UNITED STATES

NUCLEAR REGULATORY COMMISSION

REGION IV

URANIUM RECOVERY FIELD OFFICE
BOX 25325
DENVER, COLORADO 80225

OCT 03 1991

URFO:CDMC
Docket No. 40-8857
04008857520E

MEMORANDUM FOR: Docket File No. 40-8857

FROM: Cynthia D. Miller-Corbett, Project Manager

SUBJECT: ENVIRONMENTAL ASSESSMENT (EA) FOR EXPANSION OF THE POWER RESOURCES, INC., HIGHLAND URANIUM PROJECT

Attached is the EA prepared in support of the NRC approval of the revised license application and issuance of the amended Source Material License SUA-1511 for Power Resources, Inc., Highland Uranium Project, located in Converse County, Wyoming.

Cynthia D. Miller-Corbett
Cynthia D. Miller-Corbett
Project Manager

Attachment:
Power Resources, Inc., Highland Uranium Project, Environmental Assessment

bcc:
PDR/DCS
URFO r/f
LJCallan, RIV
LLUR Branch, LLWM
CMiller-Corbett
8857/520E/CDMC/91/10/03/M (EA)

PM:URFO CMC	DD:URFO	D:URFO:RIV
CMiller-Corbett/lv	EHawkins	REHall
10/3/91	10/3/91	10/3/91

EdH 10/4/91

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ENVIRONMENTAL ASSESSMENT

FOR

POWER RESOURCES, INC.

HIGHLAND URANIUM PROJECT

CONVERSE COUNTY, WYOMING

DOCKET NO. 40-8857

9112020137

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1.0 INTRODUCTION

1.1 Background

By letter dated March 10, 1991, Power Resources, Inc. (PRI) submitted a revised (amended) license application for the Highland Uranium Project, Converse County, Wyoming in conjunction with a request to amend the license to allow expansion of the present in situ leaching activities. The submittal is herein referred to as the West Highland Amendment (WHA). The WHA replaces the original license application dated December 1985. This Environmental Assessment (EA) is in response to the licensee's request to expand the uranium in situ leach mining at the Highland Uranium Project.

Production of uranium ore at the existing facility is licensed by Source Material License SUA-1511. The facility, the Highland Uranium Project, is located in central Converse County, Wyoming, about 25 miles north of Douglas and 24 miles northeast of Glenrock (Figure 1). The project area was originally licensed and worked by Exxon Corporation for uranium mining and processing, and research and development of in situ leaching. Currently, the Highland Uranium Project comprises approximately 4063 acres, with uranium production well-field operations authorized by the NRC covering approximately 210 acres. The request submitted by PRI to expand mining activities proposes the addition of nearly 11,451 acres to well-field production, bringing the total well-field area to approximately 15,515 acres, of which approximately 1550 acres would be utilized for well field operations. The proposed expansion incorporates land immediately adjacent to the existing and approved Highland Uranium Project in situ leach mining fields. The purpose of the proposed expansion is to increase the originally licensed mining activity area which was reviewed in the Environmental Assessment (EA) dated July 1987, as mining activity in two of the four previously approved fields nears completion.

The original EA was finalized July 1, 1987. At that time, the NRC issued Source Material License SUA-1511 to Everest Minerals Corporation (EMC). On July 18, 1989, the NRC approved the transfer of EMC-licensed mining activities to Sparkling City Nuclear; on October 20, 1989, the NRC approved the transfer of licensed mining activities from Sparkling City Nuclear to PRI. The licensee activities and commitments for the Highland Uranium Project associated with uranium ore production, including well-field construction and operation, uranium ore processing techniques, waste material disposal, monitoring, radiation safety, and environmental considerations, as well as reclamation and restoration programs for the proposed operation expansion, are comparable to the activities and programs presently authorized and in place. Much of the information necessary for the proposed West Highland Amendment expansion EA is comparable and may be found in the original EA for the Highland Uranium Project. When appropriate, information available in the original EA has been referenced or used herein. It is noted here that because of the license transfer, the original EA document for the Highland Uranium Project refers to the current mining corporation, PRI, as EMC.

In brief, uranium ore production at the Highland Uranium Project entails extraction of uranium from a subsurface ore zone interval named the Highland

