ADDENDUM 6.1-A

RESTORATION ACTION PLAN

WITH FINANCIAL ASSURANCE ESTIMATE

PREAMBLE

This preamble is intended to provide NRC staff with a brief legal and regulatory discussion of the contents of the attached restoration action plan (RAP) for Strata Energy, Ltd.'s (Strata) proposed Ross *in-situ* leach uranium recovery (ISR) project near Oshoto in the State of Wyoming. Strata is submitting this RAP as a stand-alone document so that NRC staff reviewing Strata's license application will be able to address relevant decommissioning and decontamination (D&D) requirements and related financial assurance cost estimates associated with aquifer restoration and surface reclamation at the proposed Ross ISR Project in one document rather than having to search the entirety of the license application for all relevant D&D and financial assurance information. In addition, preparation of the attached RAP is in accordance with the NRC's requirements for ISR licensing as defined in 10 CFR Part 40, Appendix A, Criterion 9 and all regulations deemed to apply to ISR site D&D. Given that as discussed below previous RAPs were submitted as stand-alone documents, Strata has determined that submission of a stand-alone RAP is appropriate.

Under the Commission's regulations, RAPs find their origin in the Commission's interpretation of 10 CFR Part 40, Appendix A, Criterion 9 in the Hydro Resources, Inc. (HRI) administrative litigation regarding HRI's proposed ISR project at Church Rock and Crownpoint, New Mexico (hereinafter the Crownpoint Uranium Project or "CUP"). Beginning in 1997, HRI and several interveners entered into administrative litigation before NRC's Atomic Safety and Licensing Board (Licensing Board) to determine whether several aspects of HRI's CUP license application and NRC Staff review of that application satisfied the Atomic Energy Act of 1954 as amended (AEA) and the NRC's implementing regulations pursuant thereto. During this litigation, in 1998, NRC staff issued HRI License SUA-1508 to construct and operate the proposed CUP. After concluding the initial litigation regarding the Licensing Board's determination that the proposed CUP adequately addressed groundwater restoration and financial assurance, in 2000, the NRC considered an appeal to that decision. In 2000, the NRC determined that a license applicant for an ISR project must have an NRC-approved RAP, including a detailed financial assurance calculation methodology and preliminary cost estimates, prior to being issued a license to operate any proposed ISR project. Importantly, while it determined that a license applicant must have the aforementioned RAP in place prior to being issued a license, the NRC also determined that the actual financial assurance mechanism (e.g., surety bond, letter of credit, cash deposit, etc.) need not be in place until the licensee is prepared to commence licensed operations. Accordingly, when submitting a license application for a new ISR project, a license applicant is required to prepare and submit a detailed financial assurance calculation methodology and preliminary cost estimates based solely on the information permitted to be obtained pre-license issuance by the applicant under NRC regulations; however, a license applicant is not required to have a final financial assurance cost estimate and a financial assurance mechanism in place until right before it is ready to commence licensed operations and after issuance of an NRC license.

The HRI litigation also provided ISR license applicants with additional guidance on the methodology for preparing RAPs and for calculating preliminary financial assurance cost estimates for such RAPs. For example, the Licensing Board, the NRC, and the United States Court of Appeals for the Tenth Circuit all have agreed that 10 CFR Part 40, Appendix A, Criterion 9 permits ISR license applicants to account for and rely upon the use of existing site equipment such as the central processing plant (CPP), existing wellfields, wellfield equipment, and other already-available site equipment when calculating financial assurance cost estimates for groundwater restoration. The NRC's interpretation logically implements the provisions of Criterion 9 as independent contractors likely will rely on the availability of existing wellfields, the CPP, and other site facilities to initiate and/or continue and complete groundwater restoration at an ISR site. In addition, existing 11e.(2) byproduct material storage areas and site equipment such as front-end loaders will be required to complete site D&D, including surface reclamation tasks such as soil cleanup in accordance with 10 CFR Part 40, Appendix A, Criterion 6(6).

The HRI decision also permits licensees to utilize qualified site employees for the performance of multiple, unrelated site tasks during the course of groundwater restoration and site D&D in developing financial assurance cost estimates. ISR sites are highly automated, and standard industry practices dictate that a single site employee can perform multiple tasks based on the training they receive and expertise they possess.

In addition to the aforementioned requirements, NRC regulations at 10 CFR Part 40, Appendix A, Criterion 9 also require that a *licensee* submit updates to its financial assurance cost estimates on an *annual* basis and that such estimates must account for a variety of economic and site-specific factors such as inflation (Consumer Price Index), changes in costs of materials and for personnel, changes in costs of 11e.(2) byproduct material or other waste disposal, changes in costs of required site processes such as well plugging, and changes in site-specific factors such as the level of effort and duration required for groundwater restoration (e.g., pore volumes). This requirement is intended to ensure that all financial assurance mechanisms posted by a licensee remain current and sufficient to perform required groundwater restoration and site D&D as required and in a timely fashion. Based on this requirement, ISR license applicants also are only required to present financial assurance cost estimates in license applications that account for the first year of proposed activities or the first stage of licensed operations, including construction of the CPP and the initial wellfield(s). To require otherwise would be unnecessary as an ISR license applicant will not proceed beyond certain initial site activities in the first year and given the aforementioned NRC interpretation that a financial assurance mechanism need not be in place until the commencement of operations and that an ISR licensee will be required to update its initial financial assurance cost estimates from its license application prior to posting its financial assurance mechanism and commencing licensed operations. Accordingly, ISR licensees will continue to post adequate financial assurance cost estimates in accordance with NRC's mission of protecting public health and safety and the environment.

To comply with the NRC's directive above in the HRI litigation, HRI proposed four (4) RAPs, one for each of its proposed CUP ISR sites and each of which was approved by NRC staff subject to minor adjustments by the Licensing Board. Each of these RAPs, with the Licensing Board's adjustments, was approved by the NRC and the Tenth Circuit over the full course of that litigation.

Using these RAPs as guidance and considering that NRC staff does not currently have guidance for the composition of stand-alone RAPs, Strata is proposing a RAP for its proposed Ross ISR Project that closely follows the HRI RAPs' format. However, Strata has used updated assumptions reflecting current standard industry practices and included the work required and associated costs to reclaim all facilities associated with the CPP and the first five (5) wellfield modules, rather than just the first year's estimated construction. This is conservative in that uranium recovery operations are unlikely to occur in five modules during the first year of licensed activities. In the attached RAP, Strata is including a comprehensive site D&D plan, including aquifer restoration for the first five wellfield modules and D&D of the CPP and all other site activities required to be completed to return the Ross site to unrestricted use. These activities include D&D of site equipment, demolition of the CPP, reclamation of the initial wellfield modules, and off-site disposal of all wastes, including 11e.(2) byproduct material. The RAP also includes preliminary financial assurance cost estimates for all site D&D activities.

As can be seen from the RAP, Strata has accounted for all NRC interpretations offered in the HRI case to reflect the most current NRC practices for financial assurance. Strata believes that this RAP provides NRC staff with a user-friendly, stand-alone guide to Strata's approach to site D&D and financial assurance.

Strata Energy, Inc.
RESTORATION ACTION PLAN
License No: SUA-++++
December 2010

RESTORATION ACTION PLAN

A. INTRODUCTION

The following summarizes the Restoration Action Plan for the CPP, first five (5) wellfield modules and all related facilities anticipated to be constructed during the first year of licensed activities of the Ross ISR Project near Oshoto, Wyoming. The estimate puts the costs of restoration to be performed by an independent contractor at $9,672,068.85 over an approximately 3-year period during which the CPP, the initial five (5) wellfield modules, and associated infrastructure would be reclaimed to a condition agreed upon by NRC that would return the site to unrestricted use. The RAP encompasses the full cycle of activities necessary for:

- Facility decommissioning,
- Aquifer restoration and well plugging,
- Radiological survey and environmental monitoring,
- Project management and miscellaneous costs, and
- Labor and equipment overhead and contractor profit.

Strata's submittal presented herein employs assumptions that are based on best professional judgment given the data currently available. Annual reviews would provide the iterative format by which NRC can continually update the financial assurance amount based on work completed at the site and newly available information.

B. FINANCIAL ASSURANCE MECHANISM

The financial assurance mechanism to be used by Strata is shown in Attachment RAP-1.

C. CONSOLIDATION OF STATE, EPA AND NRC FINANCIAL ASSURANCE INSTRUMENTS

In addition to being crafted to comply with NRC criteria, Strata's proposed financial assurance estimate is designed to address the U.S. Environmental Protection Agency (EPA) Underground Injection Control criteria and the Wyoming Environmental Quality Act requirements for a reclamation performance bond. These multi-compliant sureties will require multi-agency concurrence as to amounts and surety forms. The bond examples shown in Attachment RAP-1 are designed to be consistent with 10 CFR Part 40, Appendix A, Criterion 9 (Financial Criteria) which allows for consolidation of State and Federal financial or surety arrangements established to meet restoration, reclamation, and decommissioning costs provided that "the portion of the surety which covers the decommissioning and reclamation of the mill, mill tailings site and associated areas is clearly identified and committed for use in accomplishing these activities." Absent a mill or tailings, essentially all of the process facility, wellfield, and ancillary components of the operations would be subject to the decommissioning requirements of the Wyoming Department of Environmental Quality, U.S. Environmental Protection Agency and the NRC.

D. COST DETAILS FOR RESTORATION AND RECLAMATION ACTIVITIES

1. Introduction

Attachment RAP-2 contains details concerning cost basis figures and assumptions, calculations and methodologies used in deriving cost estimates for the full cycle of groundwater restoration, well plugging and abandonment, surface decommissioning and reclamation, closure and ultimate license termination. Cost references are provided in Attachment RAP-3. This information is designed to be descriptive enough for the NRC staff to determine the acceptability of Strata's proposed cost figures and is based on the estimated costs for an independent contractor to perform the decommissioning and reclamation work in accordance with 10 CFR Part 40, Appendix A, Criterion 9 and the Wyoming Environmental Quality Act and its accompanying rules and regulations and guidelines. Strata has developed its cost estimates to address all items in Appendix C of the NRC's "Standard Review Plan for In Situ Leach Uranium Extraction License Applications" (NUREG-1569, dated June 2003).

The following tabulation summarizes the costs necessary to hire an independent contractor to assume all decommissioning and reclamation activities required after full development of the CPP, first five (5) wellfield modules and associated facilities. Descriptions of the work are provided below, and detailed costs estimates for each major item of work are provided in attachments RAP-2(A) through (G).

Item	Cost
Aquifer restoration	$ 2,866,412.03
Facilities area reclamation	$ 2,344,689.50
Wellfield equipment & disposal	$ 1,653,423.27
Well abandonment	$ 1,030,261.08
Radiological surveys	$ 37,857.50
Revegetation	$ 66,000.00
Misc. reclamation activities	$ 268,082.14
Subtotal	$ 8,266,725.52
Project management @ 2%	$ 165,334.51
Contingency @ 15%	$ 1,240,008.83
Total	$ 9,672,068.86

2. Aquifer Restoration

2.1. Introduction

Aquifer restoration costs for the first five wellfield modules are presented in Attachment RAP-2(A). The costs are broken down into separate phases of work:

- Groundwater sweep,
- Reverse osmosis (RO) with permeate injection,
- Groundwater recirculation,
- Monitoring,
- Labor, and
- Miscellaneous.

For each phase of work, the estimated number of pore volume displacements (PVDs) required to complete that phase is provided in the attachment. The tables also provide the assumptions and unit prices for all the work necessary to complete each phase of work for the first five wellfield modules. A summary sheet is provided showing the total costs for each phase, followed by detailed calculation sheets to show how the total costs were derived. For the first five wellfield modules, the PVDs of water to be handled and the aquifer restoration costs are estimated to be as follows:

Item	PVDs	Cost
Groundwater sweep	0.5	$ 52,669.28
RO with permeate injection	7.0	$ 521,579.74
Groundwater recirculation	1.0	$ 12,613.01
Monitoring	---	$ 94,500.00
Labor	---	$1,943,550.00
Miscellaneous	---	$ 241,500.00
Total for groundwater restoration	8.5	$2,866,412.03

Restoration progress is typically measured on the basis of the number of PVDs processed during each phase of groundwater restoration. A pore volume is a term used by the ISR industry to define an indirect measurement of a unit volume of aquifer affected by ISR recovery or restoration (ISR GEIS, NRC 2009). This report distinguishes between the *in-situ* pore volume (PV) and the pore volume displacement (PVD), which is used to describe the volume of water displaced during ISR uranium recovery and aquifer restoration. Following industry standard, Strata proposes to calculate a PVD as follows:

PVD = thickness x wellfield area x porosity x flare x conversion factor

The **thickness** is the average completion thickness for the recovery and injection wells. Based on exploration drilling, the ore zone thickness ranges from 5 to 30 feet and averages approximately 9 feet across the proposed project area. The average completion thickness is typically about 20% greater than the average ore zone thickness and is expected to average approximately 11 feet. This method of calculation is consistent with currently permitted and operating ISR production facilities (COGEMA 2008, CBR 2000).

The **wellfield area** is the surficial area of the injection and recovery well patterns for each wellfield module. Based on the delineation of recoverable resources within the proposed project area, the average area per wellfield module is estimated to be 248,000 square feet.

The **porosity** or pore space is defined as the collective open spaces of the formation or a measure of the amount of liquid or gas that may be absorbed or produced by a particular formation (ISR GEIS). The porosity of the ore zone within the proposed project area was determined by laboratory analysis of core samples collected during exploration drilling. The porosity is estimated to average 34% across the proposed project area.

The **flare** is a proportionality factor that estimates the amount of aquifer water outside of the pore volume that has been affected by lixiviant flow during the recovery phase (GEIS). Flare estimates usually include a horizontal and vertical flare factor. The horizontal flare is the volume of water affected by lixiviant outside the edge of the wellfield pattern. The vertical flare is the volume of water affected by lixiviant above and below the completion interval. Strata estimates the horizontal flare at 35% and the vertical flare at 20%. This is consistent with other ISRs as described in TR Section 6.1.6. The horizontal flare estimate is also supported by the results and simulations presented in the groundwater model report as described in TR Addendum 2.7-H.

An estimate of the PVD of a typical wellfield module is calculated as follows, where 7.48 is the conversion factor for cubic feet to gallons of water:

$$\text{PVD} = 11.0 \text{ feet} \times 248{,}000 \text{ ft}^2 \times 0.34 \times 1.62 \times 7.48 = 11.2 \text{ million gallons}$$

The duration of the aquifer restoration phase was based on the processing and circulation of 8.5 pore volumes of groundwater at the liquid processing rates specified in the calculation work sheets for each phase in Attachment RAP-2(A). The financial assurance will be maintained at this level until the number of pore volumes required to satisfactorily complete each phase has been demonstrated.

Strata will adjust the financial assurance budget for aquifer restoration during each annual update review to reflect experience gained from actual operation. Because the restoration equipment such as wellfield pumps, lined retention ponds, the deep disposal wells, the RO units, laboratory equipment, trucks, and field equipment will have been incurred for production process operations, they are considered operational capital and are not included as capital requirements in any of the RAP budget items. NRC will be able to verify the availability of the restoration equipment during routine inspections.

2.2 Description of Work

The first stage of aquifer restoration is groundwater sweep, in which groundwater is pumped from the wellfield module with no reinjection. This causes water from the formation surrounding the wellfield module to sweep through the wellfield toward the recovery wells. Based on the anticipated aquifer restoration schedule (refer to S-1 in Attachment RAP-3), during most aquifer restoration normal operations, when some wellfield modules are undergoing groundwater sweep while others are in RO treatment with permeate injection, the water removed from the groundwater sweep is taken to the RO units (see below) and the purified water (RO permeate) is reinjected into the wellfield module(s) undergoing RO treatment with permeate injection. The brine from the RO units is taken to the lined retention ponds and then to a deep disposal well. For the first wellfield module undergoing groundwater sweep, it is assumed there are no wells concurrently in RO treatment with permeate injection. Thus, the groundwater from the groundwater sweep will be taken to the RO units, the high-quality permeate will be discharged (assuming a temporary WYPDES permit can be obtained) and the brine will be taken to the deep disposal wells. It is estimated that the groundwater sweep will remove about 0.5 PVD from the wellfield at a rate of 75 gpm per wellfield module. Only one wellfield will typically be in this phase of restoration at one time. The duration of the sweep will be about two months per module.

RO is a water treatment process whereby the majority of dissolved ions, which are too large to pass through a filter that passes pure water molecules, are concentrated into brine. The product water that passes through the filter typically meets drinking water standards and during most restoration activities is reinjected back into the wellfield. This reinjection of relatively pure water mixes with formation water and helps bring the quality of the underground solutions toward baseline quality. During restoration the brine is pumped to a surge tank or lined retention pond to level out flow rates and then pumped to one of the disposal wells. Groundwater recovered from a depleted portion of the ore zone will be treated with an antiscalant and/or sulfuric acid to prevent fouling; these are the only pretreatment chemicals budgeted. The water will also pass through a pre-filtration system for particulate removal. To achieve RO purification, the pretreated solution is pressurized and directed to the first step of a two-stage RO process. Approximately 70 percent of the total feed volume will be converted to product water in the first stage. The brine water of the first stage will then act as the feed for the second stage, which yields an overall permeate recovery rate of approximately 85 percent. The RO equipment is sized to operate at a nominal capacity of 1,100 gpm. This is sufficient to treat the approximately 515 gpm from each of two modules typically in the RO treatment with permeate injection phase and one module in the groundwater sweep phase. It is estimated that each module will require RO treatment with permeate injection for about 4 months. With two modules at a time undergoing RO treatment with permeate injection for a 4-month period, the time to sequentially complete this process for the five initial wellfield modules will be about 12 months. The total time for groundwater sweep plus RO treatment with permeate injection is anticipated to be 14 months (refer to reference S-1 in Attachment RAP-3).

