noise, air quality, and traffic impacts are not specific to groundwater restoration and are described in detail in Chapter 4.0 of the ER.

Potential water quality impacts include those potentially occurring to surface water and groundwater. Surface water quality impacts could occur in the event of a leak, spill, or equipment failure that would result in release of a process fluid to surface water. Instrumentation and controls designed to limit the likelihood of a surface water release and the magnitude of any release are described in Section 3.1. Potential accident scenarios and mitigation measures are described in Section 7.5 of this report and Section 4.4 and 5.4 of the ER. Potential surface water quality impacts are not limited to groundwater restoration, but are similar to those expected during construction, production, and decommissioning.

Potential groundwater quality impacts are also similar to those expected during production and are discussed in Section 4.4 of the ER. Potential groundwater quality impacts during groundwater restoration include horizontal and vertical excursions of recovery solutions, potential water quality impacts to the adjacent non-exempted aquifer from hot spots or constituents exhibiting increasing trends during stability monitoring, or potential shallow groundwater quality impacts to spills and leaks. Generally there is less potential for groundwater quality impacts during restoration compared to production since, a) the injection and recovery flow rates are lower in restoration compared to production, b) the duration that each wellfield module is in groundwater restoration is typically much lower than the production duration, and c) the

6.2.6 Containment Barrier Wall Reclamation

At the end of operations at the proposed Ross ISR Facility, the containment barrier wall (CBW) at the CPP will be reclaimed to the extent necessary to restore the natural flux of shallow aquifer groundwater beneath the CPP and in the immediate vicinity outside the CBW. The reclamation of this wall will be accomplished by creating a series of breaches, also known as finger drains, along the CBW. Each finger drain will consist of a 1.5 ft wide by 25 ft long trench that is cut through the CBW at a right angle and to a depth that is 2 ft below the lowest historical groundwater level. Gravel will be placed in the trench from the bottom to a point 2 ft above the highest recorded groundwater level such that a highly permeable flow path is created through the CBW. The remaining trench will be backfilled with topsoil and seeded.

This method of CBW reclamation was selected as a means of effectively restoring the groundwater system in the CPP area, while minimizing surface and environmental disturbance.

Selected monitoring wells that were used to characterize the shallow aquifer at the site before installation of the CBW will be retained, and water levels will be monitored following CBW reclamation to verify that the natural flow of shallow ground water through the CBWs and beneath the CPP has been restored. Measured groundwater levels that show no appreciable gradient across the CBWs will verify that the CBW reclamation and groundwater system restoration are complete.

6.2.7 Surface Restoration and Contouring

There will be very few construction activities that will require any major contouring during reclamation due to the nature of ISR recovery. The central plant area and primary access road are the only areas that will require significant contouring during decommissioning. During decommissioning, the excess fill from the central plant area that was either used to construct the primary access road or stored in a stockpile will be hauled the short distance to the central plant area, redistributed, and compacted in place. All disturbed areas will be re-contoured as necessary to blend in with the natural terrain and consistent with the pre-construction topography. Any affected drainage

including those owned and/or operated by Strata and those owned and/or operated by other ISR licensees, and from other water treatment entities generating uranium-loaded IX resins that are the same or substantially similar to those generated at ISR facilities. Uranium-loaded IX resin will be transported to the Ross ISR Project in tanker trailers with 500 cubic-foot or standard resin capacity. Based on a typical concentration of 50 g/L U_3O_8 (ISR GEIS Section 4.2.2.2), each truckload of uranium-loaded IX resin will contain approximately 1,500 pounds U_3O_8. Based on a maximum processing rate of 2.25 million pounds of U_3O_8 equivalent derived from uranium-loaded IX resin, up to 4 shipments would be made to the facility each day.

A transportation accident resulting in release of uranium-loaded IX resin would have a lower risk than the relatively low risk from an accident involving yellowcake described previously. As described in Section 4.2.2.2 of the ISR GEIS, IX resin contains a much lower concentration of uranium than yellowcake and the uranium is chemically bound to the IX resin and is therefore less likely to spread and easier to remediate in the event of a spill. Further, although there would be more frequent shipments of uranium-loaded IX resin than yellowcake, the distance traveled would typically be less, so the total distance traveled would likely be less. If an accident occurred with loaded resin the impacted soils will be salvaged and shipped to a licensed 11e.(2) byproduct material disposal site, the topsoil and vegetation will be replaced, and Strata will perform a post-reclamation radiological survey to verify that no long-term hazards would be present.