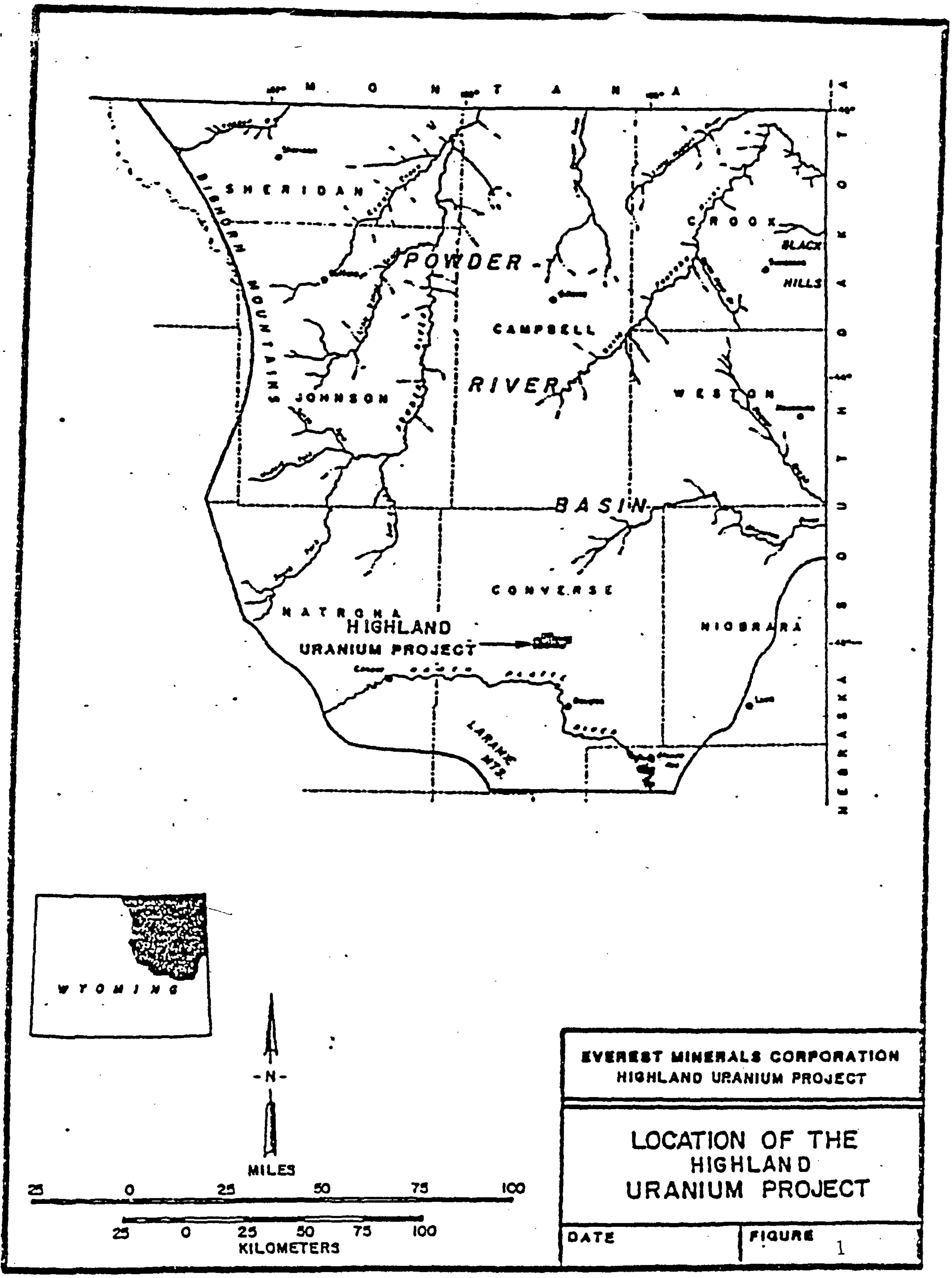

M O N T A N A
SHERIDAN
BIGHORN MOUNTAINS
JOHNSON
POWDER
RIVER
BASIN
CAMPBELL
CROOK
BLACK HILLS
WESTON
CONVERSE
NATRONA
NIOBRARA
HIGHLAND
URANIUM PROJECT
LARAMIE MTS.
WYOMING
-N-
MILES
25 0 25 50 75 100
25 0 25 50 75 100
KILOMETERS
EVEREST MINERALS CORPORATION
HIGHLAND URANIUM PROJECT
LOCATION OF THE
HIGHLAND
URANIUM PROJECT
DATE
FIGURE 1

FIGURE 1

Sand Group. The Highland Sand Group includes several sandstone intervals generally referred to as the Lower, Middle, and Upper Sand. These strata are from 0 to 50 feet thick. The uranium ore in situ leaching process consists of lixiviant injection into a series of well patterns and extraction of the uranium ore-bearing lixiviant through a recovery well located central to each well pattern. Well patterns are commonly constructed with the recovery well surrounded by four injection wells at the corners of a square with 70-foot sides. The lixiviant is comprised of ground water containing gaseous carbon dioxide and oxygen. PRI is authorized to operate the Central Processing Facility (CPF), formerly named the Main Processing Facility (MPF), with a total well-field volume throughput not to exceed 7500 gallons per minute (gpm). To ensure that process emissions associated with the project are accurate, the total throughput of 7500 gpm will not be revised if approval of the WHA is granted.

1.2 Proposed Action

This EA is a review of the environmental and safety aspects of the proposed West Highland Amendment (WHA). The NRC approval of the WHA will allow expansion of well-field production operations to incorporate the area herein referenced as the E-field into the Highland Uranium Project. The E-Field includes portions of Section 22, Section 23, and Section 15, T36N, R73W. The commercial scale operation of the existing PRI site was previously evaluated in a Final Environmental Statement dated November 1978 (NUREG-0489) and the original EA.

A revised Safety Evaluation Report (SER), which is largely a revision of the original SER, will accompany this EA. The staff preparation of these two documents will evaluate the potential impacts associated with the proposed expansion of commercial operation of the PRI site. Should the NRC issue a Finding of No Significant Impact based upon the licensee's application materials, previous operational data, and the former EA, a revised commercial source material license would be issued to PRI.

1.3 Review Scope

1.3.1 Federal and State Authorities

Under Title 10, Code of Federal Regulations, Part 40, a NRC source material license is required in order to "...receive, possess, use, transfer...any source material..." (i.e., uranium and/or thorium in any form, or ores containing 0.05 percent of more by weight of those substances). In addition, the Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA) requires persons who conduct uranium source material operations to obtain a byproduct material license to own, use, or possess tailings and wastes generated by the operation (including above-ground wastes from in situ operations). This environmental assessment has been prepared under 10 CFR Part 51. In accordance with 10 CFR Part 51, an EA serves to (a) briefly provide sufficient evidence and analysis for determining whether to prepare an environmental impact statement or a finding of no significant impact, (b) aid the NRC's compliance with NEPA when no environmental impact statement is necessary, and (c) facilitate preparation of an environmental impact statement when one is necessary.

The United States Department of the Interior, Bureau of Land Management (BLM), administers the Federally-owned surface and mineral estate and implements the various Federal regulations pertaining to the Federal lands. As such, the Federal lands within the permit boundary area are subject to the regulations found at 43 CFR 3809. the purpose of which are to ". . . establish procedures to prevent unnecessary or undue degradation of Federal lands which may result from operations authorized by the mining laws." In addition, these regulations further require the operator to ". . . comply with all pertinent Federal and State laws, including but not limited to the following: (a) air quality . . ., (b) water quality . . ., (c) solid wastes . . ., (d) fisheries, wildlife, and plant habitat . . ., 3) cultural and paleontological resources . . . " The BLM, therefore, is involved in reviewing the amendment application and environmental assessment as a cooperating agency and only insofar as the proposed activities will directly or indirectly affect the Federally-owned surface estate.