The third phase of aquifer restoration is groundwater recirculation, which begins after completion of the RO treatment with permeate injection phase. In this phase, water from the production zone will be pumped from recovery wells and recirculated into injection wells in the same module. This recirculation will homogenize the groundwater and help reduce the risk of "hot spots," or areas of unusually high concentrations of dissolved constituents. The only treatment that will occur during recirculation will be filtration and/or uranium/vanadium removal. It is expected that one PVD will be removed from the wellfield during this phase, at a rate of 300 gpm per module. The total duration of active aquifer restoration (groundwater sweep, RO treatment with permeate injection, and groundwater recirculation) is estimated to be 15 months for the first five wellfield modules.

There will be up to five deep disposal wells at the Ross ISR Project used for disposal of brine and any other waste water that does not meet criteria for discharge. However, only three deep disposal wells are anticipated to be installed during the first year of licensed activities. The capital costs will have been borne by Strata during construction of the plant facilities, but there will be operating and maintenance costs and costs for antiscalant and corrosion inhibitors. The lined retention ponds will be used to store the water until it is ready for deep well disposal. Ponds will have excess capacity to handle variations in water production, since the capacity of each deep disposal well will be relatively fixed by formation characteristics.

The final step in aquifer restoration will be the stability monitoring phase, which will be used to ensure that chemical species of concern do not increase in concentration subsequent to restoration. The stability monitoring phase is described in Section 6.1.2.5 of the TR and includes well sampling, data analysis and reporting. If the stability monitoring indicates that one or more dissolved parameters in the restored wellfield is trending above the target restoration value (TRV) for that parameter, it may be necessary to repeat one or more of the active restoration phases (groundwater sweep, RO with reinjection, or recirculation).

3. Facilities Area Decommissioning and Reclamation

Following wellfield restoration and stability monitoring, when it is certain that the water treatment equipment is no longer needed, reclamation can begin on the surface facilities. Procedures are fully described in Sections 6.2 and 6.3 of the TR. Detailed cost estimates for the facilities area decommissioning and reclamation are provided in Attachment RAP-2(B). The following tabulation shows a summary of the major cost items for this phase of work.

Item	Cost
Buildings	$ 411,373.56
Equipment	$ 516,538.25
Concrete	$ 860,964.28
Ponds	$ 170,195.09
Earthwork	$ 385,618.32
Total Facilities Reclamation Cost	$2,344,689.50

3.1 Buildings

Structures and equipment will be decontaminated or deposited at an NRC or agreement state approved waste facility site. Details regarding disposal of structures and equipment are discussed in Section 6.3 of the TR. Buildings to be removed include the CPP, chemical storage building, warehouse/maintenance building, administration building, and security building. Decontamination of salvageable building materials, equipment, pipe, and other materials to be released for unrestricted use will be accomplished by completing a preliminary radiological survey to determine the location and extent of the contamination and to identify any hazards as described in Section 6.3.3 of the TR. Processing and water treatment equipment, including tanks, filters, IX columns, pipes, and pumps, will be prepared, including decontamination if necessary, for use at another location or dismantled and disposed of in accordance with applicable regulations. Materials contaminated with other industrial constituents will be disposed of at an appropriately licensed facility. Decontaminated and non-contaminated materials will be removed for salvage or disposed of at an appropriately licensed solid waste facility. Structures will be decontaminated, if necessary, and moved to a new location and salvaged or disposed at an appropriately licensed solid waste facility. Concrete flooring, foundations, and foundation materials will be decontaminated, if necessary, broken up, and disposed of at an appropriately licensed facility.

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) surrounding 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 up-gradient and down-gradient reaches of the CBW. A "one-pass" trencher, very similar to that used to construct the CBW, will be utilized to install the finger drains. 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. During the "one-pass" operation, 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.

This method of CBW reclamation was selected as a means of effectively restoring the ground water flow system in the CPP area, while minimizing surface and environmental disturbance. The cost estimate for this phase of work is included in Attachment RAP-2(B).

4. Wellfield Equipment Removal and Disposal

Decommissioning and reclamation of the wellfields will include removal of the module buildings and all pipes and utilities connecting the wells to the module buildings and the CPP, shredding or chipping the solid materials to reduce the volume, and disposing of these materials in an approved municipal landfill or licensed 11e.(2) waste site as appropriate, and reclaiming the surface as described for the other surface facilities. The unit quantities and prices for each item of work in this task are included in Attachment RAP-2(C). The costs for this phase of work are summarized as follows:

Item	Cost
Wellfield piping	$1,480,069.23
Module buildings	$ 80,643.90
Valve manholes	$ 53,560.40
Wellheads	$ 14,910.00
Access roads	$ 24,239.74
Total wellfield reclamation cost	$1,653,423.27

5. Well Abandonment

All injection, recovery and monitor wells will be cemented from total depth to the surface as described in TR Addenda 2.6-E and 4.2-A. This work includes reclamation and abandonment of the 450 wellfield wells, 162 monitor wells and the 3 deep disposal wells that will be constructed during development of the initial five wellfield modules. The unit quantities and prices for each item of work in this task are included in Attachment RAP-2(D). The costs for this phase of work are summarized as follows:

Item	Cost
Recovery, injection and monitor wells	$ 717,931.08
Deep disposal wells	$ 312,330.00
Total well abandonment cost	$1,030,261.08

6. Radiological Surveys

During equipment decontamination, smear samples of building and equipment surfaces will be collected and analyzed for radiological contamination. The results of these samples will drive decontamination efforts. Following removal of all structures and regrading of the site to approximate original contours, and before topsoil is spread on the regraded area, a gamma survey and soil sampling will be conducted as described in Section 6.4 of the TR. Soils will be cleaned up in accordance with the requirements of 10 CFR Part 40, Appendix A, including consideration of ALARA goals and the chemical toxicity of uranium. The proposed limits and ALARA goals for cleanup of soils are summarized in section 6.4-3 of the TR. Any areas which do not meet these limits will be remediated by removing contaminated soils to an appropriately licensed site and regraded. This process will be repeated until all sites meet the ALARA goals for cleanup. The unit costs and areas subject to these surveys are provided in Attachment RAP-2(E). The total cost for this item of work is estimated to be $37,857.50.

7. Revegetation

At the completion of the previous tasks, and after topsoil has been spread across all regraded areas, all of the disturbed lands will be seeded with vegetation species that will return the lands to their pre-project conditions. The surface reclamation plan goals will be to return the land to equal or better condition than existed prior to uranium recovery, thus making it available for "unrestricted use." The reclaimed land will be capable of supporting livestock grazing, dry land farming and wildlife habitat. Baseline soils, vegetation, and radiological data will be used to guide the reclamation activities. Unit prices and the area to be revegetated are provided in Attachment RAP-2(F). The estimated cost to revegetate the area is $66,000.

8. Miscellaneous Reclamation Activities

Costs for miscellaneous reclamation activities not covered in the preceding sections are provided in Attachment RAP-2(G) and are summarized as follows:

Item	Cost
Fence removal	$ 36,361.62
Overhead power line removal	$ 0.00
Buried electrical line removal	$ 89,100.00
Buried gas line removal	$ 49,686.00
Transformer removal and disposal	$ 14,080.00
Surface water monitoring sta. removal	$ 7,035.60
Air quality/met. sta. removal	$ 6,205.36
Culvert removal	$ 5,613.56
Chipper/shredder rental/operation	$ 60,000.00
Total miscellaneous costs	$268,082.14

9. References

CBR (Crow Butte Resources, Inc.), 2000, Mine Unit 1 Restoration Report, Crow Butte Uranium Project, January 10, 2000, NRC ADAMS Accession No. ML003677938.

COGEMA Mining, Inc., 2008, Irigaray and Christensen Ranch Projects U.S. NRC License Renewal Application, Source Material License SUA-1341, May 2008, NRC ADAMS Accession No. ML081890414.

NRC (U.S. Nuclear Regulatory Commission), 2009, NUREG-1910, Generic Environmental Impact Statement for In-Situ Leach Uranium Milling Facilities, Final Report, May 2009.

ATTACHMENT RAP-1
FORM OF FINANCIAL ASSURANCE

The financial assurance funding mechanism is currently unknown; however, Strata will provide a mechanism for the approved financial assurance estimate in accordance with the conditions as set forth in 10 CFR Part 40, Appendix A, Criterion 9, prior to beginning active uranium recovery operations.

ATTACHMENT RAP-2
DETAILED COST ESTIMATES

RECLAMATION SUMMARY

	Item	Attachment	Worksheets	Cost
I.	Aquifer Restoration	RAP-2(a)	AR-1 through AR-8	$ 2,866,412.03
II.	Facilities Area	RAP-2(b)	FAC-1 through FAC-12	$ 2,344,689.50
III.	Wellfield Equipment	RAP-2(c)	WF-1 through WF-12	$ 1,653,423.27
IV.	Well Abandonment	RAP-2(d)	WA-1	$ 1,030,261.08
V.	Radiological Survey	RAP-2(e)	RAD-1	$ 37,857.50
VI.	Revegetation	RAP-2(f)	VEG-1	$ 66,000.00
VII.	Miscellaneous	RAP-2(g)	MISC-1 through MISC-2	$ 268,082.14
	Subtotal			$ 8,266,725.52
VIII.	Project Management @ 2%			$ 165,334.51
IX.	Contingency @ 15%			$ 1,240,008.83
	Total Reclamation Cost			**$ 9,672,068.86**

Attachment RAP-2(A)
Costs for Aquifer Restoration

I. AQUIFER RESTORATION SUMMARY

AR-1

	Item		Cost
I.	Groundwater Sweep	$	52,669.28
II.	Reverse Osmosis with Permeate Injection	$	521,579.74
III.	Groundwater Recirculation	$	12,613.01
IV.	Monitoring	$	94,500.00
V.	Labor	$	1,943,550.00
VII.	Miscellaneous	$	241,500.00
	Total Aquifer Restoration Cost	**$**	**2,866,412.03**

TECHNICAL ASSUMPTIONS			
Item		**Unit**	**Notes**
Average wellfield module area	248,000	sq-ft	Refer to RAP text
Average wellfield module area	5.7	ac	Calculated
Average completed thickness	11	ft	Refer to RAP text
Affected volume			
Vertical flare factor	20%		Refer to RAP text
Horizontal flare factor	35%		Refer to RAP text
Porosity	34%		Refer to RAP text
Gallons per cubic foot	7.48		Conversion factor
Gallons per pore volume displacement (PVD)	11,239,316	gal	Calculated
Total number of wellfield modules	5		Refer to RAP text
Number of injection, recovery, and monitor wells			
Average recovery wells per module	36		Preliminary wellfield design
Average injection wells per module	54		1.5 injection wells: 1 recovery well
Average recovery/injection wells per module	90		Calculated
Total recovery/injection wells per 5 modules	450		Calculated
Monitor wells (total all modules)	162		Assumes all monitor wells will be installed for both mine units
Total recovery/injection/monitor wells	612		Calculated
Average well depth	500	ft	TR Table 6.1-7 (OZ depth = 410-700 ft)

GROUNDWATER SWEEP COST ESTIMATE PER MODULE			
Operating Assumptions			**References**
Flow rate	75	gpm	TR Table 6.1-4
PVDs required	0.5	PVD	Refer to RAP text
Total groundwater sweep volume	5,619,658	gal	Calculated
Total groundwater sweep volume	5,620	kgal	Calculated
Duration of Groundwater Sweep			
Minutes	74,929	min	Calculated
Days	52	days	Calculated
Recovery Well Pumping Costs			
Average flow rate per pump	17	gpm	Estimated average recovery rate based on aquifer tests
Number of pumps required	5		Calculated
Power input per pump	4.0	kW	Reference P-1
Electrical requirement	20.0	kW	Calculated
Electrical consumption	24,976	kWh	Calculated
Power cost	$ 0.04	/kWh	Tiered rate is $0.03 to $0.04 per PRECorp
Total Recovery Well Pumping Cost	$ 999.05		
Recovery Booster Pumps			
Average flow	75	gpm	
Electrical requirement	5.0	kW	Reference P-2; reduced by 75% due to much lower flow rate
Electrical consumption	6,244	kWh	Calculated
Power cost	$ 0.04	/kWh	Tiered rate is $0.03 to $0.04 per PRECorp
Total Recovery Booster Pumping Cost	$ 249.76		
Reverse Osmosis Treatment			
2-Stage RO treatment cost	$ 0.88	/kgal	Reference RO-1
Total RO Treatment Cost	$ 4,945.60		
Permeate Disposal			
Permeate volume after Stage 1 RO	3,934	kgal	70% recovery (TR Fig. 3.1-13)
Permeate volume after Stage 2 RO	4,777	kgal	50% recovery (TR Fig. 3.1-13)
Excess permeate Module 1*	100%		
Excess permeate Modules 2-5*	0%		
Average excess permeate	20%		Calculated
Average excess permeate	955	kgal	Calculated
Cost of permeate disposal	$ 0.15	/bbl	Estimated disposal cost (land application, WYPDES discharge, etc.)
Cost of permeate disposal	$ 3.57	/kgal	Calculated
Total Permeate Disposal Cost	$ 3,412.14		
Brine Disposal			
Brine volume after Stage 1 RO	1,686	kgal	30% of influent (TR Fig. 3.1-13)
Brine volume after Stage 2 RO	843	kgal	50% of influent (TR Fig. 3.1-13)
Deep disposal well cost	$ 1.10	/kgal	See DDW-1 worksheet
Total Brine Disposal Cost	$ 927.30		
TOTAL COST PER MODULE	**$ 10,533.86**		
TOTAL COST FOR 5 MODULES	**$ 52,669.28**		

*Excess permeate will only be generated when the first module undergoes groundwater sweep. After that all permeate will be reinjected into modules undergoing RO treatment with permeate injection. Therefore, the volume has been divided by 5 to in order to find the total cost per module.

I. AQUIFER RESTORATION - RO TREATMENT WITH PERMEATE INJECTION

REVERSE OSMOSIS TREATMENT WITH PERMEATE INJECTION COST PER MODULE			
Operating Assumptions			
Average flow rate	515	gpm	TR Table 6.1-4
PVDs required	7	PVDs	Refer to RAP text
Total RO/permeate injection volume	78,675,212	gal	Calculated
Total RO/permeate injection volume	78,675	kgal	Calculated
Duration of RO treatment with permeate injection			
Minutes	152,767	min	Calculated
Days	106	days	Calculated
Recovery Well Pumping Costs			
Average flow rate per pump	17	gpm	Estimated average recovery rate based on aquifer tests
Number of pumps required	31		Calculated
Power input per pump	4.0	kW	Reference P-1
Electrical requirement	124.0	kW	Calculated
Electrical consumption	315,719	kWh	Calculated
Power cost	$ 0.04	/kWh	Tiered rate is $0.03 to $0.04 per PRECorp
Total Recovery Well Pumping Cost	$ 12,628.77		
Recovery Booster Pumps			
Average flow rate	515	gpm	
Electrical requirement	20.0	kW	Reference P-2
Electrical consumption	50,922	kWh	Calculated
Power cost	$ 0.04	/kWh	Tiered rate is $0.03 to $0.04 per PRECorp
Total Recovery Booster Pumping Cost	$ 2,036.90		
Reverse Osmosis Treatment			
2-Stage RO treatment cost	$ 0.88	/kgal	Reference RO-1
Total RO Treatment Cost	$ 69,234.19		
Brine Disposal			
Brine volume after Stage 1 RO	23,603	kgal	30% of influent (TR Fig. 3.1-13)
Brine volume after Stage 2 RO	11,801	kgal	50% of influent (TR Fig. 3.1-13)
Cost per kgal	$ 1.10	/kgal	Reference DDW-1
Total Brine Disposal Cost	$ 12,981.41		
CPP Permeate Pumps			
Average flow rate per pump	467.5	gpm	TR Figure 3.1-13 (935 gpm/2 - 2 modules in RO treatment/permeate injection at once)
Electrical requirement	15	kW	Reference P-4
Electrical consumption	38,192	kWh	Calculated
Power cost	$ 0.04	/kWh	Tiered rate is $0.03 to $0.04 per PRECorp
Total CPP Permeate Pump Cost	$ 1,527.67		
Injection Booster Pump			
Average flow rate per pump	467.5	gpm	See above
Electrical requirement	58	kW	Reference P-3
Electrical consumption	147,675	kWh	Calculated
Power cost	$ 0.04	/kWh	Tiered rate is $0.03 to $0.04 per PRECorp
Total Injection Booster Pump Cost	$ 5,907.01		
TOTAL COST PER MODULE	**$ 104,315.95**		
TOTAL COST FOR 5 MODULES	**$ 521,579.74**		