Transportation of loaded resin from satellite facilities not operated by Strata will be the responsible of the satellite facility, and covered under its source and byproduct material license. Strata will assume responsibility of the loaded resin when the shipment has reached the site. An unlikely but credible accident could occur if the truck was involved in a collision which ruptured the tanker trailer. The risk of an accident within the CPP area is low due to the short distance which would be traveled and the low speed limit of roads within the CPP area. In addition, if an accident did occur, cleanup and remediation efforts are expected to be very prompt considering the proximity to trained personnel.

GLOSSARY

11e.(2) byproduct material: The tailings or wastes produced by extracting or concentrating uranium or thorium from any ore processed primarily for its source material content. Also byproduct material.

Barber Amendment Area: An area, approximately 15 miles south of the proposed project within the Lance District, that is currently being evaluated by Strata as an ISR Satellite to the Ross ISR Project. Wellfields and an IX Plant would provide loaded resins to the Ross CPP. Mineralization occurs in similar Lance Formation sandstones, confined by thick shales as those present at the proposed project area.

Bleed: A solution drawn to adjust production or to restore groundwater by removing more fluids from the production zone than are injected, causing fresh groundwater to flow into the production area and minimizing the potential movement of lixiviant out of the wellfield.

Brine: Water with concentrated dissolved solids generated from the production and restoration reverse osmosis units.

Buffer area: Area extending a specified distance outside the proposed project area for analyzing baseline conditions and potential impacts. The distance from the proposed project area varies by resource.

Byproduct material: See 11e.(2) byproduct material.

Central plant area: The fenced area that will include the central processing plant, storage facilities, office/warehouse facilities, lined ponds, and other piping and equipment. The central plant area is proposed in portions of the NESE and SENE of Section 18, Township 53 North, Range 67 West.

Containment barrier wall: A highly impermeable, *in-situ* mixture of soil and bentonite that will form a continuous containment barrier. Also soil-bentonite slurry wall.

Deadwood/Flathead Formations: The Cambrian aged sandstones targeted at the Ross ISR Project for disposal of liquid waste. The Deadwood/Flathead formations are below the Madison Formation (lowermost USDW) and hydraulically isolated by the Englewood Shale Formation.

Deep monitoring zone (DM): The first water-bearing interval that lies stratigraphically below the uranium ore-bearing sands in the Upper Fox Hills Formation, and the target completion interval for the deep monitor wells. Also described as "BFS" horizon in the Lower Fox Hills Formation.

6.0 CONTAINMENT BARRIER WALL AND DEWATERING SYSTEM DESIGN AND CONSTRUCTION

The containment barrier wall (CBW) and dewatering infrastructure will be necessary to reduce the potential for hydrostatic uplift of the retention ponds liner system. As discussed in Attachment A, the location of the CPP resides in an area of shallow groundwater. The groundwater is believed to enter the CPP area within the valley fill. The valley fill is generally clay rich with low permeability although there are also discontinuous sandy intervals. The CBW is designed to cut off the “sand channel” conduits which contribute to thigh groundwater in the area.

6.1 Containment Barrier Wall

The CBW will consist of a highly impermeable in-situ mixture of soil and bentonite that forms a continuous barrier upgradient of the CPP area. The CBW will be approximately 2 feet wide and will extend from the ground surface through the soil and unconsolidated surficial material to a point at a minimum of 2 feet into bedrock or a maximum depth of approximately 35 feet. The soil-bentonite mixture will contain approximately 4% bentonite by dry weight.

Figure 6-1 provides the approximate alignment of the CBW. The depth will range from approximately 4 feet to approximately 35 feet. The depth and extents of the CBW were estimated from borehole data and from piezometers installed in May 2010 and August 2011. Cross Section A-A (Figure 2) of Attachment A provides a geological cross section along the CBW. Bedrock intercepts were interpreted from the logs and used as the basis for the variable CBW depth.

The proposed CBW alignment runs along the south edge of the CPP area as shown on Figure 6-1. The CBW is not currently planned around the entire CPP area because boreholes indicated that bedrock along the east and west sides of the site are generally shallow (within 3-5 feet of the existing ground).