The Wyoming Department of Environmental Quality (WDEQ) administers and implements the State's rules and regulations for land and water-use permits. PRI currently holds a commercial permit from WDEQ for the existing site and has applied to the WDEQ for a permit to operate in the proposed site expansion.

1.3.2 Basis of NRC Review

An impact appraisal for the original commercial licensing of the PRI site has been performed by the NRC, Uranium Recovery Field Office. This report documents that appraisal with the addition of appropriate updated information. The staff has performed the appraisal of environmental and safety considerations associated with the proposed license in accordance with Title 10, Code of Federal Regulations (10 CFR Part 51, Licensing and Regulatory Policy and Procedures for Environmental Protection).

In conducting this appraisal, the staff considered the following:

- Environmental and operational information submitted by PRI for both the existing and proposed sites.
- Additional information submitted in the licensee's application.
- Information derived from professional papers, journals, and test books; NRC Regulations and Regulatory Guides; as well as other Federal, State, and local agencies; and independent consultants.

2.0 SITE DESCRIPTION

2.1 <u>Location and Land Use</u>

The proposed expansion of the commercial in situ leach facility is located, primarily on PRI property, west of the existing facility in central Converse

County, Wyoming, approximately 25 miles north of Douglas and 24 miles northeast of Glenrock. The PRI property includes approximately 15,500 acres of leases and claims, plus the addition of parts of two geographic sections west of this acreage in Township 36 North, Range 73 West. The land comprising both the approved and proposed facility operations has historically been used for seasonal sheep and cattle grazing.

Due to the extent of land ownership, the licensee is required by license condition to propose a restricted area boundary for inclusion into their license prior to operation of the facility.

2.2 Geology and Hydrogrology of the Ore Body

2.2.1 Geologic and Hydrogeologic Setting

The PRI facility is located in the southern portion of the Powder River Basin. The land surface at the site is characterized by gently rolling uplands which have been extensively dissected. The Highland Sand Group hosting the economic mineral zone is comprised of fluvial sandstones of the Fort Union Formation. The regional dip in this area is in a northwesterly direction at approximately 0.6 degree. There is no known faulting in the immediate area of the Highland operation.

The Highland Sand Group extends throughout much of the southwest Powder River Basin and regionally forms a single aquifer. Individual sandstones that contain uranium deposits are tongue-like extensions off the edge of the thick (50 foot) central Highland Sandstone unit, and are referred to as the lower, middle, and upper members. These sandstones are generally separated by 10 to 20 feet of siltstone and shales, although erosion of the silt and clay beds has allowed vertical continuity of the individual sandstones in some places.

The Highland Sand Group is confined above and below by shale units. The generalized stratigraphic column and cross section describing the mined area are shown in Figures 2 and 3.

2.2.2 Water Quality and Aquifer Testing

In the Highland project area, there are three possible aquifers which could potentially be affected by the proposed operations. These are:

A. Shallow (less than 200 feet) Holocene alluvial deposits.

B. Intermediate (200 to 400 feet) Eocene Wasatch Formation.

C. Deep (400+ feet) Paleocene Fort Union Formation ore sand aquifer.

These first two are of little concern as there are no continuous, well-developed aquifers in either Holocene or Eocene Formations at the Highland project area. The deeper ore sand aquifer is the only ground-water system that could be affected by in situ mining.