RECIRCULATION COST PER MODULE			
Operating Assumptions			
Average flow rate	300	gpm	TR Table 6.1-4
PVDs required	1	PVD	TR Table 6.1-3
Total recirculation volume	11,239,316	gal	Calculated
Total recirculation volume	11,239	kgal	Calculated
Duration of recirculation			
Minutes	37,464	min	Calculated
Days	26	day	Calculated
Recovery Well Pumping Costs			
Average flow rate per pump	17	gpm	Estimated average recovery rate based on aquifer tests
Number of pumps required	18		Calculated
Power input per pump	4.0	kW	Reference P-1
Electrical requirement	72.0	kW	Calculated
Electrical consumption	44,957	kWh	Calculated
Power cost	$ 0.04	/kWh	Tiered rate is $0.03 to $0.04 per PRECorp
Total Recovery Well Pumping Cost	$ 1,798.29		
Injection Booster Pump			
Average flow rate per pump	300	gpm	
Electrical requirement	29.0	kW	Reference P-2; reduced by 50% due to lower flow rate
Electrical consumption	18,108	kWh	Calculated
Power cost	$ 0.04	/kWh	Tiered rate is $0.03 to $0.04 per PRECorp
Total Injection Booster Pump Cost	$ 724.31		
TOTAL COST PER MODULE	**$ 2,522.60**		
TOTAL COST FOR 5 MODULES	**$ 12,613.01**		

MONITORING			
Monitoring during Active Restoration			
Excursion Monitoring			
Monitoring period	7	months	Reference S-1; 2 months groundwater sweep plus 4 months RO/permeate injection plus 1 month recirculation
Number of wells to sample	10	wells	Estimated monitor wells per module
Number of samples per month per well	2		Based on sampling every 2 weeks
Price per sample	$ 50.00		Approximate 2011 contract laboratory cost
Excursion monitoring cost	$ 7,000.00		Calculated
Restoration Verification Monitoring			
Monitoring period	7	months	Reference S-1; 2 months groundwater sweep plus 4 months RO/permeate injection plus 1 month recirculation
Number of wells to sample	2	wells	Based on 1 per 3-4 acres (5.7 acres/4)
Number of samples per month per well	1		Based on sampling every month
Price per sample	$ 330.00		Approximate 2011 contract laboratory cost
Verification monitoring cost	$ 4,620.00		Calculated
Total Active Restoration Monitoring Cost	$ 11,620.00		
Stability Monitoring			
Excursion Monitoring			
Monitoring period	12	months	Reference S-1
Number of wells to sample	10	wells	Estimated monitor wells per module
Number of samples per month per well	0.33		Based on sampling quarterly
Price per sample	$ 50.00		Approximate 2011 contract laboratory cost
Excursion monitoring cost	$ 2,000.00		
Stability Verification Monitoring			
Monitoring period	12	months	Reference S-1
Number of wells to sample	2	wells	Based on 1 per 3-4 acres (5.7 acres/4)
Number of samples per well	8		TR Section 6.1.2.5
Price per sample	$ 330.00		Approximate 2011 contract laboratory cost
Verification monitoring cost	$ 5,280.00		Calculated
Total Stability Monitoring Cost	$ 7,280.00		
TOTAL MONITORING COST PER MODULE	**$ 18,900.00**		
TOTAL COST FOR 5 MODULES	**$ 94,500.00**		

LABOR			
Operating Assumptions			
Time of active aquifer restoration	15	months	Reference S-1
Time of stability monitoring/decommissioning without active restoration	21	months	Reference S-1
Employees			
Active Aquifer Restoration			
Number of employees	20		Reference ER Table 4.2-1
Annual salary	$ 50,000.00		Reference ER Section 4.10.1.2
Overhead multiplier	1.0		Benefits and payroll taxes included in salary
Profit multiplier	1.12		Estimate
Total employee annual cost	$ 56,000.00		Calculated
Total Employee Cost during Active Restoration	$ 1,400,000.00		
Stability Monitoring/Decommissioning			
Number of employees	5		
Annual salary	$ 50,000.00		Reference ER Section 4.10.1.2
Overhead multiplier	1.0		Benefits and payroll taxes included in salary
Profit multiplier	1.12		Estimate
Total employee annual cost	$ 56,000.00		Calculated
Total Employee Cost During Stability Monitoring/Decommissioning	$ 490,000.00		
Total Employee Cost	$ 1,890,000.00		
Vehicles			
Number of vehicles	10		From emissions spreadsheet
Miles per day per vehicle	10	miles	Estimate (within licensed area)
Cost per mile	$ 0.51	/mile	Based on IRS mileage rate for 2011
Number of days per year	350	days	Based on vehicles running 50 weeks out of the year
Number of years	3.0	years	Calculated
Total Vehicle Cost	$ 53,550.00		
TOTAL LABOR COST	**$1,943,550.00**		

I. AQUIFER RESTORATION - MISCELLANEOUS

MISCELLANEOUS			
Operating Assumptions			
Time of active aquifer restoration	15	months	Reference S-1
Time of stability monitoring/decommissioning without active restoration	21	months	Reference S-1
Utilities			
Active Aquifer Restoration			
Monthly electricity cost	$ 8,000.00		From preliminary plant design (excludes process-related electrical consumption)
Monthly gas cost	$ 6,000.00		From preliminary plant design (excludes process-related gas consumption)
Active restoration utilities	$ 210,000.00		During 15 months of aquifer restoration
Stability Monitoring/Decommissioning			
Monthly electricity cost	$ 1,000.00		Estimate for administration building, warehouse, etc.
Monthly gas cost	$ 500.00		Estimate for administration building, warehouse, etc.
Stability monitoring/ decommissioning utilities	$ 31,500.00		During 21 months of stability monitoring/decommissioning without active restoration
Total Utilities Cost	$ 241,500.00		
Capital			
Pumping systems	$ -		Pumping systems in place during operation phase
RO systems	$ -		RO units in place during operation phase
Deep disposal wells			Deep disposal wells in place during operation phase
Excursion cleanup cost	$ -		Cost estimates will be updated in the event an excursion occurs
Total Capital Cost	$ -		
TOTAL MISCELLANEOUS COST	**$ 241,500.00**		

Attachment RAP-2(B)
Costs for Facilities Area Decommissioning and Reclamation

II. FACILITIES AREA - SUMMARY

FAC-1

	Item	Cost	
I.	Buildings	$	411,373.56
II.	Equipment	$	516,538.25
III.	Concrete	$	860,964.28
IV.	Lined Retention Ponds	$	170,195.09
V.	Earthwork	$	385,618.32
	Total Facilities Cost	**$**	**2,344,689.50**

I. Buildings (Excludes Concrete)			
CPP			
Dimensions			
Length	370	ft	TR Fig. 3.2-1
Width	200	ft	TR Fig. 3.2-1
Height	30	ft	Preliminary CPP design
Volume	2,220,000	ft^3	Calculated
Demolition			
Demolition unit cost	$ 0.125	$/ft^3$	WDEQ/LQD Guideline 12, Appendix K (Ref. LQD-K), less 50% for lack of interior building walls per RSMeans 02 41 16.13.5000
Demolition cost	$ 277,500.00		
Transportation			
Unit building weight	15	lb/ft^2	ASCE 7-05
Building weight	555	tons	Calculated
Salvage %	60%		Conservatively assumes zero net salvage value
Weight of material to dispose	222	tons	Calculated
Density of construction debris	2,000	lb/yd^3	Typical of construction debris
Volume of material for disposal	222	yd^3	Calculated
Volume per truck	20	yd^3	ER Section 4.13.1.1.2.1
Number of trucks	12	trucks	Calculated
Distance to landfill	23	miles	Moorcroft landfill
Cost per mile	$ 3.00	/mile	Actual 2010 costs from northeast Wyoming contract waste hauler
Total Transportation Cost	$ 828.00		
Disposal			
Disposal fee	$ 56.80	/ton	Reference L-1
Disposal cost	$ 12,609.60		Calculated
Total CPP Cost	**$ 290,937.60**		
Chemical Storage Building			
Dimensions			
Length	98	ft	TR Fig. 3.2-8
Width	50	ft	TR Fig. 3.2-8
Height	30	ft	Preliminary design
Volume	147,000	ft^3	Calculated
Demolition			
Demolition unit cost	$ 0.125	$/ft^3$	WDEQ/LQD Guideline 12, Appendix K (Ref. LQD-K), less 50% for lack of interior building walls per RSMeans 02 41 16.13.5000
Demolition cost	$ 18,375.00		
Transportation			
Unit building weight	15	lb/ft^2	ASCE 7-05
Building weight	37	tons	Calculated
Salvage %	60%		Conservatively assumes zero net salvage value
Weight of material to dispose	15	tons	Calculated
Density of construction debris	2,000	lb/yd^3	Typical of construction debris
Volume of material for disposal	15	yd^3	Calculated
Volume per truck	20	yd^3	ER Section 4.13.1.1.2.1
Number of trucks	1	trucks	Calculated
Distance to landfill	23	miles	Moorcroft landfill
Cost per mile	$ 3.00	/mile	Actual 2010 costs from northeast Wyoming contract waste hauler
Total Transportation Cost	$ 69.00		
Disposal			
Disposal fee	$ 56.80	/ton	Reference L-1
Disposal cost	$ 834.96		Calculated
Total Chemical Storage Building Cost	**$ 19,278.96**		

Warehouse/Maintenance Building			
Dimensions			
Length	150	ft	TR Fig. 3.1-16
Width	100	ft	TR Fig. 3.1-16
Height	30	ft	Estimate
Volume	450,000	ft^3	Calculated
Demolition			
Demolition unit cost	$ 0.125	$\$/ft^3$	WDEQ/LQD Guideline 12, Appendix K (Ref. LQD-K), less 50% for lack of interior building walls per RSMeans 02 41 16.13.5000
Demolition cost	$ 56,250.00		
Transportation			
Unit building weight	15	lb/ft^2	ASCE 7-05
Building weight	113	tons	Calculated
Salvage %	60%		Conservatively assumes zero net salvage value
Weight of material to dispose	45	tons	Calculated
Density of construction debris	2,000	lb/yd^3	Typical of construction debris
Volume of material for disposal	45	yd^3	Calculated
Volume per truck	20	yd^3	ER Section 4.13.1.1.2.1
Number of trucks	3	trucks	Calculated
Distance to landfill	23	miles	Moorcroft landfill
Cost per mile	$ 3.00	/mile	Actual 2010 costs from northeast Wyoming contract waste hauler
Total Transportation Cost	$ 207.00		
Disposal			
Disposal fee	$ 56.80	/ton	Reference L-1
Disposal cost	$ 2,556.00		Calculated
Total Warehouse/Maint. Bldg. Cost	**$ 59,013.00**		
Administration Building			
Dimensions			
Length	100	ft	TR Fig. 3.1-16
Width	100	ft	TR Fig. 3.1-16
Height	15	ft	Estimate
Volume	150,000	ft^3	Calculated
Demolition			
Demolition Unit Cost	$ 0.25	$\$/ft^3$	From WDEQ/LQD Guideline 12, Appendix K (Ref. LQD-K)
Demolition Cost	$ 37,350.00		
Transportation			
Unit building weight	15	lb/ft^2	ASCE 7-05
Building weight	75	tons	Calculated
Salvage %	25%		Conservatively assumes zero net salvage value
Weight of material to dispose	56	tons	Calculated
Density of construction debris	2,000	lb/yd^3	Typical of construction debris
Volume of material for disposal	56	yd^3	Calculated
Volume per truck	20	yd^3	ER Section 4.13.1.1.2.1
Number of trucks	3	trucks	Calculated
Distance to landfill	23	miles	Moorcroft landfill
Cost per mile	$ 3.00	/mile	Actual 2010 costs from northeast Wyoming contract waste hauler
Total Transportation Cost	$ 207.00		
Disposal			
Disposal fee	$ 56.80	/ton	Reference L-1
Disposal cost	$ 3,195.00		Calculated
Total Administration Building Cost	**$ 40,752.00**		

Security Building			
Dimensions			
Length	20	ft	Preliminary design
Width	20	ft	Preliminary design
Height	12	ft	Estimate
Volume	4,800	ft^3	Calculated
Demolition			
Demolition Unit Cost	$ 0.25	$\$/ft^3$	Reference LQD-K
Demolition Cost	$ 1,195.20		
Transportation			
Unit building weight	15	lb/ft^2	ASCE 7-05
Building weight	3	tons	Calculated
Salvage %	25%		Conservatively assumes zero net salvage value
Weight of material to dispose	2	tons	Calculated
Density of construction debris	2,000	lb/yd^3	Typical of construction debris
Volume of material for disposal	2	yd^3	Calculated
Volume per truck	20	yd^3	ER Section 4.13.1.1.2.1
Number of trucks	1	trucks	Calculated
Distance to landfill	23	miles	Moorcroft landfill
Cost per mile	$ 3.00	/mile	Actual 2010 costs from northeast Wyoming contract waste hauler
Total Transportation Cost	$ 69.00		
Disposal			
Disposal fee	$ 56.80	/ton	Reference L-1
Disposal cost	$ 127.80		Calculated
Total Security Building Cost	**$ 1,392.00**		
TOTAL BUILDING DEMOLITION/DISPOSAL COST	**$ 411,373.56**		

II. Equipment Removal/Disposal				
CPP	Quantity	Unit Volume	Volume	
Equipment List		(ft^3/unit)	(ft^3)	
Lab equipment	1	75	75	Estimate
Caustic soda tank	4	2,271	9,082	TR Figure 3.2-1
RO unit	4	1,389	5,556	TR Table 3.2-2
Restoration guard column	1	1,350	1,350	TR Table 3.2-2
Waste water (brine) tank	1	10,857	10,857	TR Table 3.2-2
Pumps	12	4	48	Estimate
Backwash tank	2	1,696	3,393	TR Table 3.2-2
De-sanding tank	3	1,696	5,089	TR Table 3.2-2
Thickener tank	2	26,179	52,358	TR Table 3.2-2
Uranium precipitation tank	10	942	9,425	TR Table 3.2-2
Vanadium precipitation tank	5	226	1,131	TR Table 3.2-2
Elution tank	6	2,375	14,250	TR Table 3.2-2
IX column	15	1,350	20,250	TR Table 3.2-2
Resin conditioning/resin water tank	2	2,036	4,072	TR Table 3.2-2
Resin screen	6	128	768	Preliminary CPP design from Lyntek
Yellowcake dryer	1	15,000	15,000	Estimate
Filter press	1	288	288	Preliminary CPP design from Lyntek
Wet scrubber	1	300	300	Preliminary CPP design from Lyntek
Vanadium dryer	1	15,000	15,000	Preliminary CPP design from Lyntek
Vanadium filter	1	300	300	Preliminary CPP design from Lyntek
		Total volume =	168,593	ft^3
		Total volume =	6,244	yd^3
Dismantling/Demolition/Decontamination				
Dismantling/demolition duration	90	days	Estimate	
Daily dismantling/demolition cost	$ 1,525.00	/day	RSMeans 2011, 02 42 10.20.9000, cost for hydraulic crane and crew	
Dismantling/demolition cost	$ 137,250.00			
Dismantled/demolished volume	3,122	yd^3	50% of total volume, estimate	
Decontamination unit cost	$ 31.00	/yd^3	From industry comparison	
Total Decontamination Cost	$ 96,782.00		Calculated	
Total Cost	$ 234,032.00			
Transportation				
Salvage percentage	50%		Estimate	
Salvage volume	1,561	yd^3	Assume no net salvage value	
Volume to landfill	1,171	yd^3	75% of demolished, non-salvaged volume, estimate	
Volume to 11e.(2) disposal site	390	yd^3	25% of demolished, non-salvaged volume, estimate	
Volume per truckload	20	yd^3	ER Section 4.13.1.1.2.1	
Number of trucks to landfill	59	trucks	Calculated	
Distance to landfill	23	miles	To Moorcroft	
Number of trucks to 11e.(2) disposal site	20	trucks	Calculated	
Distance to 11e.(2) disposal site	235	miles	To Pathfinder Shirley Basin Facility	
Transportation cost	$ 3.00	/mile	Actual 2010 costs from northeast Wyoming contract waste hauler	
Total transportation cost	$ 18,171.00			
Disposal				
Landfill disposal fee	$ 56.80	/ton	Reference L-1	
Equipment debris bulk density	2,000	lb/yd^3	Typical of construction debris	
Equipment weight	1,171	tons	Calculated	
Landfill cost	$ 66,498.60		Calculated	
11e.(2) disposal fee	$ 405.00	/yd^3	Industry comparison, $15/$ft^3$	
11e.(2) disposal cost	$ 158,051.25		Calculated	
Total disposal cost	$ 224,549.85		Calculated	
Total CPP Equipment Cost	$ 476,752.85			