The CBW will be tied into the shallow bedrock on the east and west sides, effectively creating a dam to shallow groundwater flowing into the site. The north end of the CPP site is hydraulically downgradient from the CPP and CBW and should therefore contribute little groundwater flow to the site. Although some infiltration of surface runoff can be expected from the facilities flood control diversion during storm events, it will be minimal and will easily be handled by the dewatering infrastructure proposed within the CPP area. In addition, operational groundwater monitoring described in Section 5.7.8.2 will allow Strata to detect inflow from the east, west, and north sides of the site.

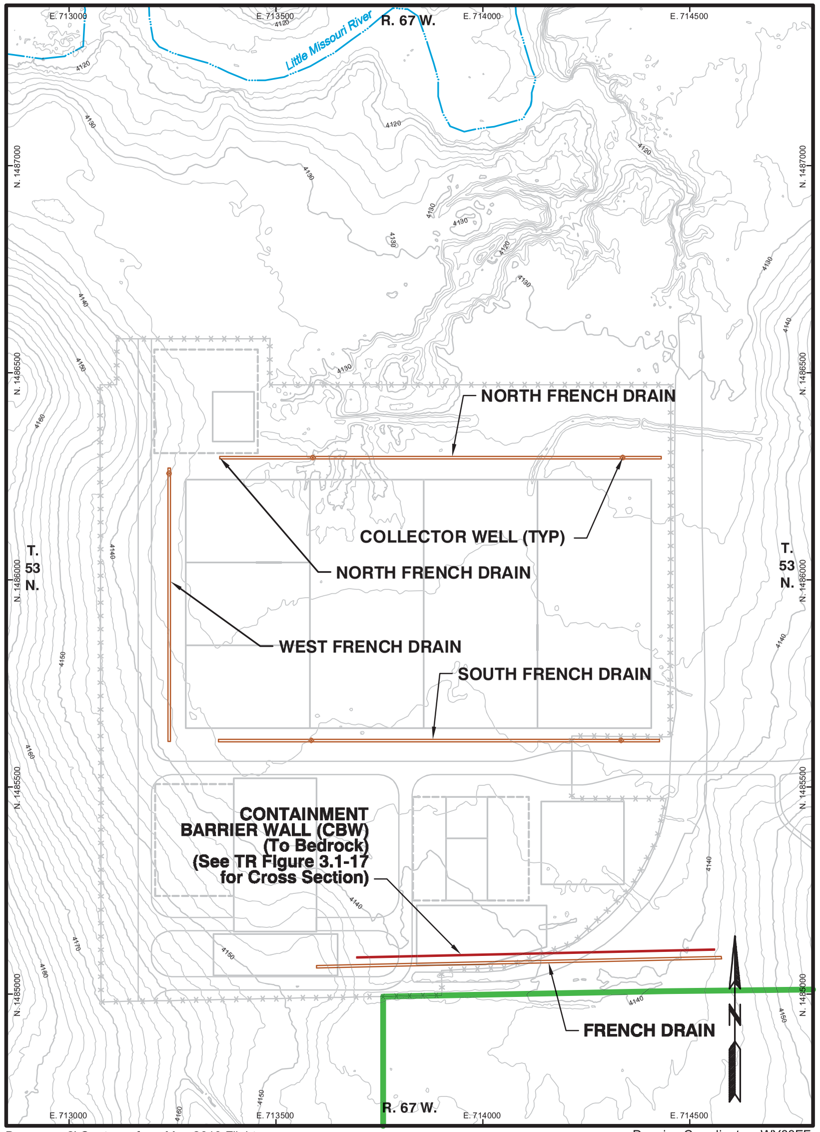
6.2 Dewatering Infrastructure

Four French drains are planned to dewater and maintain a depressed groundwater level throughout the operational life of the project. One French drain will be located directly upgradient of the CBW and three will be located within the interior of the site. French drains will consist of approximately 1.5-foot wide drainage trenches constructed of clean sand or fine gravel surrounding 5" perforated HDPE pipe. The French drains will slope at a minimum of 0.5% toward collector wells. Figure 6-1 presents the approximate locations and lengths of the French drains. The French drains will be installed such that the bottoms of the drains are 5 to 7 feet below the bottom of the ponds. Collector wells will be constructed of 2-foot diameter corrugated steel pipe extending from the French drain to the ground surface. A submersible pump will be installed inside each collector well. The collector wells will be fitted with pressure transducers to monitor water level and to control submersible pumps. Pump discharge piping will be approximately 3" diameter HDPE piping. The buried pump discharge piping will provide flexibility to convey the groundwater to an outfall structure within the facilities flood control diversion (assuming the water meets effluent limits) or to the lined retention ponds (if contaminated).