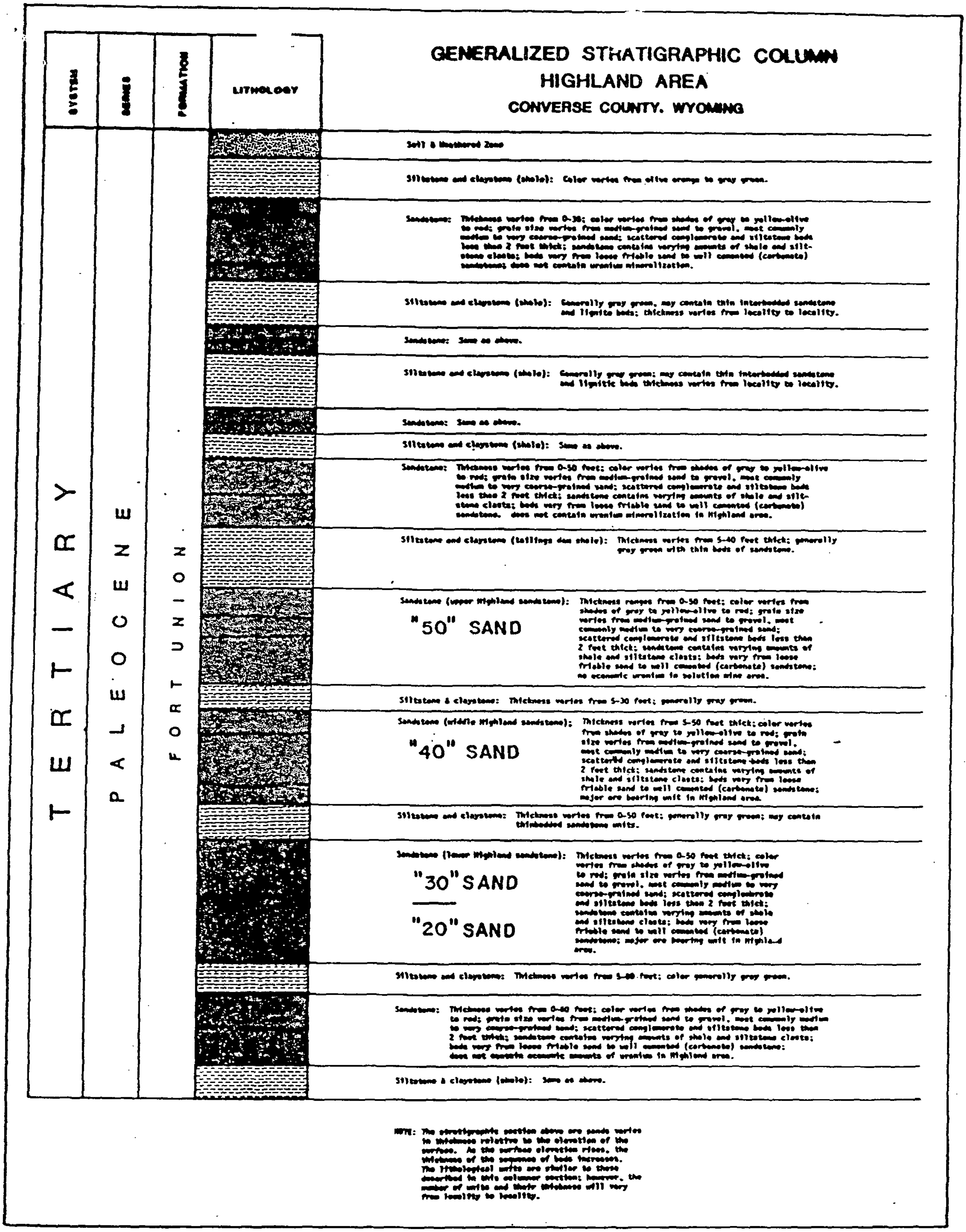
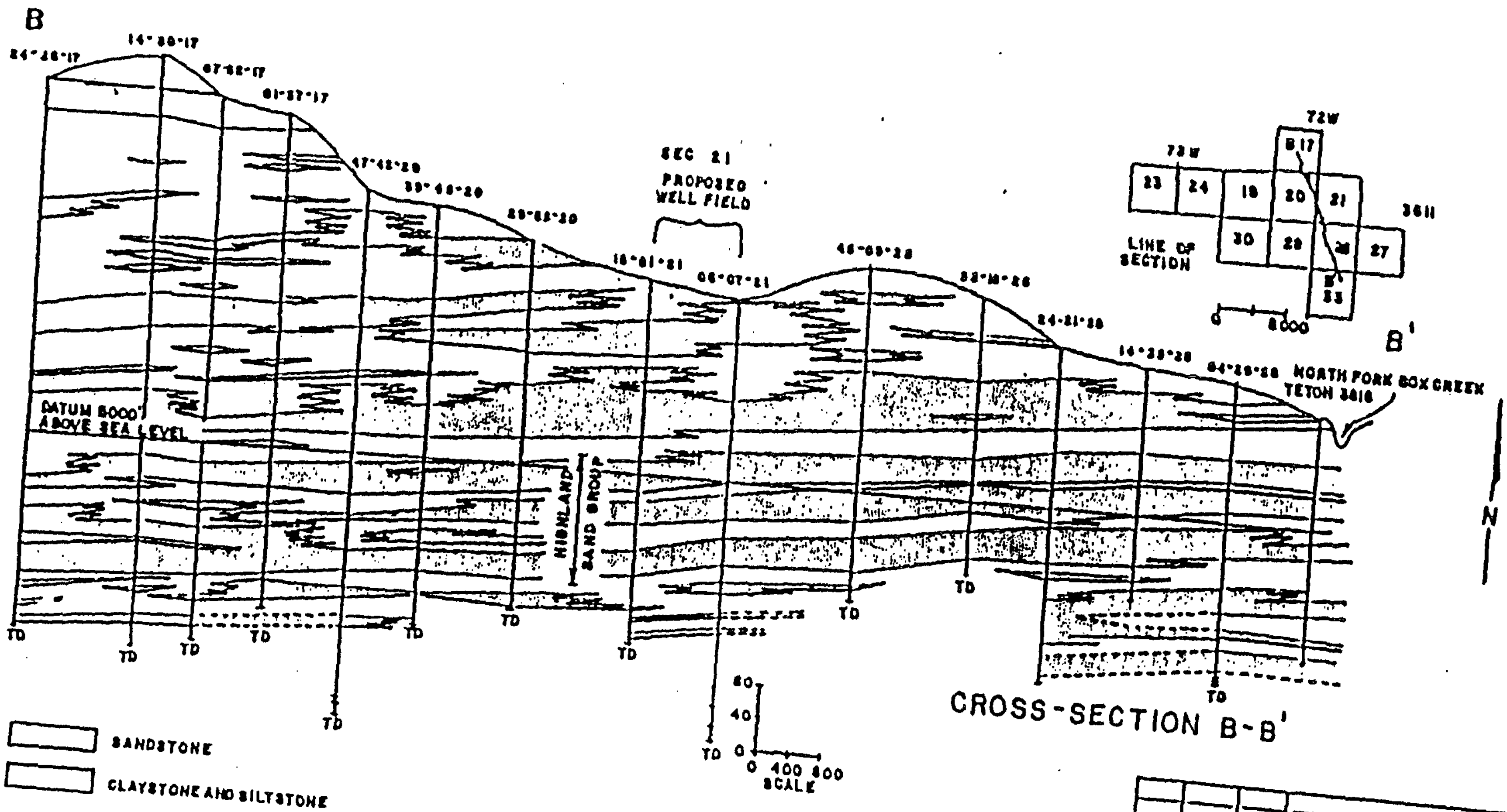