Chemical Storage	Quantity	Unit Volume	Volume	
Equipment List		(ft^3/unit)	(ft^3)	
Sulfuric Acid	1	1,357	1,357	TR Table 3.2-2
Hydrogen Peroxide	1	1,357	1,357	TR Table 3.2-2
Ammonium Sulfate Mix	2	2,232	4,464	TR Table 3.2-2
Bicarbonate Mix	3	2,232	6,696	TR Table 3.2-2
Ammonia	1	419	419	TR Table 3.2-2
Carbon Dioxide	1	419	419	TR Table 3.2-2
Oxygen	2	419	838	Preliminary design from Lyntek
		Total Volume =	15,551	ft^3
		Total Volume =	576	yd^3
Dismantling/Demolition				
Dismantling/demolition duration	15	days	Estimate	
Daily dismantling/demolition cost	$ 1,525.00	/day	RSMeans 2011, 02 42 10.20.9000, cost for hydraulic crane and crew	
Dismantling/demolition cost	$ 22,875.00			
Dismantled/demolished volume	288	yd^3	50% of total volume, estimate	
Decontamination unit cost	$ 31.00	/yd^3	Industry comparison	
Total decontamination cost	$ 8,928.00		Calculated	
Total Demolition Cost	$ 31,803.00			
Transportation				
Salvage percentage	50%		Estimate	
Salvage volume	144	yd^3	Assume no net salvage value	
Volume to landfill	144	yd^3	100% of demolished, non-salvaged volume, estimate	
Volume per truckload	20	yd^3	ER Section 4.13.1.1.2.1	
Number of trucks to landfill	8	trucks	Calculated	
Distance to landfill	23	miles	To Moorcroft	
Cost per mile	$ 3.00	/mile	Actual 2010 costs from northeast Wyoming contract waste hauler	
Total Transportation Cost	$ 552.00			
Disposal				
Landfill disposal fee	$ 56.80	/ton	Reference L-1	
Equipment debris bulk density	2,000	lb/yd^3	Typical of construction debris	
Equipment weight	144	tons	Calculated	
Landfill cost	$ 8,179.20		Calculated	
Landfill disposal fee	$ 56.80	/yd^3	Reference L-1	
Total Disposal Cost	$ 16,358.40			
Total Chemical Storage Cost	$ 39,785.40			
Warehouse/Maintenance	$ -		Equipment costs included in building cost	
Administration Building	$ -		Equipment costs included in building cost	
Security	$ -		Equipment costs included in building cost	
TOTAL EQUIPMENT REMOVAL/DISPOSAL COST	**$ 516,538.25**			

III. Concrete Removal/Disposal			
CPP			
Dimensions			
Floor slab			
Length	370	ft	Refer to TR Fig. 3.2-1
Width	200	ft	Refer to TR Fig. 3.2-1
Thickness	0.5	ft	Estimate
Footers			
Length	1,140	ft	Building perimeter
Width	2	ft	Estimate
Thickness	3	ft	Estimate
Demolition			
Floor slab area	74,000	ft^2	Calculated
Floor slab demolition unit cost	$ 5.05	$/ft^2$	WDEQ/LQD Guideline 12 Appendix K (Ref. LQD-K)
Floor slab milling unit cost	$ 0.20	$/ft^2$	From RSMeans 2011, 32 01 16.71.5200
Floor slab demolition cost	$ 373,700.00		Calculated
Floor slab milling cost	$ 14,504.00		Calculated
Footer demolition unit cost	$ 18.14	/ft	WDEQ/LQD Guideline 12 Appendix K (Ref. LQD-K)
Footer demolition cost	$ 20,679.60		
Total demolition cost	$ 408,883.60		
Transportation			
Volume to landfill	1,933	yd^3	Volume of footer plus 90% of floor slab, estimate; includes 30% swell factor for void space
Volume to 11e.(2) disposal site	178	yd^3	10% of floor slab volume, estimate; includes 30% swell factor for void space
Volume per truckload	20	yd^3	ER Section 4.13.1.1.2.1
Number of trucks to landfill	97	trucks	Calculated
Distance to landfill	23	miles	Moorcroft
Number of trucks to 11e.(2) disposal site	9	trucks	Calculated
Distance to 11e.(2) disposal site	235	miles	Pathfinder Shirley Basin Facility
Transportation cost	$ 3.00	/mile	Actual 2010 costs from northeast Wyoming contract waste hauler
Total transportation cost	$ 13,038.00		
Disposal			
Landfill disposal fee	$ 56.80	/ton	Reference L-1
Density of concrete	100	lb/ft^3	Estimate for demolished concrete
Landfill cost	$ 148,222.44		
11e.(2) disposal fee	$ 405.00	$/yd^3$	Industry comparison, $15/ft^3
11e.(2) disposal cost	$ 72,150.00		
Total Disposal Cost	$ 220,372.44		
Total CPP Concrete Cost	$ 642,294.04		

Chemical Storage Area			
Dimensions			
Floor slab			
Length	98	ft	TR Figure 3.2-8
Width	50	ft	TR Figure 3.2-8
Thickness	0.5	ft	Estimate
Curb			
Length	296	ft	TR Figure 3.2-8
Height	4	ft	TR Figure 3.2-8
Thickness	1	ft	TR Figure 3.2-8
Curb area	1,184	ft^2	Calculated
Demolition			
Floor slab/curb area	6,084	ft^2	Calculated
Floor slab/curb demolition unit cost	$ 5.05	$/ft^2$	WDEQ/LQD Guideline 12 Appendix K (Ref. LQD-K)
Floor slab milling unit cost	$ -	$/ft^2$	No radiological contamination
Floor slab demolition cost	$ 30,724.20		
Floor slab milling cost	$ -		No radiological contamination
Total Demolition Cost	$ 30,724.20		
Transportation			
Volume to landfill	175	yd^3	Volume of slab/curb; includes 30% swell factor for void space
Volume to 11e.(2) disposal site	0.0	yd^3	No contamination
Volume per truckload	20	yd^3	ER Section 4.13.1.1.2.1
Number of trucks to landfill	9	trucks	Calculated
Distance to Landfill	0	trucks	Calculated
Number of trucks to 11e.(2) disposal site	23	miles	Moorcroft
Distance to 11e.(2) Disposal Site	235	miles	Pathfinder Shirley Basin Facility
Transportation cost	$ 3.00	/mile	Actual 2010 costs from northeast Wyoming contract waste hauler
Total transportation cost	$ 621.00		
Disposal			
Landfill disposal fee	$ 56.80	/ton	Reference L-1
Density of concrete	100	lb/ft^3	Estimate for demolished concrete
Landfill cost	$ 13,416.73		
11e.(2) disposal fee	$ 405.00	$/yd^3$	Industry comparison, $15/ft^3$
11e.(2) disposal cost	$ -		
Total Chemical Storage Concrete Cost	$ 31,345.20		

Warehouse/Maintenance/Admin Building			
Dimensions			
Floor slab			
Length	250	ft	TR Figure 3.1-16
Width	100	ft	TR Figure 3.1-16
Thickness	0.33	ft	Estimate 4" slab
Footers			
Length	700	ft	Perimeter length
Width	2	ft	Estimate
Thickness	3	ft	Estimate
Demolition			
Floor slab area	25,000	ft^2	Calculated
Floor slab demolition unit cost	$ 5.05	$/ft^2$	WDEQ/LQD Guideline 12 Appendix K (Ref. LQD-K)
Floor slab milling unit cost	$ -	$/ft^2$	No radiological contamination
Floor slab demolition cost	$ 126,250.00		Calculated
Floor slab milling cost	$ -		Calculated
Footer demolition unit cost	$ 18.14	/ft	WDEQ/LQD Guideline 12 Appendix K (Ref. LQD-K)
Footer demolition cost	$ 12,698.00		
Total demolition cost	$ 138,948.00		
Transportation			
Volume to landfill	603	yd^3	Volume of footer plus floor slab; includes 30% swell factor for void space
Volume to 11e.(2) disposal site	0	yd^3	10% of floor slab volume, estimate; includes 30% swell factor for void space
Volume per truckload	20	yd^3	ER Section 4.13.1.1.2.1
Number of trucks to landfill	31	trucks	Calculated
Distance to landfill	23	miles	Moorcroft
Number of trucks to 11e.(2) disposal site	0	trucks	No radiological contamination
Distance to 11e.(2) disposal site	235	miles	Pathfinder Shirley Basin Facility
Transportation cost	$ 3.00	/mile	Actual 2010 costs from northeast Wyoming contract waste hauler
Total transportation cost	$ 2,139.00		
Disposal			
Landfill disposal fee	$ 56.80	/ton	Reference L-1
Density of concrete	100	lb/ft^3	Estimate for demolished concrete
Landfill cost	$ 46,238.04		
11e.(2) disposal fee	$ 405.00	$/yd^3$	Industry comparison, $15/$ft^3$
11e.(2) disposal cost	$ -		
Total Disposal Cost	$ 46,238.04		
Total Warehouse/Maintenance/ Admin. Building Concrete Cost	$ 187,325.04		
TOTAL CONCRETE COST	**$ 860,964.28**		

IV. Pond Removal/Disposal			
Liner Demolition/Disposal			
GSE Fabrinet Geocomposite Liner (secondary liner around pond perimeter)			
Demolition			
Surface area	350,892	ft^2	Preliminary lined retention pond design
Liner demolition unit cost	$ 0.11	$\$/ft^2$	10% of the installation cost of HDPE liner; RSMeans 2011 33 47 13.53.1100
Total Liner Demolition Cost	$ 38,598.12		Calculated
Thickness	220	mil	Mfr. Specifications
Volume	238	yd^3	Calculated
Liner swell factor	50%		Estimate
Liner disposal volume	357	yd^3	Calculated
Transportation			
Volume of material	357	yd^3	
Volume per truck	20	yd^3	ER Section 4.13.1.1.2.1
Number of trucks	18	trucks	Calculated
Distance to landfill	23	miles	To Moorcroft; no radiological contamination since this is a secondary liner
Transportation cost	$ 3.00	$/mile	Actual 2010 costs from northeast Wyoming contract waste hauler
Total Transportation Cost	$ 1,242.00		
Disposal			
Landfill disposal fee	$ 56.80	/ton	Reference L-1
Density of demolished liner	6	lb/ft^3	Calculated from mass per unit area of 0.162 lb/ft^2 and disposal volume
Total Disposal Cost	$ 1,644.28		
Total Geocomposite Liner Cost	$ 41,484.40		
HDPE Liner (primary liner)			
Demolition			
Surface area	640,407	ft^2	Preliminary lined retention pond design
Liner demolition unit cost	$ 0.11	$\$/ft^2$	10% of the installation cost of HDPE liner; RSMeans 2011 33 47 13.53.1100
Total Liner Demolition Cost	$ 70,444.77		Calculated
Thickness	36	mil	Preliminary lined retention pond design
Volume	71	yd^3	Calculated
Liner swell factor	50%		Estimate
Liner disposal volume	107	yd^3	Calculated
Transportation			
Volume of material	107	yd^3	
Volume per truck	20	yd^3	ER Section 4.13.1.1.2.1
Number of trucks	6	trucks	Calculated
Distance to 11e.(2) disposal site	235	miles	Pathfinder Shirley Basin Facility
Transportation cost	$ 3.00	$/mile	Actual 2010 costs from northeast Wyoming contract waste hauler
Total Transportation Cost	$ 4,230.00		
Disposal			
11e.(2) disposal fee	$ 405.00	$\$/yd^3$	Industry comparison, $\$15/ft^3$
Disposal cost	$ 43,227.47		
Total Cost	$ 117,902.24		
Total Liner Demolition/Disposal Cost	**$ 159,386.64**		

Leak Detection Pipes			
Demolition			
Pipe length	5,172	ft	Preliminary lined retention pond design
Pipe size	4	in	Preliminary lined retention pond design
Outside diameter	4.5	in	Assume SCH 40 PVC
Demolition unit cost	$ 2.02	/ft	RSMeans 2011, 02 41 13.38.1600
Total Demolition Cost	$ 10,447.44		Calculated
Volume	571	ft^3	Calculated
Chipped volume reduction	50	%	Estimate based on use of chipper/shredder
Chipped volume	286	ft^3	Calculated
Transportation			
Volume of material	11	yd^3	
Volume per truck	20	yd^3	ER Section 4.13.1.1.2.1
Number of trucks	1	truck	Calculated
Distance to landfill	23	miles	To Moorcroft
Cost per mile	$ 3.00	$/mile	Actual 2010 costs from northeast Wyoming contract waste hauler
Total Transportation Cost	$ 69.00		
Disposal			
Landfill disposal fee	$ 56.80	/ton	Reference L-1
Density of chipped pipe	36	lb/ft^3	Calculated from mass per unit length of 2 lb/ft and disposal volume
Total Disposal Cost	$ 292.01		
Total Leak Detection Pipe Demolition/Disposal Cost	**$ 10,808.45**		
Leak Detection Sand	$ -		Accounted for in earthwork cost
Clay Liner	$ -		Accounted for in earthwork cost
TOTAL POND COST	**$ 170,195.09**		

V. Earthwork			
Asphalt			
Area			
Parking lot	1.03	ac	TR Figure 3.1-16
Central plant area	3.93	ac	Preliminary site design
Primary access road	0.00	ac	Gravel surface
Demolition			
Area	5.0	ac	Calculated
Asphalt ripping cost	$ 702.87	/ac	WDEQ/LQD Guideline 12, Appendix I (Ref. LQD-I)
Asphalt ripping cost	$ 3,514.35		
Pulverizing; prep for recycling	$ 3.83	$/yd^2$	RSMeans 2011, 32 01 16.73.5040
Pulverizing; prep for recycling	$ 92,686.00		
Total Asphalt Demolition/Recycling Cost	$ 96,200.35		Assumes pulverized asphalt will be made available to county at no net cost or salvage value
Total Asphalt Cost	**$ 96,200.35**		
Regrading			
Backfill			
Volume	148,088	yd^3	Volume is 50% of total cut/fill difference calculated between pre and post mine modeled surfaces
Unit cost	$ 0.913	$/yd^3$	WDEQ/LQD Guideline 12, Appendix C, level ground, 500 ft distance (Ref. LQD-C)
Total cost	$ 135,204.34		
Sand (Leak Detection Sand)			
Volume	6,520	yd^3	Volume is 30% of total, the rest will remain in place
Unit Cost	$ 0.913	$/yd^3$	WDEQ/LQD Guideline 12, Appendix C, level ground, 500 ft distance (Ref. LQD-C)
Total Cost	$ 5,952.76		
Clay (Clay Liners for Lined Retention Ponds)			
Volume	14,231	yd^3	Volume is 30% of total, the rest will remain in place
Unit Cost	$ 0.913	$/yd^3$	WDEQ/LQD Guideline 12, Appendix C, level ground, 500 ft distance (Ref. LQD-C)
Total Cost	$ 12,992.90		
Topsoil			
Volume	133,455	yd^3	Volume is from facilities disturbed area x 2' of topsoil
Unit Cost	$ 0.913	$/yd^3$	WDEQ/LQD Guideline 12, Appendix C, level ground, 500 ft distance (Ref. LQD-C)
Total Cost	$ 121,844.42		
Final Regrading			
Area	55	ac	ER Table 4.1-1
Unit Cost	$ 68.61	/ac	WDEQ/LQD Guideline 12, Appendix G (Ref. LQD-G)
Total Cost	$ 3,773.55		
Total Regrading Cost	**$ 279,767.97**		
Containment Barrier Wall Reclamation			
Reclamation cost	$ 7,650.00		RSMeans 2011, 31 23 16.13.6392; 4 day reclamation period
Gravel for finger drains	$ 2,000.00		Estimate
Total CBW Reclamation Cost	**$ 9,650.00**		
TOTAL EARTHWORK COST	**$ 385,618.32**		

Attachment RAP-2(C)
Costs for ISR Wellfield
Equipment Removal and Disposal

III. WELLFIELD EQUIPMENT REMOVAL AND DISPOSAL SUMMARY

WF-1

	Item	Cost	
I.	Wellfield Piping	$	1,480,069.23
II.	Module Buildings	$	80,643.90
III.	Valve Manholes	$	53,560.40
IV.	Wellheads	$	14,910.00
V.	Access Roads	$	24,239.74
	Total Wellfield Cost	**$**	**1,653,423.27**

I. Wellfield Piping			
Production Trunklines			
Pipe Data			
Total length of recovery trunklines	5,400	ft	From preliminary site layout
Total length of injection trunklines	5,400	ft	From preliminary site layout
Total production trunkline length	10,800	ft	Calculated
Outside diameter	24	in	24" SDR 11 HDPE
Wall thickness	2.18	in	PPI Design Handbook for PE Pipe
Unit weight	65.2	lb/ft	PPI Design Handbook for PE Pipe
Pipe material volume	11,207.9	ft^3	Calculated
Chipped/shredded volume	16,811.8	ft^3	Estimated as 1.5 x pipe material volume
Bulk weight	42.0	lb/ft^3	Calculated
Volume per truck load	540	ft^3	ER Section 4.13.1.1.2.1
Total number of truck loads	32		Calculated
Removal			
Unit cost of removal	$ 9.33	/ft	RSMeans 2011; 02 41 13.38.1900, 31 23 16.13.0120 and 31 23 16.13.3080; excavation and backfill cost reduced by 50% to account for common trenches
Total cost of removal	$ 100,764.00		
Transport and Disposal			
Landfill - Transportation			
Percent to be shipped	50%		0% of recovery trunklines; 100% of injection trunklines
Loads to landfill	16		Calculated
Distance to landfill	23	miles	Distance to Moorcroft
Transportation cost per mile	$ 3.00	/mile	Actual 2010 costs from northeast Wyoming contract waste hauler
Transportation cost	$ 1,104.00		Calculated
Landfill - Disposal			
Landfill disposal fee	$ 56.80	/ton	Reference L-1
Chipped pipe bulk density	42	lb/ft^3	See calculation above
Chipped pipe weight	176.5	tons	Calculated
Landfill disposal cost	$ 10,026.54		Calculated
Total Landfill Cost	$ 11,130.54		
11e.(2) Disposal Site			
11e.(2) - Transportation			
Percent to be shipped	50%		100% of recovery trunklines; 0% of injection trunklines
Loads to 11e.(2) disposal site	16		Calculated
Distance to 11e.(2) disposal site	235	miles	Pathfinder Shirley Basin Facility
Transportation cost per mile	$ 3.00	/mile	Actual 2010 costs from northeast Wyoming contract waste hauler
Transportation cost	$ 11,280.00		Calculated
11e.(2) - Disposal			
11e.(2) disposal fee	$ 405.00	$/yd^3$	Industry comparison, $15/ft^3
11e.(2) disposal cost	$ 126,088.33		See calculation above
Total 11e.(2) Disposal Cost	$ 137,368.33		
Total Transportation and Disposal Cost	$ 148,498.88		
Total Production Trunkline Cost	**$ 249,262.88**		