As discussed in Attachment A (Section 6.5), the anticipated flow from bedrock sources is expected to be 28 gpd. This low flow will be easily handled by the dewatering system. The system will be operated such that the water level will be a minimum of one foot below the bottom of the ponds.

6.3 Containment Barrier Wall Contingency Plan

The CBW and French drains will be among the first things constructed at the CPP. Dewatering of the area will then be initiated to allow for construction of the remainder of the facilities. Strata will know by the initial dewatering efforts if the CBW/French drain system will be successful at the site. If it is observed that dewatering efforts are not working, additional options may be

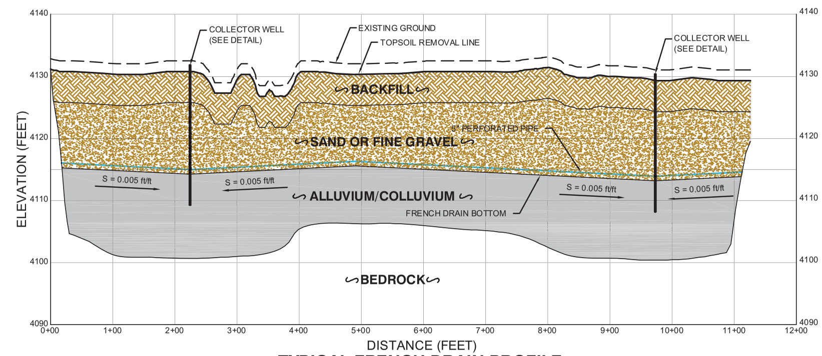


Basemap: 2' Contours from May 2010 Flight

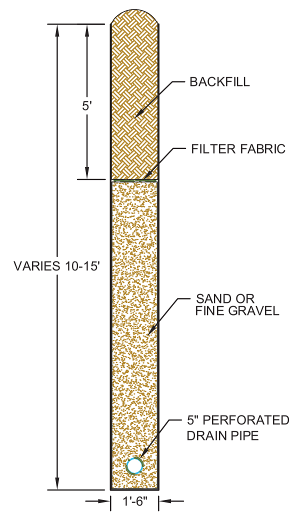
LOCATION MAP

Drawing Coordinates: WY83EF

GRAPHIC SCALE (FEET) 0 150 300 450 600

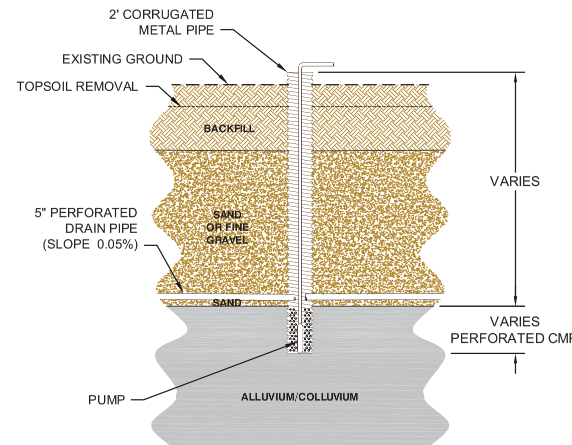


TYPICAL FRENCH DRAIN PROFILE



FRENCH DRAIN CROSS SECTION

GRAPHIC SCALE (FEET) 0 2 4



FRENCH DRAIN COLLECTOR WELL CROSS SECTION

GRAPHIC SCALE (FEET) 0 5 10

LEGEND

- PROPOSED ROSS PERMIT BOUNDARY
- CONTAINMENT BARRIER WALL (CBW)

Note: See Attachment A, Figure 2 for geologic cross section along CBW.

PENINSULA STRATA ENERGY

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REVISIONS	
Date	Description
2/5/14	Edit CBW, French Drain

ADDENDUM 3.1-A
FIGURE 6-1

CBW AND FRENCH DRAIN DETAILS

Drawn By: MBM
Checked By: DEB
Date: 3/27/12

FILE: ROSS_RAI_CBW_FD_R1

WWC ENGINEERING
www.wwcengineering.com

3.2 Ponds

Work required to reclaim the ponds will include brine disposal in the deep disposal wells, removal of the liner and brine residue to a licensed 11.e(2) disposal site, disposal of all non-11.e(2) solid waste from the leak detection piping to an approved landfill, regrading to restore original topography, topsoil replacement and revegetation. This work is described in Section 6.2 of the TR and the detailed quantities and unit prices used to estimate the reclamation costs are provided in Attachment RAP-2(B).