GENERALIZED STRATIGRAPHIC COLUMN
HIGHLAND AREA
CONVERSE COUNTY. WYOMING
SYSTEM
SERIES
FORMATION
LITHOLOGY
TERTIARY
PALEOCENE
FORT UNION
Soil & Weathered Zone
Siltstone and claystone (shale): Color varies from olive orange to gray green.
Sandstone: Thickness varies from 0-30; color varies from shades of gray to yellow-olive to red; grain size varies from medium-grained sand to gravel, most commonly medium to very coarse-grained sand; scattered conglomerate and siltstone beds less than 2 feet thick; sandstone contains varying amounts of shale and siltstone clasts; beds vary from loose friable sand to well cemented (carbonate) sandstone; does not contain uranium mineralization.
Siltstone and claystone (shale): Generally gray green, may contain thin interbedded sandstone and lignite beds; thickness varies from locality to locality.
Sandstone: Same as above.
Siltstone and claystone (shale): Generally gray green; may contain thin interbedded sandstone and lignitic beds thickness varies from locality to locality.
Sandstone: Same as above.
Siltstone and claystone (shale): Same as above.
Sandstone: Thickness varies from 0-50 feet; color varies from shades of gray to yellow-olive to red; grain size varies from medium-grained sand to gravel, most commonly medium to very coarse-grained sand; scattered conglomerate and siltstone beds less than 2 feet thick; sandstone contains varying amounts of shale and siltstone clasts; beds vary from loose friable sand to well cemented (carbonate) sandstone. does not contain uranium mineralization in Highland area.
Siltstone and claystone (tailings dam shale): Thickness varies from 5-40 feet thick; generally gray green with thin beds of sandstone.
Sandstone (upper Highland sandstone): Thickness ranges from 0-50 feet; color varies from shades of gray to yellow-olive to red; grain size varies from medium-grained sand to gravel, most commonly medium to very coarse-grained sand; scattered conglomerate and siltstone beds less than 2 feet thick; sandstone contains varying amounts of shale and siltstone clasts; beds vary from loose friable sand to well cemented (carbonate) sandstone; no economic uranium in solution mine area.
"50" SAND
Siltstone & claystone: Thickness varies from 5-30 feet; generally gray green.
Sandstone (middle Highland sandstone): Thickness varies from 5-50 feet thick; color varies from shades of gray to yellow-olive to red; grain size varies from medium-grained sand to gravel, most commonly medium to very coarse-grained sand; scattered conglomerate and siltstone beds less than 2 feet thick; sandstone contains varying amounts of shale and siltstone clasts; beds vary from loose friable sand to well cemented (carbonate) sandstone; major ore bearing unit in Highland area.
"40" SAND
Siltstone and claystone: Thickness varies from 0-50 feet; generally gray green; may contain thinbedded sandstone units.
Sandstone (lower Highland sandstone): Thickness varies from 0-50 feet thick; color varies from shades of gray to yellow-olive to red; grain size varies from medium-grained sand to gravel, most commonly medium to very coarse-grained sand; scattered conglombrate and siltstone beds less than 2 feet thick; sandstone contains varying amounts of shale and siltstone clasts; beds very from loose friable sand to well cemented (carbonate) sandstone; major ore bearing unit in Highla.d area.
"30" SAND
"20" SAND
Siltstone and claystone: Thickness varies from 5-80 feet; color generally gray green.
Sandstone: Thickness varies from 0-40 feet; color varies from shades of gray to yellow-olive to red; grain size varies from medium-grained sand to gravel, most commonly medium to very coarse-grained sand; scattered conglomerate and siltstone beds less than 2 feet thick; sandstone contains varying amounts of shale and siltstone clasts; beds very from loose friable sand to well cemented (carbonate) sandstone; does not contain economic amounts of uranium in Highland area.
Siltstone & claystone (shale): Same as above.
NOTE: The stratigraphic section above are sands varies in thickness relative to the elevation of the surface. As the surface elevation rises, the thickness of the sequence of beds increases. The lithological units are similar to those described in this columnar section; however, the number of units and their thickness will vary from locality to locality.

Figure 2



REV. NO	DATE	BY	DESCRIPTION

EVEREST MINERALS CORPORATION
HIGHLAND URANIUM PROJECT

FIGURE 3
PRE MINING GEOLOGIC CROSS SECTION
OF THE HIGHLAND SITE

DESIGN:	DRAWN:	DATE:
SCALE: Shown	DRAWING NO:	

Prior to existing mining activities, Exxon Corporation operated an R&D pilot in situ leach facility (ISL) at the mining area. The R&D pilot ISL was in operation for 3 years. Subsequently, a ground-water restoration program was started at the site in 1981. Ground-water restoration was conducted using ion exchange, reverse osmosis, and ground-water sweep from 1981 to 1984, and again from 1986 to 1987. Restoration was considered complete when all 28 monitored ground-water constituents were returned to stable baseline concentrations, with the exception of slightly elevated iron and manganese concentrations in three production wells.

Table 1 shows the analytical results of the stability monitoring following operation of the R&D pilot ISL. Table 2 summarizes the baseline ground-water quality obtained from Sections 21 and 24 mine areas.

2.2.3 Confinement of the Ore Zone

Vertical confinement of the ore zone at the PRI facility is provided by shale sections with low hydraulic conductivities. Aquifer tests conducted on the shale unit above and below the Highland Sandstone indicate hydraulic conductivities of 10E-7 cm/sec or 655. This is in large contrast to the hydraulic conductivity values measured in the ore zone strata which average 2.2E-3 cm/s.

Lateral confinement is accomplished by pumping of the recovery wells. This procedure maintains a small cone of depression around each production well, causing a hydraulic potential towards the production well.

3.0 PROCESS DESCRIPTION

3.1 In Situ Leaching Process

The in situ leaching methods involve: (1) the injection of a leach solution (lixiviant) into a uranium-bearing ore body to oxidize the uranium, (2) the mobilization by complexing the uranium, with a chemical carrier, and (3) the production of the solution bearing the uranium complex via recovery wells. Uranium is separated from the leach solution by conventional milling methods (ion exchange) in a surface facility. The existing operation utilizes two satellite stations, Satellite Nos. 1 and 2, and one main facility, the Central Processing Facility (CPF). The WHA proposes a new satellite, Satellite No. 3.