Restoration Trunklines			
Pipe Data			
Total length of recovery trunklines	5,400	ft	From preliminary site layout
Total length of injection trunklines	5,400	ft	From preliminary site layout
Total restoration trunkline length	10,800	ft	Calculated
Outside diameter	12.75	in	12" SDR 11 HDPE
Wall thickness	1.16	in	PPI Design Handbook for PE Pipe
Unit weight	18.4	lb/ft	PPI Design Handbook for PE Pipe
Pipe material volume	3,167.8	ft^3	Calculated
Chipped/shredded volume	4,751.6	ft^3	Estimated as 1.5 x pipe material volume
Bulk weight	42.0	lb/ft^3	Calculated
Volume per truck load	540	ft^3	ER Section 4.13.1.1.2.1
Total number of truck loads	9		Calculated
Removal			
Unit cost of removal	$ 6.99	/ft	RSMeans 2011; 02 41 13.38.1800, 31 23 16.13.0120 and 31 23 16.13.3080; excavation and backfill cost reduced by 50% to account for common trenches
Total cost of removal	$ 75,492.00		
Transport and Disposal			
Landfill - Transportation			
Percent to be shipped	50%		0% of recovery trunklines; 100% of injection trunklines
Loads to landfill	5		Calculated
Distance to landfill	23	miles	Distance to Moorcroft
Transportation cost per mile	$ 3.00	/mile	Actual 2010 costs from northeast Wyoming contract waste hauler
Transportation cost	$ 310.50		Calculated
Landfill - Disposal			
Landfill disposal fee	$ 56.80	/ton	Reference L-1
Chipped pipe bulk density	42	lb/ft^3	See calculation above
Chipped pipe weight	49.9	tons	Calculated
Landfill disposal cost	$ 2,833.88		Calculated
Total Landfill Cost	$ 3,144.38		
11e.(2) Disposal Site			
11e.(2) - Transportation			
Percent to be shipped	50%		100% of recovery trunklines; 0% of injection trunklines
Loads to 11e.(2) disposal site	5		Calculated
Distance to 11e.(2) disposal site	235	miles	Pathfinder Shirley Basin Facility
Transportation cost per mile	$ 3.00	/mile	Actual 2010 costs from northeast Wyoming contract waste hauler
Transportation cost	$ 3,172.50		Calculated
11e.(2) - Disposal			
11e.(2) disposal fee	$ 405.00	$/yd^3$	Industry comparison, $15/ft^3
11e.(2) disposal cost	$ 35,637.32		See calculation above
Total 11e.(2) Disposal Cost	$ 38,809.82		
Total Transportation and Disposal Cost	$ 41,954.20		
Total Restoration Trunkline Cost	**$ 117,446.20**		

Module Feeder Lines			
Pipe Data			
Total length of recovery feeder lines	4,500	ft	Estimate 900' per module
Total length of injection feeder lines	4,500	ft	Estimate 900' per module
Total feeder line length	9,000	ft	Calculated
Outside diameter	8.625	in	8" SDR 11 HDPE
Wall thickness	0.78	in	PPI Design Handbook for PE Pipe
Unit weight	8.43	lb/ft	PPI Design Handbook for PE Pipe
Pipe material volume	1,201.5	ft^3	Calculated
Chipped/shredded volume	1,802.2	ft^3	Estimated as 1.5 x pipe material volume
Bulk weight	42.0	lb/ft^3	Calculated
Volume per truck load	540	ft^3	ER Section 4.13.1.1.2.1
Total number of truck loads	4		Calculated
Removal			
Unit cost of removal	$ 5.10	/ft	RSMeans 2011; 02 41 13.38.1700, 31 23 16.13.0120 and 31 23 16.13.3080; excavation and backfill cost reduced by 50% to account for common trenches
Total cost of removal	$ 45,900.00		
Transport and Disposal			
Landfill - Transportation			
Percent to be shipped	50%		0% of recovery feeder lines; 100% of injection feeder lines
Loads to landfill	2		Calculated
Distance to landfill	23	miles	Distance to Moorcroft
Transportation cost per mile	$ 3.00	/mile	Actual 2010 costs from northeast Wyoming contract waste hauler
Transportation cost	$ 138.00		Calculated
Landfill - Disposal			
Landfill disposal fee	$ 56.80	/ton	Reference L-1
Chipped pipe bulk density	42	lb/ft^3	See calculation above
Chipped pipe weight	18.9	tons	Calculated
Landfill disposal cost	$ 1,074.85		Calculated
Total Landfill Cost	$ 1,212.85		
11e.(2) Disposal Site			
11e.(2) - Transportation			
Percent to be shipped	50%		100% of recovery feeder; 0% of injection feeder lines
Loads to 11e.(2) disposal site	2		Calculated
Distance to 11e.(2) disposal site	235	miles	Pathfinder Shirley Basin Facility
Transportation cost per mile	$ 3.00	/mile	Actual 2010 costs from northeast Wyoming contract waste hauler
Transportation cost	$ 1,410.00		Calculated
11e.(2) - Disposal			
11e.(2) disposal fee	$ 405.00	$/yd^3$	Industry comparison, $\$15/ft^3$
11e.(2) disposal cost	$ 13,516.68		See calculation above
Total 11e.(2) Disposal Cost	$ 14,926.68		
Total Transportation and Disposal Cost	$ 16,139.52		
Total Feeder Line Cost	**$ 62,039.52**		

Individual Well Flow Lines			
Pipe Data			
Total length of recovery flow lines	90,000	feet	36 recovery wells x 500' per well
Total length of injection flow lines	135,000	feet	54 injection wells x 500' per well
Total well flow line length	225,000	feet	Calculated
Outside diameter	2.375	inches	2" SDR 11 HDPE
Wall thickness	0.216	inches	PPI Design Handbook for PE Pipe
Unit weight	0.64	lb/ft	PPI Design Handbook for PE Pipe
Pipe material volume	2,289.2	ft^3	Calculated
Chipped/shredded volume	3,433.7	ft^3	Estimated as 1.5 x pipe material volume
Bulk weight	42.0	lb/ft^3	Calculated
Volume per truck load	540	ft^3	ER Section 4.13.1.1.2.1
Total number of truck loads	7		Calculated
Removal			
Unit cost of removal	$ 3.16	/ft	RSMeans 2011; 02 41 13.38.1600, 31 23 16.13.0120 and 31 23 16.13.3080; excavation and backfill cost reduced by 75% to account for common trenches
Total cost of removal	$ 711,000.00		
Transport and Disposal			
Landfill - Transportation			
Percent to be shipped	50%		0% of recovery flow lines; 100% of injection flow lines
Loads to landfill	4		Calculated
Distance to landfill	23	miles	Distance to Moorcroft
Transportation cost per mile	$ 3.00	/mile	Actual 2010 costs from northeast Wyoming contract waste hauler
Transportation cost	$ 241.50		Calculated
Landfill - Disposal			
Landfill disposal fee	$ 56.80	/ton	Reference L-1
Chipped pipe bulk density	42	lb/ft^3	See calculation above
Chipped pipe weight	36.1	tons	Calculated
Landfill disposal cost	$ 2,047.88		Calculated
Total Landfill Cost	$ 2,289.38		
11e.(2) Disposal Site			
11e.(2) - Transportation			
Percent to be shipped	50%		100% of recovery flow lines; 0% of injection flow lines
Loads to 11e.(2) disposal site	4		Calculated
Distance to 11e.(2) disposal site	235	miles	Pathfinder Shirley Basin Facility
Transportation cost per mile	$ 3.00	/mile	Actual 2010 costs from northeast Wyoming contract waste hauler
Transportation cost	$ 2,467.50		Calculated
11e.(2) - Disposal			
11e.(2) disposal fee	$ 405.00	$/yd^3$	Industry comparison, $15/ft^3
11e.(2) disposal cost	$ 25,753.06		See calculation above
Total 11e.(2) Disposal Cost	$ 28,220.56		
Total Transportation and Disposal Cost	$ 30,509.94		
Total Individual Well Flow Line Cost	**$ 741,509.94**		

Downhole Well Pipe, Pumps and Electrical Wire			
Pipe Data			
Total length of recovery pipes	90,000	ft	36 recovery wells x 500' per well x 5 modules
Total length of injection pipes	135,000	ft	54 injection wells x 500' per well x 5 modules
Total downhole pipe length	225,000	ft	Calculated
Outside diameter	2.375	in	2" SDR 11 HDPE
Wall thickness	0.216	in	PPI Design Handbook for PE Pipe
Unit weight	0.64	lb/ft	PPI Design Handbook for PE Pipe
Pipe material volume	2,289.2	ft^3	Calculated
Chipped/shredded volume	3,433.7	ft^3	Estimated as 1.5 x pipe material volume
Bulk weight	42.0	lb/ft^3	Calculated
Volume per truck load	540	ft^3	ER Section 4.13.1.1.2.1
Total number of truck loads	7		Calculated
Electrical Wire and Pump Data			
Length of downhole wire	90,000	ft	Same as recovery well downhole pipe
Unit volume	0.002	ft^3/ft	Estimate
Volume of downhole wire	180	ft^3	
Number of pumps	180	pumps	36 recovery wells x 5 modules
Unit volume	0.5	ft^3/ea	Estimate
Volume of pumps	90	ft^3	
Volume per truck load	540	ft^3	ER Section 4.13.1.1.2.1
Total number of truck loads	1		Calculated
Downhole Pipe and Pump Removal			
Unit cost of removal	$ 1.01	/ft	RSMeans 2011; 02 41 13.38.1600; reduced by 50% due to ease of removal
Total cost of removal	$ 227,250.00		
Transport and Disposal			
Landfill - Transportation			
Percent to be shipped	50%		0% of recovery pipes; 100% of injection pipes
Loads to landfill	4		Calculated
Distance to landfill	23	miles	Distance to Moorcroft
Transportation cost per mile	$ 3.00	/mile	Actual 2010 costs from northeast Wyoming contract waste hauler
Transportation cost	$ 276.00		Calculated
Landfill - Disposal			
Landfill disposal fee	$ 56.80	/ton	Reference L-1
Chipped pipe bulk density	42	lb/ft^3	See calculation above
Chipped pipe weight	36.1	tons	Calculated
Pump and wire bulk density	2,000	lb/ft^3	Typical for construction debris
Pump and wire weight	10.0	tons	Calculated
Landfill disposal cost	$ 4,095.77		Calculated
Total Landfill Cost	$ 4,371.77		
11e.(2) Disposal Site			
11e.(2) - Transportation			
Percent to be shipped	50%		100% of recovery pipes; 0% of injection pipes
Loads to 11e.(2) disposal site	4		Calculated
Distance to 11e.(2) disposal site	235	miles	Pathfinder Shirley Basin Facility
Transportation cost per mile	$ 3.00	/mile	Actual 2010 costs from northeast Wyoming contract waste hauler
Transportation cost	$ 2,820.00		Calculated
11e.(2) - Disposal			
11e.(2) disposal fee	$ 405.00	$/yd^3$	Industry comparison, $15/ft^3
11e.(2) disposal cost	$ 27,778.06		
Total 11e.(2) Disposal Cost	$ 30,598.06		
Total Transportation and Disposal Cost	$ 34,969.82		
Total Downhole Well Pipe Cost	**$ 262,219.82**		

Deep Disposal Well Pipe			
Pipe Data			
Total length of pipeline	9,155	ft	From preliminary site layout
Outside diameter	4.50	in	4" SDR 11 HDPE
Wall thickness	0.409	in	PPI Design Handbook for PE Pipe
Unit weight	2.29	lb/ft	PPI Design Handbook for PE Pipe
Pipe material volume	334.2	ft^3	Calculated
Chipped/shredded volume	501.3	ft^3	Estimated as 1.5 x pipe material volume
Bulk weight	42.0	lb/ft^3	Calculated
Volume per truck load	540	ft^3	ER Section 4.13.1.1.2.1
Total number of truck loads	1		Calculated
Removal			
Unit cost of removal	$ 4.30	/ft	RSMeans 2011; 02 41 13.38.1600, 31 23 16.13.0120 and 31 23 16.13.3080; excavation and backfill cost reduced by 50% to account for common trenches
Total cost of removal	$ 39,366.50		
Transport and Disposal			
Landfill - Transportation			
Percent to be shipped	0%		100% 11e.(2) byproduct material
Loads to landfill	0		Calculated
Distance to landfill	23	miles	Distance to Moorcroft
Transportation cost per mile	$ 3.00	/mile	Actual 2010 costs from northeast Wyoming contract waste hauler
Transportation cost	$ -		Calculated
Landfill - Disposal			
Landfill disposal fee	$ 56.80	/ton	Reference L-1
Chipped pipe bulk density	42	lb/ft^3	See calculation above
Chipped pipe weight	0.0	tons	Calculated
Landfill disposal cost	$ -		Calculated
Total Landfill Cost	$ -		
11e.(2) Disposal Site			
11e.(2) - Transportation			
Percent to be shipped	100%		100% 11e.(2) byproduct material
Loads to 11e.(2) disposal site	1		Calculated
Distance to 11e.(2) disposal site	235	miles	Pathfinder Shirley Basin Facility
Transportation cost per mile	$ 3.00	/mile	Actual 2010 costs from northeast Wyoming contract waste hauler
Transportation cost	$ 705.00		Calculated
11e.(2) - Disposal			
11e.(2) disposal fee	$ 405.00	$/yd^3$	Industry comparison, $15/ft^3$
11e.(2) disposal cost	$ 7,519.36		See calculation above
Total 11e.(2) Disposal Cost	$ 8,224.36		
Total Transportation and Disposal Cost	$ 8,224.36		
Total Deep Disposal Well Pipeline Cost	**$ 47,590.86**		
TOTAL WELLFIELD PIPING COST	**$ 1,480,069.23**		

II. Module Buildings			
Building Demolition - Excludes Foundation			
Length	40	ft	TR Section 3.1.4
Width	15	ft	TR Section 3.1.4
Height	9	ft	TR Section 3.1.4
Volume	5,400	ft^3	Calculated
Demolition			
Demolition Unit Cost	$ 0.125	$/ft^3$	From WDEQ/LQD Guideline 12, Appendix K (Ref. LQD-K), less 50% for lack of interior building walls per RSMeans 02 41 16.13.5000
Demolition Cost	$ 675.00		
Transportation			
Unit building weight	15	lb/ft^2	ASCE 7-05
Building weight	5	tons	Calculated
Salvage %	50%		Conservatively assumes zero net salvage value
Weight of material to dispose	2	tons	Calculated
Density of construction debris	2,000	lb/yd^3	Typical of construction debris
Volume of material for disposal	2	yd^3	Calculated
Volume per truck	20	yd^3	ER Section 4.13.1.1.2.1
Number of trucks	1	trucks	Calculated
Distance to landfill	23	miles	Moorcroft landfill
Cost per mile	$ 3.00	/mile	Actual 2010 costs from northeast Wyoming contract waste hauler
Total Transportation Cost	$ 69.00		
Disposal			
Disposal fee	$ 56.80	/ton	Reference L-1
Disposal cost	$ 127.80		Calculated
Total Building Demolition Cost	**$ 871.80**		
Concrete Demolition and Disposal			
Dimensions			
Base			
Length	40	ft	TR Section 3.1.4
Width	15	ft	TR Section 3.1.4
Thickness	0.5	ft	Estimate
Walls			
Length	110	ft	Perimeter length
Height	6	ft	TR Figure 3.1-9
Thickness	0.5	ft	Estimate
Demolition			
Base/wall area	1,260	ft^2	Calculated
Concrete demolition unit cost	$ 5.05	$/ft^2$	WDEQ/LQD Guideline 12 Appendix K (Ref. LQD-K)
Concrete demolition cost	$ 6,363.00		
Transportation			
Volume to landfill	15.2	yd^3	50% of volume of slab/walls; includes 30% swell factor for void space
Volume to 11e.(2) disposal site	15.2	yd^3	50% of volume of slab/walls; includes 30% swell factor for void space
Volume per truckload	20	yd^3	ER Section 4.13.1.1.2.1
Number of trucks to landfill	1	trucks	Calculated
Distance to landfill	23	miles	Moorcroft
Number of trucks to 11e.(2) disposal site	1	trucks	Calculated
Distance to 11e.(2) disposal site	235	miles	Pathfinder Shirley Basin Facility
Transportation cost	$ 3.00	/mile	Actual 2010 costs from northeast Wyoming contract waste hauler
Total Transportation Cost	$708.00		