3.2 Earthwork

After the buildings and ponds are demolished and removed, the entire site will be regraded to restore the original topography, topsoil will be replaced to approximate its original depth, and the area will be regraded. Earthwork costs to complete the regrading of the CPP, parking areas, and access roads are provided in Attachment RAP-2(B). The work is described in detail in Section 6.2 of the TR.

3.3 Containment Barrier Wall

The containment barrier wall (CBW) at the CPP will be reclaimed to the extent necessary to restore the flow pattern of shallow groundwater. Reclamation of this wall will be accomplished by creating a series of breaches, also known as finger drains, along the CBW. Each finger drain will consist of a 1.5 ft wide by ~25 ft long trench that is cut through the CBW at a right angle and to a depth that is ~2 ft below the lowest historical ground water level. Gravel will be placed in the trench from the bottom to a point ~2 ft above the highest recorded ground water level such that a highly permeable flow path is created through the CBW. The remaining trench will be backfilled with topsoil and seeded.

Technical Report Change Index

Page	Original Location[1]	Revision	Source of Revision
Technical Report			
3-15	¶ 1, Line 7	Changed "would" to "will"	Correction based on Draft License Condition 9.2
3-20	¶ 3, Line 9	Changed "would" to "will"	Correction based on Draft License Condition 9.2
3-24	¶ 2, Line 5	Changed "will be constructed around the perimeter" to "will be constructed hydraulically upgradient"	Final Design Modification
3-24	¶ 2, Line 7	Changed "surrounding" to "upgradient of"	Final Design Modification
3-24	¶ 3, Lines 2 & 3	Deleted end of sentence referencing the CBW as a "continous contaminant barrier"	Final Design Modification
3-25	¶ 2	Delete paragraph to remove discussion related to construction of the CBW using a "one-pass" trenching system	Final Design Modification
3-44	Figure 3.1-16	Revised CBW location and added upgradient french drain location	Final Design Modification
3-46	Figure 3.1-18, Sheet 1	Revised CBW location and added upgradient french drain location	Final Design Modification
4-12	Sec. 4.2.2, ¶ 4, Line 6	Changed "around the perimeter" to "hydraulically upgradient"	Final Design Modification
4-13	¶ 1, Lines 1 & 2	Changed "within the CBW boundary" to "in the CPP area"	Final Design Modification
4-15	¶ 3, Line 9	Deleted "within the CBW"	Final Design Modification
4-23	¶ 2, Line 3	Changed "would" to "will"	Correction based on Draft License Condition 9.2
4-32	Figure 4.2-1, Sheet 1	Removed CBW from figure	Final Design Modification
5-43	¶ 2, Line 8	Changed "would" to "will"	Correction based on Draft License Condition 9.2
5-69	Sec. 5.7.6.2.1, ¶ 1, Line 10	Changed "would" to "will" (1st occurrence)	Correction based on Draft License Condition 9.2
5-85	¶ 2, Line 3	Changed "CBW will be constructed around the perimeter" to "CBW will be constructed hydraulically upgradient"	Final Design Modification
5-85	¶ 2, Line 4	Changed "both inside and outside the CBW" to "on both sides of the CBW"	Final Design Modification

[1] Denotes paragraph on TR page considering partial paragraphs or paragraphs within subsections as noted.