The residual solution, which carries some unutilized lixiviant is reconstituted with gaseous carbon dioxide and oxygen, and returned to the mining zone for additional uranium recovery. The cycle described continues until the ore zone is depleted or until it is no longer feasible to recover the uranium.

Conventional extraction methods, which usually result in large amounts of spoil and tailings, can produce a significant impact on the environment. In contrast, solution mining leaves no tailings. The greatest potential impact of the in situ leach extraction method is to the ore zone ground-water quality. The extent to which in situ mining can be beneficially conducted is limited in that the ore zone conditions must be suitable for containing and controlling

Table 1

SPM/1-06-87
filename FINREST

Wellfield Data After 1986 Active Restoration Program
Sample date 1 Oct 1986

Power Resources, Inc.

Well Number	I-1	I-2	I-3	I-4	P-1	P-2	P-3	P-4	P-5	P-6	P-7	P-8
X=east	407,700	407,612	407,526	407,489	407,719	407,742	407,686	407,584	407,516	407,463	407,407	407,497
Y=north	878,920	878,871	878,840	878,892	878,988	878,905	878,853	878,811	878,759	878,834	878,919	878,972
Aluminum	-0.1	-0.1	-0.1	0.2	-0.1	-0.1	-0.1	-0.1	0.2	-0.1	-0.1	0.3
Arsenic	-0.004	-0.004	0.004	-0.004	-0.004	0.005	0.004	0.006	0.005	-0.004	0.007	-0.004
Bicarb	268	249	220	176	46	220	116	18	40	20	48	20
Boron	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	0.1	-0.1	0.1	-0.1	0.1	-0.1
Cadmium	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Calcium	53		62				37		21		17	
Carbonate	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
Chloride	7	8	5	8	3	3	3	4	3	3	3	9
Chromium	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05
Copper	0.02	-0.01	0.02	-0.01	-0.01	-0.01	-0.01	-0.01	0.02	-0.01	-0.01	-0.01
Fluoride	0.40	0.40	0.20	0.20	-0.10	-0.01	0.60	-0.10	-0.10	-0.10	-0.10	-0.10
Iron	0.45	-0.05	0.25	-0.05	0.44	-0.05	10.80	0.67	10.00	0.12	5.40	-0.05
Lead	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05
Manganese	0.13	0.06	0.19	0.21	0.04	0.47	0.51	-0.01	0.32	0.02	0.17	-0.01
Mercury	-0.0004	-0.0004	-0.0004	-0.0004	-0.0004	-0.0004	-0.0004	-0.0004	-0.0004	-0.0004	-0.0004	-0.0004
Ra-226	83	106	84	13	46	64	142	19	231	49	86	25
Ra-226 error	4.1	2.2	3.0	1.1	1.3	2.7	3.9	0.8	5	1.9	4.1	1.0
Ra-226 LLD	1.3	0.4	0.7	0.8	0.2	0.8	0.7	0.2	0.7	0.5	1.3	0.2
Selenium	-0.001	-0.001	-0.001	-0.001	-0.001	0.002	-0.001	0.002	0.001	-0.001	-0.001	0.006
Sodium	76		54				20		13		17	
SO4	96	74	90	123	14	74	55	-2	52	18	49	96
TDS	422	378	394	438	70	266	240	22	184	56	162	198
U(nat)	0.23	0.59	0.14	0.56	0.08	0.62	0.70	0.61	0.23	0.08	0.25	0.05
Zinc	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	0.71
pH	7.2	8.2	7.3	7.5	6.3	7.3	7.2	6.0	7.1	6.5	7.0	7.1

Well Number	P-9	P-10	P-11	M-1	M-2	M-3	M-4	M-5	G-5	G-2	G-8	G-9
X=east	407,554	407,633	407,569	407,655	407,501	407,532	407,544	407,534	407,497	407,786	407,496	407,56
Y=north	878,890	878,938	878,857	878,898	878,855	878,822	878,827	878,816	878,682	878,953	879,065	878,950
Aluminum	-0.1	0.4	-0.1	0.2	0.2	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	0.1
Arsenic	0.005	-0.004	-0.004	-0.004	-0.004	-0.004	-0.004	-0.004	-0.004	-0.004	-0.004	-0.004
Bicarb	55	78	128	176	161	171	176	177	165	201	238	295
Boron	-0.1	-0.1	0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
Cadmium	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Calcium	14		29									
Carbonate	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	2	2
Chloride	3	5	5	5	12	7	10	9	5	2	3	6
Chromium	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05
Copper	0.02	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Fluoride	-0.10	-0.10	0.10	0.20	8.80	0.20	0.20	0.10	0.39	0.20	0.20	0.30
Iron	1.80	0.47	-0.05	-0.05	0.67	-0.05	-0.03	-0.05	-0.05	-0.05	-0.05	-0.05
Lead	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05
Manganese	0.07	0.04	0.18	0.02	0.23	-0.01	-0.01	0.02	0.06	0.02	0.02	0.01
Mercury	-0.0004	-0.0004	-0.0004	-0.0004	-0.0004	-0.0004	-0.0004	-0.0004	-0.0004	-0.0004	-0.0004	-0.0004
Ra-226	9	46	7	1.7	0.9	7	11.8	7.6	399	199	16	64
Ra-226 error	1.0	1.3	0.9	0.3	0.2	0.6	0.7	0.6	4	3.0	1.1	1.6
Ra-226 LLD	0.7	0.2	0.7	0.2	0.2	0.4	0.4	0.4	0.2	0.2	0.5	0.2
Selenium	-0.001	0.001	-0.001	-0.001	-0.001	0.002	-0.001	-0.001	-0.001	0.002	-0.001	0.16″
Sodium	18		33									
SO4	44	22	44	198	76	268	230	348	114	98	84	8.
TDS	184	108	275	442	306	578	492	658	440	332	330	404
U(nat)	0.26	1.30	0.12	0.001	-0.001	0.090	0.150	0.014	0.062	0.470	0.24	0.800
Zinc	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
pH	6.7	6.7	6.9	8.2	8.8	8.2	8.0	8.2	8.4	8.3	8.4	8.4