Disposal			
Landfill disposal fee	$ 56.80	/ton	Reference L-1
Density of concrete	100	lb/ft^3	Estimate for demolished concrete
Landfill cost	$ 1,162.98		
11e.(2) disposal fee	$ 405.00	$/yd^3$	Industry comparison, $\$15/ft^3$
11e.(2) disposal cost	$ 6,142.50		
Total Disposal Cost	$ 7,305.48		
Total Concrete Cost	**$ 14,376.48**		
Piping and Equipment Disposal			
Quantity			
Volume	2	yd^3	Conservatively high estimate
Demolition			
Unit cost	$ -	$/ft^3$	Included in building demolition cost
Transportation			
Volume to landfill	0.0	yd^3	100% disposed as 11e.(2) byproduct material
Volume to 11e.(2) disposal site	2.0	yd^3	100% disposed as 11e.(2) byproduct material
Volume per truckload	20	yd^3	ER Section 4.13.1.1.2.1
Number of trucks to landfill	0.0	trucks	Calculated
Distance to landfill	23	miles	Moorcroft
Number of trucks to 11e.(2) disposal site	0.10	trucks	Calculated
Distance to 11e.(2) disposal site	235	miles	Pathfinder Shirley Basin Facility
Transportation cost	$ 3.00	/mile	Actual 2010 costs from northeast Wyoming contract waste hauler
Total Transportation Cost	$ 70.50		
Disposal			
Landfill disposal fee	$ 56.80	/ton	Reference L-1
Density of equipment	2,000	lb/ft^3	Estimate
Landfill cost	$ -		
11e.(2) disposal fee	$ 405.00	$/yd^3$	Industry comparison, $\$15/ft^3$
11e.(2) disposal cost	$ 810.00		
Total Disposal Cost	$ 810.00		
Total Piping and Equipment Cost	**$ 880.50**		
Total Cost per Module	**$ 16,128.78**		
Number of Modules	**5**		
Total Module Building Cost	**$ 80,643.90**		
III. Valve Manholes			
Concrete Demolition and Disposal			
Dimensions			
Base			
Length	12	ft	Preliminary design
Width	8	ft	Preliminary design
Thickness	0.5	ft	Preliminary design
Top			
Length	12	ft	Preliminary design
Width	8	ft	Preliminary design
Thickness	0.67	ft	Preliminary design
Walls			
Length	40	ft	Perimeter length
Height	6	ft	TR Figure 3.1-10
Thickness	0.5	ft	Estimate
Demolition			
Base/top/wall area	432	ft^2	Calculated
Concrete demolition unit cost	$ 5.05	$/ft^2$	WDEQ/LQD Guideline 12 Appendix K (Ref. LQD-K)
Concrete demolition cost	$ 2,181.60		

Transportation			
Volume to landfill	4.4	yd^3	50% of volume of slab/walls; includes 30% swell factor for void space
Volume to 11e.(2) disposal site	4.4	yd^3	50% of volume of slab/walls; includes 30% swell factor for void space
Volume per truckload	20	yd^3	ER Section 4.13.1.1.2.1
Number of trucks to landfill	0.22	trucks	Calculated
Distance to landfill	23	miles	Moorcroft
Number of trucks to 11e.(2) disposal site	0.22	trucks	Calculated
Distance to 11e.(2) disposal site	235	miles	Pathfinder Shirley Basin Facility
Transportation cost	$ 3.00	/mile	Actual 2010 costs from northeast Wyoming contract waste hauler
Total Transportation Cost	$156.56		
Disposal			
Landfill disposal fee	$ 56.80	/ton	Reference L-1
Density of concrete	100	lb/ft^3	Estimate for demolished concrete
Landfill cost	$ 340.25		
11e.(2) disposal fee	$ 405.00	$/yd^3$	Industry comparison, $\$15/ft^3$
11e.(2) disposal cost	$ 1,797.12		
Total Disposal Cost	$ 2,137.37		
Total Concrete Cost	**$ 4,475.54**		
Piping and Equipment Disposal			
Quantity			
Volume	2	yd^3	Conservatively high estimate
Demolition			
Unit cost	$ -	$/ft^3$	Included in valve manhole demolition cost
Transportation			
Volume to landfill	0.0	yd^3	100% disposed as 11e.(2) byproduct material
Volume to 11e.(2) disposal site	2.0	yd^3	100% disposed as 11e.(2) byproduct material
Volume per truckload	20	yd^3	ER Section 4.13.1.1.2.1
Number of trucks to landfill	0.0	trucks	Calculated
Distance to landfill	23	miles	Moorcroft
Number of trucks to 11e.(2) disposal site	0.10	trucks	Calculated
Distance to 11e.(2) disposal site	235	miles	Pathfinder Shirley Basin Facility
Transportation cost	$ 3.00	/mile	Actual 2010 costs from northeast Wyoming contract waste hauler
Total Transportation Cost	$70.50		
Disposal			
Landfill disposal fee	$ 56.80	/ton	Reference L-1
Density of equipment	2,000	lb/ft^3	Estimate
Landfill cost	$ -		
11e.(2) disposal fee	$ 405.00	$/yd^3$	Industry comparison, $\$15/ft^3$
11e.(2) disposal cost	$ 810.00		
Total Disposal Cost	$ 810.00		
Total Piping and Equipment Cost	**$ 880.50**		
Total Cost per Valve Manhole	**$ 5,356.04**		
Number of Valve Manholes	**10**		
Total Valve Manhole Cost	**$ 53,560.40**		

IV. Wellheads			
Recovery and Injection Wellheads			
Wellhead Data			
Number of injection/recovery wellheads	450		36 recovery wells and 54 injection wells per module, 5 modules
Weight of equipment per wellhead	200	lb	Estimate
Bulk density of wellhead equipment	100	lb/ft^3	Estimate
Weight of equipment for disposal	45	tons	
Volume of equipment for disposal	33	yd^3	
Transportation			
Volume to landfill	0.0	yd^3	100% disposed as 11e.(2) byproduct material
Volume to 11e.(2) disposal site	33.3	yd^3	100% disposed as 11e.(2) byproduct material
Volume per truckload	20	yd^3	ER Section 4.13.1.1.2.1
Number of trucks to landfill	0.0	trucks	Calculated
Distance to landfill	23	miles	Moorcroft
Number of trucks to 11e.(2) disposal site	2	trucks	Calculated
Distance to 11e.(2) disposal site	235	miles	Pathfinder Shirley Basin Facility
Transportation cost	$ 3.00	/mile	Actual 2010 costs from northeast Wyoming contract waste hauler
Total Transportation Cost	$1,410.00		
Disposal			
Landfill disposal fee	$ 56.80	/ton	Reference L-1
Density of equipment	100	lb/ft^3	Estimate
Landfill cost	$ -		
11e.(2) disposal fee	$ 405.00	$/yd^3$	Industry comparison, $\$15/ft^3$
11e.(2) disposal cost	$ 13,500.00		
Total Disposal Cost	$ 13,500.00		
Total Wellhead Cost	**$ 14,910.00**		

V. Roads			
Access Roads			
Gravel Removal			
Length of primary access road	1,320	ft	Preliminary site layout
Width of primary access road	32	ft	ER Section 4.2.1.1
Area of primary access road	1.0	ac	Calculated
Length of secondary access roads	10,000	ft	Preliminary site layout
Width of secondary access roads	16	ft	ER Section 4.1.1.1.1
Area of secondary access roads	3.7	ac	Calculated
Gravel thickness	1.0	ft	Estimate
Gravel volume	7,490	yd^3	Calculated
Blade grading unit cost	$ 68.61	/ac	WDEQ/LQD Guideline 12, Appendix G (Ref. LQD-G)
Blade grading cost	$ 320.62		
Scraper hauling unit cost	$ 1.41	/cy	WDEQ/LQD Guideline 12, Appendix C, level grade, 2,000 ft haul (Ref. LQD-C)
Scraper hauling cost	$ 10,561.42		
Gravel disposal	$ -		Assumes gravel will be made available to county at no net cost or salvage value
Gravel Removal Cost	$ 10,882.04		
Earthwork			
Area Required	0.0	ac	Cost included in Earthwork Costs
Revegetation Cost	$ -		
Scarification			
Area of graveled access roads	3.7	ac	See above
Scarification unit cost	$ 62.93	/ac	WDEQ/LQD Guideline 12, Appendix P (Ref. LQD-P)
Scarification Cost	$ 231.15		
Topsoil Replacement			
Topsoil volume	11,851.9	yd^3	Assumes 2' thickness
Topsoil replacement unit cost	$ 1.09	$/yd^3$	WDEQ/LQD Guideline 12, Appendix C, level grade, 1,000 ft haul (Ref. LQD-C)
Topsoil Replacement Cost	$ 12,918.52		
Revegetation			
Area Required	0.0	ac	Cost included in Revegetation Costs
Revegetation Cost	$ -		
Total Graveled Road Reclamation Cost	**$ 24,031.71**		
Tertiary Roads			
Scarification			
Length of tertiary access roads	18,000	ft	Preliminary site layout
Width of tertiary access roads	8	ft	ER Section 4.1.1.1.1
Area of tertiary access roads	3.3	ac	Calculated
Scarification unit cost	$ 62.93	/ac	WDEQ/LQD Guideline 12, Appendix P (Ref. LQD-P)
Scarification Cost	$ 208.03		
Revegetation			
Area Required	0.0	ac	Cost included in Revegetation Costs
Revegetation Cost	$ -		
Total Tertiary Road Reclamation Cost	**$ 208.03**		
Total Access Road Reclamation Cost	**$ 24,239.74**		
TOTAL WELLFIELD EQUIPMENT REMOVAL AND DISPOSAL	**$ 1,653,423.27**		

Attachment RAP-2(D)
Costs for Well Abandonment

Recovery, Injection and Monitor Wells			
Assumptions			
Number of wells	612	wells	Refer to AR-2
Average depth	500	ft	Refer to AR-2
Diameter	5	in	Refer to TR Section 3.1.2.1
Materials per Well			
Volume of cement required	68.2	ft^3/well	Calculated
Cement Sacks Required per Well	58.2		Based on actual quantities used during exploration drill hole plugging
Cement Sack Cost	$ 11.65		Based on actual prices during exploration drill hole plugging
Cement Cost per Well	$ 678.03		Calculated
Bentonite Sacks Required per Well	4.4		Based on actual quantities used during exploration drill hole plugging
Bentonite Bag Cost	$ 7.40		Based on actual prices during exploration drill hole plugging
Bentonite Cost per Well	$ 32.56		Calculated
Total Materials Cost Per Well	$ 710.59		
Equipment Rental			
Hours required per well	2.5	hours	Based on actual quantities used during exploration drill hole plugging
Backhoe cost per hour	$ 85.00		Based on actual prices during exploration drill hole plugging
Cementer cost per hole	$ 250.00		Based on actual prices during exploration drill hole plugging
Total Equipment Cost Per Well	$ 462.50		
Total Cost to Plug & Abandon Recovery, Injection & Monitor Wells	**$ 717,931.08**		
Deep Disposal Wells			
Assumptions			
Number of wells	3	wells	3 wells planned for first 5 modules
Cost per well	$ 104,110.00	/well	TR Addendum 4.2-A Table 15
Total Deep Disposal Well Cost	**$ 312,330.00**		
TOTAL WELL ABANDONMENT COST	**$ 1,030,261.08**		

Notes:
1. These values assume that all wells have passed the most recent MIT
2. Screens will be left in place

Attachment RAP-2(E)
Costs for Radiological Surveys

Gamma Survey			
Area required	71.5	ac	Based on anticipated disturbed wellfield area (28.5 acres) and CPP area (43 acres)
Survey cost per acre	$ 205.00	/ac	Based on pre-application baseline survey
Total Gamma Survey Cost	$ 14,657.50		
Soil Samples			
Number of samples required	20	samples	Assume 8 in central plant area and 12 in wellfield
Cost per sample	$ 660.00	/sample	Based on pre-application soil sampling
Total Soil Sampling Cost	$ 13,200.00		
Equipment & Building Smear Samples			
Number of samples required	100	samples	Estimate
Cost per sample	$ 100.00	/sample	Estimate
Total Smear Sample Cost	$ 10,000.00		
TOTAL RADIOLOGICAL SURVEY COST	**$ 37,857.50**		

Attachment RAP-2(F)
Costs for Revegetation

VI. REVEGETATION VEG-1

Area Requir	110	ac	ER Table 4.1-1
Cost per Acr	$ 600.00		Based on previous experience on an industrial ash landfill in northeastern Wyoming
Total Revegetation Cost	**$ 66,000.00**		

Attachment RAP-2(G)
Costs for Miscellaneous Reclamation Activities

I. Fence Removal			
Chainlink Security Fence			
Length around central plant area	6,117	ft	From preliminary site layout
Length around 11e.(2) Byproduct Storage Ar	2,500	ft	From preliminary site layout
Total chainlink security fence	8,617		Calculated
Unit cost for removal	$ 3.86		RSMeans 2011 02 41 13.60.1700
Chainlink fence removal	$ 33,261.62		
Barbed Wire Fence			
Length	10,000	ft	Based on 5 modules at 5.7 acres each
Unit cost for removal	$ 0.31		WDEQ/LQD Guideline 12, Appendix H (Ref. LQD-H)
Barbed wire fence removal	$ 3,100.00		
Total Fence Removal Cost	$ 36,361.62		
II. Overhead Power Line Removal			
Length	5,400	ft	Based on trunkline length
Unit cost for removal	$ -		WDEQ/LQD Guideline 12, Appendix H (Ref. LQD-H); distribution lines would typically be owned by power company and removed at no cost for their salvage value
Total Overhead Power Line Removal Cost	$ -		
III. Buried Electrical Line Removal			
Length	90,000	ft	Based on recovery well flow line length
Unit cost for removal	$ 0.99	/ft	RSMeans 2011; 02 41 13.54.100
Unit cost for excavation/backfill	$ -	/ft	Included in cost of individual flow lines
Total Buried Electrical Line Removal Cost	$ 89,100.00		
IV. Buried Gas Line Removal			
Length	9,100	ft	Preliminary site layout
Unit removal cost	$ 2.26	/ft	RSMeans 2011; 02 41 13.50.100
Unit excavation cost	$ 3.20	/ft	RSMeans 2011; 31 23 16.13.0120 and 31 23 16.13.3080 (assume 0.5 cuyd/ft)
Unit disposal cost	$ -	/ft	Assumes salvaged with no net salvage value or disposal cost
Total Gas Line Removal Cost	$ 49,686.00		
V. Transformer Removal & Disposal			
Number of transformers	32		Based on 3 per module (15), 3 per ddw (9), and 8 for the facilities
Unit removal/disposal cost	$ 440.00		RSMeans 2011, 26 05 05.10.1520
Total Transformer Removal and Disposal Cost	$ 14,080.00		
VI. Surface Water Monitoring Station Removal			
Number of surface water monitoring stations	3		From ER Section 6.2.1.1
Unit removal/disposal cost	$ 2,345.20		WDEQ/LQD Guideline 12, Appendix N (Ref. LQD-N)
Total Surface Water Monitoring Station Cost	$ 7,035.60		
VII. Air Quality/Meteorological Monitoring Station Removal			
Number of monitoring stations	7		Includes 6 air quality stations and 1 MET station
Unit removal/disposal cost	$ 886.48		WDEQ/LQD Guideline 12, Appendix N (Ref. LQD-N)
Total Monitoring Removal Cost	$ 6,205.36		

VIII. Culvert Removal			
Primary Access Road Culvert			
Length	80	ft	5' tall x 10' wide concrete box culvert
Unit removal cost	$ 15.35		Based on RSMeans 02 41 13.43.0100
Volume of concrete for disposal	57.8	yd^3	Calculated; includes 30% swell factor for void space
Volume per truckload	20	yd^3	ER Section 4.13.1.1.2.1
Number of trucks to landfill	3	trucks	Calculated
Distance to landfill	23	miles	Moorcroft
Unit transportation cost	$ 3.00	/mile	Actual 2010 costs from northeast Wyoming contract waste hauler
Transportation cost	$ 207.00		
Landfill disposal fee	$ 56.80	/ton	Reference L-1
Density of concrete	100	lb/ft^3	Estimate for demolished concrete
Landfill cost	$ 4,430.40		
Total Primary Access Road Culvert Cost	$ 4,637.40		
Wellfield Access Road Culverts			
Total length	160		Based on four 40' culverts
Unit cost	$ 6.10		WDEQ/LQD Guideline 12, Appendix J (Ref. LQD-J)
Total Wellfield Access Road Cost	$ 976.16		
Total Culvert Removal Cost	$ 5,613.56		
IX. Chipper/Shredder			
Number of days of operation	30	days	Estimate
Unit cost for rental/operation	$ 2,000.00	/day	Estimate
Total Chipper/Shredder Cost	$ 60,000.00		
TOTAL MISCELLANEOUS RECLAMATION ACTIVITIES COST	**$ 268,082.14**		

ATTACHMENT RAP-3
COST REFERENCES

C-1	Sulfuric acid cost
DDW-1	Deep well disposal
L1	Moorcroft landfill disposal costs
LQD-C	Material moving*
LQD-G	Final grading*
LQD-H	Fence and power line removal*
LQD-I	Ripping asphalt*
LQD-J	Culvert removal*
LQD-K	Building demolition*
LQD-N	Surface, air quality, and met station removal*
LQD-P	Scarification of compacted surfaces*
P1 - P9	Pumping system operation calculations
RO-1	RO operation costs
S1	Schedule

*From WDEQ/LQD Guideline 12, Standardized Reclamation Performance Bond Format and Cost Calculation Methods, November 2010

C-1

Subject: SULFURIC AND ANTI-SCALENT
From: JRaffelson@brenntag.com
Date: Thu, 30 Dec 2010 15:10:46 -0700
To: jfritz@wwcengineering.com
CC: bfjelstad@brenntag.com, JSTALEY@brenntag.com

Jack,
I was able to get a price for the sulfuric acid. We will quote $327.50/Ton delivered to the mine site. I wasn't able to get a price for the anti-scalent as we don't have enough information to quote that yet.