Technical Report Change Index

Page	Original Location[1]	Revision	Source of Revision
5-85	¶ 2, Line 5	Changed "dewater the area within the CBW" to "dewater the CPP area"	Final Design Modification
5-85	¶ 2, Line 7	Deleted "within the CBW"	Final Design Modification
5-85	¶ 3, Line 3	Deleted "within and" after the phrase "water level differentials"	Final Design Modification
5-88	¶ 1 (full), Line 7	Changed "would" to "will"	Correction based on Draft License Condition 9.2
5-88	¶ 2 (full), Line 2	Changed "would" to "will"	Correction based on Draft License Condition 9.2
5-90	¶ 3, Line 5	Changed "would" to "will"	Correction based on Draft License Condition 9.2
5-91	¶ 4, Line 2	Changed "would" to "will" (both occurrences)	Correction based on Draft License Condition 9.2
5-91	¶ 5, Line 5	Changed "would" to "will"	Correction based on Draft License Condition 9.2
5-92	¶ 1, Line 1	Changed "would" to "will"	Correction based on Draft License Condition 9.2
5-101	Figure 5.7-4	Revised CBW location and added upgradient french drain location	Final Design Modification
5-110	Figure 5.7-13	Revised CBW location and added upgradient french drain location	Final Design Modification
6-15	Sec. 6.1.5.1, ¶ 2, Line 3	Changed "would" to "will"	Correction based on Draft License Condition 9.2
6-24	¶ 1, Line 1	Changed "would" to "will"	Correction based on Draft License Condition 9.2
6-43	Sec. 6.2.6, ¶ 1, Line 2	Changed "surrounding" to "at"	Final Design Modification
6-43	Sec. 6.2.6, ¶ 1, Lines 6 & 7	Deleted "up-gradient and down-gradient reaches of the"	Final Design Modification
6-43	Sec. 6.2.6, ¶ 1, Lines 7 & 8	Deleted the following sentence "A "one-pass" trencher, very similar to that used to construct the CBW, will be utilized to install the finger drains."	Final Design Modification
6-43	Sec. 6.2.6, ¶ 1, Line 11	Deleted "During the "one-pass" operation"	Final Design Modification
7-94	¶ 1, Line 4	Changed "would" to "will"	Correction based on Draft License Condition 9.2
7-94	¶ 1, Line 5	Added "or standard resin" after "500 cubic foot"	Clarification
7-94	¶ 2, Lines 10, 11, and 12	Changed "would" to "will" (3 occurrences)	Correction based on Draft License Condition 9.2
G-1	8th Glossary Definition, Line 2	Deleted "contaminant"	Final Design Modification

[1] Denotes paragraph on TR page considering partial paragraphs or paragraphs within subsections as noted.

Technical Report Change Index

Page	Original Location[1]	Revision	Source of Revision
G-1	8th Glossary Definition, Lines 2 & 3	Deleted "around the central plant area"	Final Design Modification
		Technical Report Addendum 3.1-A	
13	Sec. 6.1, ¶ 1, Line 2	Changed "around a portion," to "upgradient"	Final Design Modification
13	Sec. 6.1, ¶ 1, Lines 7 & 8	Deleted last sentence in paragraph referencing the CBW construction method	Final Design Modification
13	Sec. 6.1, ¶ 3, Line 1	Changed "encloses the CPP area on three sides" to "runs along the south edge of the CPP area"	Final Design Modification
13	Sec. 6.1, ¶ 3, Line 2	Changed "along" to "around"	Final Design Modification
13	Sec. 6.1, ¶ 3, Lines 2 & 3	Deleted "west side of the"	Final Design Modification
13	Sec. 6.1, ¶ 3, Line 3	Deleted the word "is" after the word "bedrock" and added "along the east and west sides of the site are" after the word "bedrock"	Final Design Modification
14	¶ 1, Lines 1 & 2	Deleted last sentence in paragraph referencing groundwater flow to the west side of the site	Final Design Modification
14	¶ 1	Added a description of the function and siting criteria for the CBW	Final Design Modification
14	Sec 6.2, ¶ 1, Line 1	Changed "Three" to "Four" in reference to the number of French drains proposed at the site	Final Design Modification
14	Sec 6.2, ¶ 1, Line 2	Added a description of the locations of the French drains	Final Design Modification
16	Figure 6.1	Revised CBW location and added upgradient french drain location	Final Design Modification
		Technical Report Addendum 6.1-A	
15	Sec. 3.3, ¶ 1, Line 1	Changed "surrounding" to "at"	Final Design Modification
15	Sec. 3.3, ¶ 1, Lines 4 & 5	Deleted "up-gradient and down-gradient reaches of the"	Final Design Modification
15	Sec. 3.3, ¶ 1, Lines 5 & 6	Deleted the following sentence "A "one-pass" trencher, very similar to that used to construct the CBW, will be utilized to install the finger drains."	Final Design Modification
15	Sec. 3.3 ¶ 1, Line 9	Deleted "During the "one-pass" operation"	Final Design Modification

[1] Denotes paragraph on TR page considering partial paragraphs or paragraphs within subsections as noted.