Notes:

1. a minus sign indicates the constituent is present in concentrations below the lower detection limit
2. units are mg/l except Ra-226 in pCi/l and pH in standard units

TABLE 2

Wellfield Monitored Parameters, Wyoming Water Quality Standards, and Baseline Concentrations

	Wellfield Baseline Range	Wellfield Baseline Mean	State of Wyoming Standards: Drinking Water (Class I)	Agriculture	Livestock
Aluminum	<0.05 to 1.75	<0.18	*	5.0	5.0
Arsenic	<0.01 to 0.02	<0.01	0.05	0.1	0.2
Barium	<0.05 to 0.28	<0.06	1.0	*	*
Boron	<1.0	< 1.0	0.75	0.75	5.0
Bicarbonate	73.0 to 268.0	165	*	*	*
Carbonate	<1.0 to 48.0	<16.0	*	*	*
Cadmium	<0.002	<0.002	0.01	0.01	0.05
Calcium	4.0 to 60.0	32.0	*	*	*
Chloride	6.0 to 81.0	21.0	250	100	2000
Chromium	<0.01	<0.01	0.05	0.01	0.05
Copper	<0.01 to 0.01	<0.01	1.0	0.2	0.5
Fluoride	0.01 to 0.37	0.15	1.4 - 2.4	*	*
Iron	<0.01 to 0.83	<0.09	0.3	5.0	*
Lead	<0.05	<0.05	0.05	5.0	0.1
Manganese	<0.01 to 0.39	0.03	0.05	0.2	*
Magnesium	2.0 to 14.0	7.0	*	*	*
Mercury	<0.001	<0.001	0.002	*	0.00005
Molybdenum	<0.05	<0.05	*	*	*
Nitrate	<0.01 to 0.70	<0.04	10.0	*	*
Selenium	<0.01 to 0.01	<0.01	0.01	0.02	0.05
Silver	<0.02	<0.02	0.05	*	*
Sodium	54.0 to 129.0	87.0	*	*	*
Sulfate	62 to 224	124	250	200	3000
Zinc	<0.01 to 0.14	<0.02	5	2	25
Uranium	0.001 to 8.10	0.33	5	5	5
Radium-226 (pCi/l)	0.01 to 320.0	73.8	5	5	5
TDS	116 to 516	370	500	2000	5000
Conductivity (umhos/cm)	330 - 575	437	*	*	*
pH (std. units)	7.7 - 10.1	8.8	6.5 to 9	4.5 to 9	6.5 to 8.5

All units in mg/l except as noted

*No established water use standard

the leach solutions during the mining process. The R&D ISL pilot has shown the ore-bearing aquifer can be restored to baseline quality, premining quality use, or potential use category.

Operation of the existing PRI facility confirms the environmentally favorable mining conditions for conducting the in situ leach mining of the Highland Sand Group.

3.2 The Ore Body

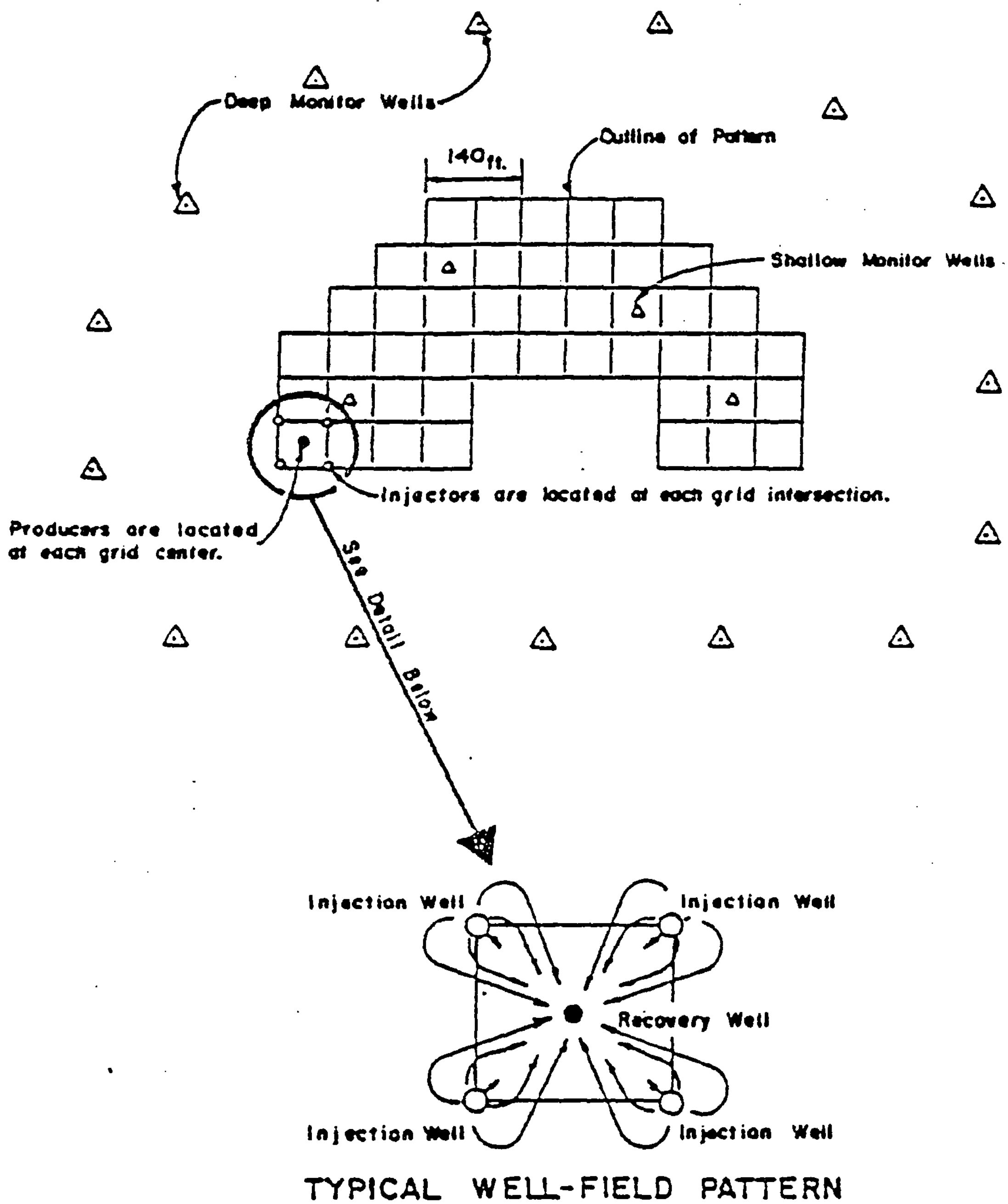
At the PRI site, the Highland Sandstone contains a roll front uranium deposit which is generally associated with fluvial sandstones and conglomerates. The uranium-bearing ore was deposited as uranium-rich, oxidized ground water migrated into a reducing environment. The shape of the ore zone is a function of the distribution and permeability of the host rock during deposition.