If you have any questions, please give me a call.

Jo Raffelson
Customer Service/Purchasing
Brenntag Pacific/Billings, MT
(406) 628-3640
(406) 628-2072 Fax

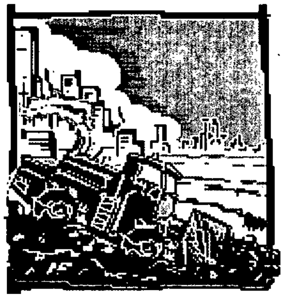
Deep Well Disposal Cost Estimate

Operating Assumptions			
Total brine volume from groundwater sweep	4,215	kgal	15% of total volume of groundwater sweep
Total brine volume from RO treatment with permeate injection	59,006	kgal	15% of total volume of RO treatment
Brine and other 11e.(2) liquid waste in ponds*	26,100	kgal	Based on 80 acre-ft normal operating pond capacity (see Figure 4.2-1 of the TR)
Total volume for disposal	89,321	kgal	Calculated
Time for operation			
Months for disposal	24	months	Based on 15 months of active aquifer restoration and 9 months of decommissioning
Average days per month	30.4		
Days for operation	730	days	Calculated
Brine Pumps to Deep Disposal Well			
Average flow rate	85	gpm	Calculated
Electrical requirement	11	kW	Reference P-8
Electrical consumption	192,614	kWh	Calculated
Power cost	$ 0.04	/kWh	Tiered rate is $0.03 to $0.04 per PRECorp
Brine Pumping Cost	$ 7,704.58		
Brine Pumping Cost	$ 0.09	/kgal	
High Pressure Disposal Well Pumps			
Average total flow	85	gpm	Calculated
Number of wells/pumps required	2		Flow range is 35 to 80 gpm per well per TR Section 4.2.3.2.1. Although 3 wells will be constructed, only 2 will typically be required at one time.
Electrical requirement per pump	55	kW	Reference P-9
Electrical consumption	1,926,144	kWh	Calculated
Power Cost	$ 0.04	/kWh	Tiered rate is $0.03 to $0.04 per PRECorp
High Pressure Disposal Well Pumping Cost	$ 77,045.76		
High Pressure Disposal Well Pumping Cost	$ 0.86	/kgal	
Chemicals			
Antiscalant	$ 0.10	/kgal	Reference RO-1; 4.4 ppm dose
Disinfectant/corrosion inhibitor	$ 0.05	/kgal	Estimate
Total Chemical Cost	$ 0.15	/kgal	
Total Chemical Cost	$ 13,398.15		
Total Brine Disposal Cost	**$ 98,148.49**		
Total Brine Disposal Cost per Kilogallon	**$ 1.10**		

*Includes decontamination water, plant washdown water, and minor amounts of prodution eluate. Brine is accounted for in quantities calculated for groundwater sweep and RO treatment with permeate injection.

L-1

Moorcroft Landfill



MOORCROFT LANDFILL:

The Moorcroft Landfill is located approximately 5 miles east of Moorcroft off Interstate 90 on the Wind Creek exit, then 1 mile north. The Summer hours are:

TUESDAY, WEDNESDAY & FRIDAY:	**1:00 pm - 7:00 pm**
SATURDAY:	**11:00 am - 7:00 pm**

LANDFILL RATES:

ALL GARBAGE HAULED TO THE MOORCROFT LANDFILL WILL BE CHARGED $2.84 PER 100 POUNDS WITH A MINIMUM $5.00 FEE.

All vehicles entering the landfill must stop at the landfill scale building to receive dumping instructions. All vehicles leaving the landfill must stop at the office to pay for the load.

ALL VEHICLES MUST WEIGH IN AND OUT EVERY TRIP.

All loads must be secured during transport. An additional fee of $15.00 will be assessed for dumping of loads which arrive unsecured.

Close Window

Appendix C
Calculations for Moving Materials With a Caterpillar 637G Push-Pull Scraper Fleet

NOTE: DRILLING AND BLASTING COSTS ARE NOT INCLUDED IN THESE CALCULATIONS. THE LQD DOES NOT CONSIDER DRILLING AND BLASTING COSTS NECESSARY WHEN USING APPENDIX C.

Material Movement By Scrapers

1) Caterpillar 637E Push-Pull Scraper		
2) Material Density	2,850. LB/BCY	CPH 40
3) Payload	75,000. LB 25.0 BCY	CPH 40
4) Maximum Vehicle Speed Loaded	33.0 MPH	CPH 40
5) Operating Efficiency Factor (50 Min./Hr.)	0.83 %	CPH 40
6) 637G PP Operating Costs	$276.22 Per Hour	100% E-W
7) Labor Costs	$40.92 Per Hour	WYDOT-WDD
8) Supervision Labor Costs	$5.74 Per Hour	1/8 of WYDOT-WDD
9) Supervisor Transportation	$2.84 Per Hour	1/8 of 100% E-W
10) 1/8 of 1 - 14,000 Gal. Water Trucks + 1 Operator	$29.23 Per Hour	1/8 of 100% E-W
11) 1/8 of 1 – 16M Blade for Road Work + 1 Operator	$21.74 Per Hour	1/8 of 100% E-W
12) . - D9R for Ripping Ovb. and Misc. Work + 1 Operator	$100.79 Per Hour	. of 100% E-W
13) Total Hourly Costs	$477.48	

TO USE TABLE: Locate your approximate grade by reference to case number. Determine cost per BCY by using distance column that approximates your distance. No calculations are necessary.

#1: Level Ground — Loaded (0% grade + 4% rolling = 4% total) — Empty (0% grade + 4% rolling = 4% total)

One-Way Distance (Ft.)	Load Time (Min.)	Travel Time Loaded (Min.)	Maneuver & Spread Time (Min.)	Travel Time Empty (Min.)	Total Cycle Time (Min.)	Trips Per Hour	Payload (BCY)	Efficiency Factor (50 min/hr)	Adjusted Productivity (BCY/Hr)	Operating Costs ($/BCY)
500	1.0	0.42	0.60	0.36	2.38	25.2	25.0	0.83	523	$0.913
1000	1.0	0.68	0.60	0.57	2.85	21.1	25.0	0.83	438	$1.090
1500	1.0	0.92	0.60	0.75	3.27	18.4	25.0	0.83	382	$1.250
2000	1.0	1.15	0.60	0.92	3.67	16.3	25.0	0.83	338	$1.413
2500	1.0	1.37	0.60	1.09	4.06	14.8	25.0	0.83	307	$1.555
3000	1.0	1.59	0.60	1.26	4.45	13.5	25.0	0.83	280	$1.705
3500	1.0	1.81	0.60	1.44	4.85	12.4	25.0	0.83	257	$1.858
4000	1.0	2.02	0.60	1.61	5.23	11.5	25.0	0.83	239	$1.999
4500	1.0	2.22	0.60	1.78	5.60	10.7	25.0	0.83	222	$2.151
5000	1.0	2.43	0.60	1.95	5.98	10.0	25.0	0.83	208	$2.296
5500	1.0	2.64	0.60	2.13	6.37	9.4	25.0	0.83	195	$2.449
6000	1.0	2.85	0.60	2.30	6.75	8.9	25.0	0.83	185	$2.581
6500	1.0	3.05	0.60	2.47	7.12	8.4	25.0	0.83	174	$2.744
7000	1.0	3.26	0.60	2.64	7.50	8.0	25.0	0.83	166	$2.876

Appendix G
Calculations for Final Grading With a Caterpillar 16M Motor Grader

Final Grading

	INPUT, UNIT AS INDICATED	COMMENT/ SOURCE
Caterpillar 16M Motor Grader		
Speed in Miles Per Hour (Second Gear)	3.3 Miles/Hour	CPH 40
Width of Grading Per Pass	8 Feet	CPH 40
Feet Per Mile	5,280 Feet	
Square Feet Per Acre	43,560 Sq. Ft.	
Operating Efficiency Factor 50 Min./Hr.	0.83 %	CPH 40
Operating Costs	$132.99 Per Hour	100% of E-W
Labor Costs	$40.92 Per Hour	WYDOT-WDD
Supervision Labor Costs	$5.74 Per Hour	1/8 of WYDOT-WDD
Supervisor Transportation	$2.84 Per Hour	1/8 of 100% of E-W
Total Hourly Costs	$182.49	
Grading Rate		
(3.3 Miles/Hour)x(5,280 Ft./Mile)x(8 Ft./Pass)	139,392 Ft^2/Hour	
(139,392 Ft^2/Hour)/(43,560 Ft^2/Acre)	3.2 Acres/Hour	
(3.2 Acres/Hour)x(0.83 Efficiency Factor)	2.66 Acres/Hour	
Operating Costs		
($182.49/Hour)/(2.66 Acres/Hour)	$68.61 Per Acre	

Appendix H
Cost Estimates for Handling Wire Fencing and Electrical Power Lines

FENCING		SOURCES
Construction 4-Strand Barbed	Overall Average - $1.87/LF	Wyoming Highway Department Weighted Average Bid Prices, 2009
Removal	Overall Average - $0.31/LF	Wyoming Highway Department, Average Bid Prices, 2009
	Power Line Removal	
Distribution Lines:	No Charge	From: Tri-County Electric
Transmission Lines:	No Charge	From: Tri-County Electric

Note: Cost estimates for power line removal are based on phone contact with Tri-County Electric. Distribution lines are owned by Tri-County Electric and would be removed upon request at no charge by Tri-County Electric. Transmission lines (lines which go from the main metering point to various electrical substations and are not owned by Tri-County Electric) would be removed by Tri-County Electric at no cost for their salvage value.

Appendix I
Cost Estimate for Ripping Asphalt Using a Caterpillar D9R Dozer

Asphalt Ripping (3"-4" Mat)

	INPUT, UNIT AS INDICATED	**COMMENT/ SOURCE**
Caterpillar D9R Dozer With 3 Shank Ripper		
Speed in Miles Per Hour	1 Mile/Hour	CPH 40
Width of Ripping Pass	3 Feet	CPH 40
Feet Per Mile	5,280 Feet	
Square Feet Per Acre	43,560 Sq. Ft.	
Operating Efficiency Factor 50 Min./Hr.	0.83 %	CPH 40
Operating Costs	$160.66 Per Hour	100% of E-W
Labor Costs	$40.92 Per Hour	WYDOT-WDD
Supervision Labor Costs	$5.74 Per Hour	1/8 of WYDOT-WDD
Supervisor Transportation	$2.84 Per Hour	1/8 of 100% of E-W
Total Hourly Costs	$210.16	
Ripper Productivity		
(1.0 Mile/Hour)x(5,280 Ft./Mile)x(3 Ft./Pass)	15,840 Ft^2/Hour	
(15,840 Ft^2/Hour)/(43,560 Ft^2/Acre)	0.36 Acres/Hour	
(0.36 Acres/Hour)x(0.83 Efficiency Factor)	0.299 Acres/Hour	
Operating Costs		
($210.16/Hour)/(0.299 Acres/Hour)	$702.87 Per Acre	

Appendix J
Cost Estimate for Culvert Removal

Culvert Removal

	INPUT, UNIT AS INDICATED	COMMENT/ SOURCE
Average Length of CMP Section	20 Feet	
Assumed Culvert Diameter	48 Inches	
Time to Cut One Band	10 Minutes	
Time to Load One 20' Section (2 People)	20 Minutes	
Average Haul, Dump and Return Time	30 Minutes	
Number of Sections of CMP Per Load	2	
Operating Efficiency Factor 50 Min./Hr.	0.83 %	
Labor	$40.92 Per Hour	WYDOT-WDD
Dump Truck (10-12 yd^3)	$64.33 Per Hour	100% of E-W
Caterpillar 980G Front-End Loader	$106.06 Per Hour	100% of E-W
Cost to Remove One 20' Section of CMP		
Labor Cost x Time to Cut One Band	$6.82	
+ ((Labor Cost x 2) + FEL Cost) x Time to Load 1 Section	$62.57	
+ (Labor Cost + Truck Cost) x Haul Time	$52.63	
Cost to Remove One 20' Section of CMP (not including dirt removal)	$122.02	

Note: Culverts may be smashed and buried in place when feasible.

Appendix K
Cost Estimates for Demolition and Removal of Railroad Spurs and Facilities Buildings

TASK	COST PER UNIT ($)	REGIONAL COST ADJUSTMENT[1]	ADJUSTED COST PER UNIT ($)
Track Removal	8.57/lin. ft.	95.7%	8.20/lin. ft.
Ballast Removal	4.12/cy	95.7%	3.94/cy
Building Demolition and Disposal[1, 2, 3]			
Mixture of Types	$0.26/ft^3$	95.7%	$0.249/ft^3$
Explosive Demolition, Concrete or Steel	$0.24/ft^3$	95.7%	$0.230/ft^3$
Disposal (Average)	8.48/cy	95.7%	8.12/cy
City Landfill Dump Charges	$100.00/ton	95.7%	$95.70/ton
Concrete Footings and Foundations			
6" Thick With Rebar	5.28sq. ft.	95.7%	5.05/sq. ft.
Footings - 2' Thick, 3' Wide	18.95/lin. ft.	95.7%	18.14/lin. ft.
Concrete Disposal On-Site	7.28/cy	95.7%	6.97/cy

Note: Operators may also provide a verifiable cost estimate from a qualified contractor for these demolition tasks. This estimate may be used for one to three consecutive years, assuming few substantial changes in mine facilities.

1 Costs From: 2011 Means Heavy Construction Cost Data & Building Construction Cost Data
2 Based on Total Volume of Building, does not include disposal cost
3 Based on Concrete Structures Volume Only, does not include disposal cost

Appendix N
Cost Estimates for Demolition and Removal of One "Standard" Surface Water Monitoring Station

	INPUT, UNIT AS INDICATED	COMMENT/ SOURCE
Assumed Time to Remove One Station	8 Hours	
Labor	$40.92 Per Hour	WYDOT-WDD
Dump Truck (10-12 yd^3)	$64.33 Per Hour	100% of E-W
Caterpillar 980G Front-End Loader	$106.06 Per Hour	100% of E-W
Cost to Remove One Surface Water Station = (Labor Cost x Time to Remove Station) + (Labor Cost + Truck Cost) x Time to Remove Station + (Labor Cost + Loader Cost) x Time to Remove Station	 $327.36 $842.00 $1,175.84	
Cost to Remove One Surface Water Station =	$2,345.20	

Appendix O
Cost Estimates for Demolition and Removal of One
"Standard" Meteorological or Air Quality Monitoring Site

	INPUT, UNIT AS INDICATED	COMMENT/ SOURCE
Assumed Time to Remove One Station	4 Hours	
Labor	$40.92 Per Hour	WYDOT-WDD
Dump Truck (10-12 yd^3)	$64.33 Per Hour	100% of E-W
Caterpillar 430D (4WD) Backhoe Loader	$31.53 Per Hour	100% of E-W
Cost to Remove One Meteorological or Air Quality Station = (Labor Cost x Time to Remove Station) + (Labor Cost + Truck Cost) x Time to Remove Station + (Labor Cost + Loader Cost) x Time to Remove Station	 $163.68 $421.00 $301.80	
Cost to Remove One Meteorological or Air Quality Station =	$886.48	

Appendix P
Cost Estimate for Scarification of Compacted Surfaces

	INPUT, UNIT AS INDICATED	COMMENT/ SOURCE
CATERPILLAR 16M MOTOR GRADER		
Speed in Miles Per Hour (First Gear)	2.4 Miles/Hour	CPH 40
Width of Scarifying Pass	12 Feet	CPH 40
Feet Per Mile	5,280 Feet	
Square Feet Per Acre	43,560 Sq. Ft.	
Operating Efficiency Factor 50 Min./Hr.	0.83%	CPH 40
Operating Costs	$132.99 Per Hour	100% of E-W
Labor Costs	$40.92 Per Hour	WYDOT-WDD
Supervision Labor Costs	$5.74 Per Hour	1/8 of WYDOT-WDD
Supervisor Transportation	$2.84 Per Hour	1/8 of 100% of E-W
Total Hourly Costs	$182.49	
SCARIFICATION RATE		
(2.4 Miles/Hour)x(5,280 Ft./Mile)x(12 Ft./Pass)	152,064 Ft^2/Hour	
(152,064 Ft^2/Hour)/(43,560 Ft^2/Acre)	3.49 Acres/Hour	
(3.49 Acres/Hour)x(0.83 Efficiency Factor)	2.90 Acres/Hour	
OPERATING COSTS		
($182.49/Hour)/(2.90 Acres/Hour)	$62.93 Per Acre	

Pumping System Description:

Name:	Well Pumps
Location:	Inside recovery wells
Purpose:	Deliver recovery solution to the module buildings

Input Data:

		Source
Flow rate:	20 gpm	High estimate per well
Inlet pressure:	4 psi	Assumes 10 feet min. water column above pump
Delivery pressure:	10 psi	Estimate of pressure required at delivery point
Maximum lift:	500 ft	Based on average 500 foot well depth
Friction head loss:	85 ft	Calculated as 83.6 ft from recovery well pump to module building
Pump efficiency:	85%	Estimate
Motor efficiency:	85%	Estimate
Specific weight:	62.4 lb/ft^3	Typical of water

Calculations:

$$\boxed{hp = \frac{Q\gamma H}{550 e_p}} \qquad \boxed{P = \frac{hp}{e_m}}$$

Where:

hp	=	Pump power input (hp)
Q	=	Flow rate (cfs)
γ	=	Specific weight of fluid (lb/ft^3)
e_p	=	Pump efficiency
P	=	Motor power input
e_m	=	Motor efficiency

Pressure head:	14 ft
Friction losses:	85 ft
Elevation head:	500 ft
Total dynamic head:	599 ft
Pump power input:	3.6 hp
Motor power input:	4.2 hp
	3.1 kW
For estimate	4.0 kW

Pumping System Description:

Name:	Recovery Solution Booster Pumps
Location:	Inside module buildings
Purpose:	Deliver recovery solution from the recovery wells to the CPP

Input Data:

		Source
Flow rate:	800 gpm	High estimate per module based on production
Inlet pressure:	10 psi	Residual pressure from recovery well pumps
Delivery pressure:	50 psi	High estimate of pressure required at delivery point
Pump elevation:	4200 ft	Typical module building elevation
Delivery elevation:	4150 ft	High estimate of final CPP elevation
Friction head loss:	50 ft	Calculated as 43 ft from Module 1 to CPP
Pump efficiency:	85%	Estimate
Motor efficiency:	85%	Estimate
Specific weight:	62.4 lb/ft^3	Typical of water

Calculations:

$$\boxed{hp = \frac{Q\gamma H}{550e_p}}$$

$$\boxed{P = \frac{hp}{e_m}}$$

Where:

hp	=	Pump power input (hp)
Q	=	Flow rate (cfs)
γ	=	Specific weight of fluid (lb/ft^3)
e_p	=	Pump efficiency
P	=	Motor power input
e_m	=	Motor efficiency

Pressure head:	92 ft
Friction losses:	50 ft
Elevation head:	-50 ft
Total dynamic head:	92 ft
Pump power input:	21.9 hp
Motor power input:	25.8 hp
	19.2 kW
For estimate	**20.0 kW**

Pumping System Description:

Name:	Injection Booster Pumps
Location:	Inside module buildings
Purpose:	Deliver barren lixiviant to the injection wells during production or permeate during aquifer restoration

Input Data:

		Source
Flow rate:	800 gpm	High estimate per module based on production
Inlet pressure:	20 psi	Residual pressure from CPP booster pumps
Delivery pressure:	140 psi	Max. injection pressure at module building (TR Section 3.1.2.3)
Pump efficiency:	85%	Estimate
Motor efficiency:	85%	Estimate
Specific weight:	62.4 lb/ft^3	Typical of water

Calculations:

$$\boxed{hp = \frac{Q\gamma H}{550 e_p}} \qquad \boxed{P = \frac{hp}{e_m}}$$

Where:

hp	=	Pump power input (hp)
Q	=	Flow rate (cfs)
γ	=	Specific weight of fluid (lb/ft^3)
e_p	=	Pump efficiency
P	=	Motor power input
e_m	=	Motor efficiency

Pressure head:	277 ft
Total dynamic head:	277 ft
Pump power input:	65.9 hp
Motor power input:	77.5 hp
	57.8 kW
For estimate	58.0 kW

Pumping System Description:

Name:	CPP Permeate Pumps
Location:	Inside CPP
Purpose:	Deliver permeate to the module buildings

Input Data:

		Source
Flow rate:	467.5 gpm	High estimate per module (see TR Figure 3.1-13 and assume 2 modules in RO treatment with permeate injection)
Inlet pressure:	10 psi	Low estimate of residual pressure after RO
Delivery pressure:	20 psi	High estimate of pressure required at delivery point
Pump elevation:	4150 ft	High estimate of final CPP elevation
Delivery elevation:	4200 ft	Typical module building elevation
Friction head loss:	50 ft	Calculated as 43 ft from Module 1 to CPP
Pump efficiency:	85%	Estimate
Motor efficiency:	85%	Estimate
Specific weight:	62.4 lb/ft^3	Typical of water

Calculations:

$$\boxed{hp = \frac{Q\gamma H}{550e_p}}$$

$$\boxed{P = \frac{hp}{e_m}}$$

Where:

hp	=	Pump power input (hp)
Q	=	Flow rate (cfs)
γ	=	Specific weight of fluid (lb/ft^3)
e_p	=	Pump efficiency
P	=	Motor power input
e_m	=	Motor efficiency

Pressure head:	23.1 ft
Friction losses:	50 ft
Elevation head:	50 ft
Total dynamic head:	123.1 ft
Pump power input:	17.1 hp
Motor power input:	20.1 hp
	15.0 kW
For estimate	15.0 kW

Pumping System Description:

Name:	Restoration RO Prefiltration Pumps
Location:	Inside CPP
Purpose:	Deliver recovery solution to guard column and RO prefiltration

Input Data:

		Source
Flow rate:	1100 gpm	Typical restoration flow from restoration recovery wells (see TR Figure 3.1-13)
Inlet pressure:	50 psi	Delivery pressure from module buildings
Delivery pressure:	130 psi	From preliminary RO design by Lyntek
Pump efficiency:	85%	Estimate
Motor efficiency:	85%	Estimate
Specific weight:	62.4 lb/ft^3	Typical of water

Calculations:

$$\boxed{hp = \frac{Q\gamma H}{550 e_p}}$$

$$\boxed{P = \frac{hp}{e_m}}$$

Where:

hp	=	Pump power input (hp)
Q	=	Flow rate (cfs)
γ	=	Specific weight of fluid (lb/ft^3)
e_p	=	Pump efficiency
P	=	Motor power input
e_m	=	Motor efficiency

Pressure head:	184.6 ft
Total dynamic head:	184.6 ft
Pump power input:	60.4 hp
Motor power input:	71.0 hp
	53.0 kW
For estimate	53.0 kW

Pumping System Description:

Name:	Restoration RO Stage 1 Feed Pump
Location:	Inside CPP
Purpose:	Deliver filtered recovery solution to Stage 1 RO

Input Data:		Source
Flow rate:	1100 gpm	Restoration flow from restoration recovery wells (see Figure 3.1-13)
Inlet pressure:	100 psi	Estimated delivery pressure from guard column and prefiltration
Delivery pressure:	385 psi	From preliminary RO design by Lyntek
Pump efficiency:	85%	Estimate
Motor efficiency:	85%	Estimate
Specific weight:	62.4 lb/ft^3	Typical of water

Calculations:

$$\boxed{hp = \frac{Q\gamma H}{550e_p}}$$

$$\boxed{P = \frac{hp}{e_m}}$$

Where:

hp	=	Pump power input (hp)
Q	=	Flow rate (cfs)
γ	=	Specific weight of fluid (lb/ft^3)
e_p	=	Pump efficiency
P	=	Motor power input
e_m	=	Motor efficiency

Pressure head:	657.7 ft
Total dynamic head:	657.7 ft
Pump power input:	215.1 hp
Motor power input:	253.1 hp
	188.8 kW
For estimate	189.0 kW

Pumping System Description:

Name:	Restoration RO Stage 2 Feed Pump
Location:	Inside CPP
Purpose:	Deliver brine from Stage 1 RO to Stage 2 RO

Input Data:

		Source
Flow rate:	330 gpm	Brine from Stage 1 RO (see TR Figure 3.1-13)
Inlet pressure:	10 psi	Delivery pressure from holding tank and prefiltration
Delivery pressure:	760 psi	From preliminary RO design by Lyntek
Pump efficiency:	85%	Estimate
Motor efficiency:	85%	Estimate
Specific weight:	62.4 lb/ft^3	Typical of water

Calculations:

$$\boxed{hp = \frac{Q\gamma H}{550 e_p}}$$

$$\boxed{P = \frac{hp}{e_m}}$$

Where:

hp	=	Pump power input (hp)
Q	=	Flow rate (cfs)
γ	=	Specific weight of fluid (lb/ft^3)
e_p	=	Pump efficiency
P	=	Motor power input
e_m	=	Motor efficiency

Pressure head:	1730.8 ft
Total dynamic head:	1730.8 ft
Pump power input:	169.9 hp
Motor power input:	199.8 hp
	149.1 kW
For estimate	150.0 kW

Pumping System Description:

Name:	Brine Pump to Deep Disposal Wells
Location:	Inside CPP
Purpose:	Deliver brine from storage tank to disposal well pumps

Input Data:

		Source
Flow rate:	190 gpm	Brine from Stage 2 RO and other liquid waste (see TR Figure 3.1-13)
Inlet pressure:	5 psi	Delivery pressure from storage tank
Delivery pressure:	50 psi	High estimate of pressure required at disposal surge pumps
Pump elevation:	4150 ft	High estimate of final CPP elevation
Delivery elevation:	4190 ft	Typical deep disposal well elevation
Friction head loss:	70 ft	Calculated as 66 ft based on typical deep disposal well distance from CPP
Pump efficiency:	85%	Estimate
Motor efficiency:	85%	Estimate
Specific weight:	62.4 lb/ft^3	Typical of water

Calculations:

$$\boxed{hp = \frac{Q\gamma H}{550 e_p}}$$

$$\boxed{P = \frac{hp}{e_m}}$$

Where:

hp	=	Pump power input (hp)
Q	=	Flow rate (cfs)
γ	=	Specific weight of fluid (lb/ft^3)
e_p	=	Pump efficiency
P	=	Motor power input
e_m	=	Motor efficiency

Pressure head:	103.8 ft
Friction losses:	70 ft
Elevation head:	40 ft
Total dynamic head:	213.8 ft
Pump power input:	12.1 hp
Motor power input:	14.2 hp
	10.6 kW
For estimate	11.0 kW

Pumping System Description:

Name:	High Pressure Disposal Well Pumps
Location:	Adjacent to deep disposal wells
Purpose:	Deliver concentrated brine to deep disposal well

Input Data:		Source
Flow rate:	50 gpm	Typical disposal rate per well (range is 35-80 gpm per TR Section 4.2.3.2.1)
Inlet pressure:	50 psi	Delivery pressure from brine pump
Delivery pressure:	1846 psi	Limiting surface injection pressure per Table 14 in TR Addendum 4.2-A
Pump efficiency:	85%	Estimate
Motor efficiency:	85%	Estimate
Specific weight:	62.4 lb/ft^3	Typical of water

Calculations:

$$hp = \frac{Q\gamma H}{550 e_p}$$

$$P = \frac{hp}{e_m}$$

Where:

hp	=	Pump power input (hp)
Q	=	Flow rate (cfs)
γ	=	Specific weight of fluid (lb/ft^3)
e_p	=	Pump efficiency
P	=	Motor power input
e_m	=	Motor efficiency

Pressure head:	4144.6 ft
Total dynamic head:	4144.6 ft
Pump power input:	61.6 hp
Motor power input:	72.5 hp
	54.1 kW
For estimate	55.0 kW

RO Operation Costs

Name:	2-Stage Restoration RO
Location:	Inside CPP
Purpose:	Treat recovery solution from wellfields during groundwater sweep

Input Data:				Source
Stage 1 RO design feed rate		1100	gpm	See TR Figure 3.1-13
Stage 2 RO design feed rate		330	gpm	See TR Figure 3.1-14
Total groundwater sweep volume		28,098	kgal	0.5 PVD x 5 modules
Total RO with permeate injection volume		393,376	kgal	7.0 PVD x 5 modules
Total volume treated		421,474	kgal	7.5 PVD x 5 modules
Months of operation		14	months	See reference S-1; 14 months total groundwater sweep plus RO treatment with permeate injection
Average monthly Stage 1 feed rate		30,105	kgal/mo	
Average monthly Stage 2 feed rate		9,032	kgal/mo	
Sulfuric Acid (H_2SO_4):				
H_2SO_4 concentration for Stage 1 RO		147	ppm	Modeled using Visual MINTEQ: reduce pH from 8.0 to 7.0
H_2SO_4 concentration for Stage 2 RO		343	ppm	Modeled using Visual MINTEQ: reduce pH from 8.2 to 7.5
H_2SO_4 grade		93%		Concentrated sulfuric acid
H_2SO_4 required for Stage 1 RO		2.59	kgal/mo	
H_2SO_4 required for Stage 2 RO		1.81	kgal/mo	
Total H_2SO_4 required		4.40	kgal/mo	
Unit H_2SO_4 cost	$	327.50	/ton	Quote delivered from Brenntag chemical (see reference C-1)
Monthly H_2SO_4 cost	$	11,048	/month	
Monthly H_2SO_4 cost per kgal feed	$	0.37	/kgal	
Antiscalant:				
Antiscalant concentration for Stage 1 RO		3	ppm	Per recommendation from Avista Technologies
Anti-scalant concentration for Stage 2 RO		4.4	ppm	Per recommendation from Avista Technologies
Cost for Stage 1 RO antiscalant per kgal feed	$	0.07	/kgal	Cost estimate for Vitek 3000 from Avista Technologies
Cost for Stage 2 RO antiscalant per kgal feed	$	0.10	/kgal	Cost estimate for Vitek 3000 from Avista Technologies
Monthly Stage 1 RO antiscalant cost	$	2,047	/month	
Monthly Stage 2 RO antiscalant cost	$	903	/month	
Monthly antiscalant cost	$	2,950	/month	
Monthly antiscalant cost per kgal feed	$	0.10	/kgal	

RO Operation Costs (Continued)

Pre-Filtration Pumping System:

Average power requirement		53	kW	Reference P-5
Electrical consumption per month		38,669	kWh	Calculated
Power cost	$	0.04	/kWh	From PRECorp
Monthly pre-filtration pumping system cost	$	1,546.75		
Monthly cost per kgal feed	$	0.05	/kgal	

Pre-Filtration System Operating Costs:

Monthly cost per kgal feed	$	0.01	/kgal	Estimate

Stage 1 RO Feed Pump

Average power requirement		189	kW	Reference P-6
Electrical consumption per month		137,894	kWh	
Power cost	$	0.04	/kWh	From PRECorp
Monthly pre-filtration pumping system cost	$	5,515.78		
Monthly cost per kgal feed	$	0.18	/kgal	

Stage 2 RO Feed Pump

Average power requirement		150	kW	Reference P-7
Electrical consumption per month		109,440	kWh	
Power cost	$	0.04	/kWh	From PRECorp
Monthly pre-filtration pumping system cost	$	4,377.60		
Monthly cost per kgal feed	$	0.15	/kgal	

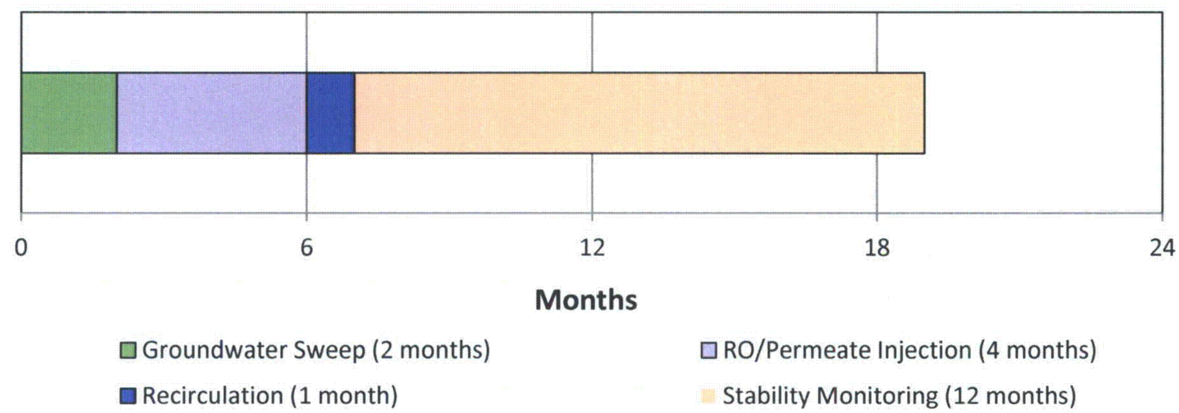
Membranes:

Monthly membrane cost	$	0.02	/kgal	Based on preliminary RO design by Lyntek

Total RO operation cost per month	$	0.88	/kgal

S-1

Planned Aquifer Restoration Schedule - Typical for Single Wellfield Module



Planned Aquifer Restoration Schedule - First 5 Wellfield Modules