Roll front ore bodies are prevalent in most of the established uranium mining districts in the western United States. In situ leaching, however, can be conducted only on those ore deposits that meet certain criteria. These generally include: (1) the ore deposit must be located in a saturated zone, (2) the ore deposit must be confined both above and below by low permeability zones, (3) the ore deposit must have adequate permeability, and (4) the ore deposit must be amenable to chemical leaching.

The ore of the Highland Sandstone at the PRI site appears to meet the criteria for beneficial in situ leach mining. Previous operational data from the Exxon R&D ISL and current operational data from PRI confirms that the deposit has the chemical properties necessary to allow in situ leaching of uranium. Aquifer testing for existing mine units indicates the ore zone is saturated, permeability is adequate, and the ore zone is adequately confined. Moreover, the licensee will be required by license condition to submit an aquifer testing proposal that identifies the hydraulic characteristics of all areas proposed to be mined. The licensee will also be required by license condition to submit baseline water quality data as well as propose upper control limits for the mining unit prior to lixiviant injection in a mining area.

3.3 Well Field Design and Operation

The operation of the Research and Development In Situ Leach project performed during ownership of the Highland Uranium Project by the original source material license holder, as well as the mining activities conducted at the Highland Uranium Project to date, have provided considerable ore zone data. This data was instrumental in developing PRI's present well-field design and operational strategy which has proven to be successful and which would be employed in the proposed WHA. Section 3.3 of the original license application contains a description of well-field patterns and injection, recovery, and monitoring construction and testing. This section also refers to the use of monitoring wells for baseline water quality data collection. A typical mining pattern is shown in Figure 4.



HIGHLAND URANIUM PROJECT

TYPICAL 5-SPOT MINING PATTERN

DATE 3/4/85

Figure 4

3.4 Uranium Recovery Process

3.4.1 Chemical Leaching

The leach solution or lixiviant to be used for dissolution and recovery of uranium at the PRI facility comprises a bicarbonate solution formed by adding gaseous carbon dioxide and and oxygen. Previous mining operations have demonstrated that this lixiviant will recover uranium and leave the production zone in such a state that restoration of the affected water will be successful. To ensure continued successful restoration, the licensee will be prohibited by license condition from altering lixiviants without prior approval of the NRC.

3.4.2 Plant Processing

The uranium recovery process that occurs once the uranium has been extracted from the ore zone involves three primary steps: (1) uranium adsorption; (2) resin elution; and (3) precipitation of uranium.

Soluble uranium that is recovered as a carbonate complex is produced from the well fields and directed to the satellite facilities' ion exchange circuits at a flow rate equal to or less than the maximum combined satellite design capacity of 7500 gpm. Table 3 shows the typical process plant chemical reactions in the recovery operation. At the satellite station, the recovered fluid is introduced into the series of pressurized downflow ion exchange columns where uranium will be adsorbed onto resin beads. Following this, barren leach solution exiting the columns is reconstituted with carbon dioxide and returned to the well field for oxygen addition and reinjection into the mining units to repeat the leach cycle.

Once the resin has been fully loaded with uranium, it is transferred to the elution circuit at the CPF, where the uranium is stripped from the resin beads with a brine-soda ash-sodium sesquicarbonate solution. The uranium is then precipitated with ammonia or hydrogen peroxide. The resultant yellowcake slurry then undergoes washing and centrifuge dewatering. At this point, the yellowcake slurry is dried and packaged onsite.

The general layout of the process plant is as shown on Figure 5. A schematic flow diagram of the process circuit is shown in Figure 6. The licensee will be required to maintain this process circuit. Any changes will require appropriate license amendment.

3.5 Radium Settling Basins and Purge Storage Reservoir

The radium settling basins for Satellite Nos. 1 and 2 consist of two 3-acre-foot lined ponds located east of Satellite No. 1. These are used to settle out the radium-barium sulfate (used to reduce the fresh water stream radium-226 concentration) which remains after initial removal by the filter press. The filter press is housed in Satellite No. 1. Water that passes through these basins then goes to the Purge Storage Reservoir where it is stored prior to periodic sprinkler irrigation. The existing Radium Settling Basins are connected to Satellite Nos. 1 and 2 by a 3-inch polyethylene

Table 3

Typical Process Plant Chemical Reactions

Reconstitute Leach Solution

$$CO_2 + H_2O \longrightarrow HCO_3^- + H^+$$

Uranium Extraction from Leach Solution

$$UO_2(CO_3)_2^{-2} + 2RCl \longrightarrow 2Cl^- + R_2UO_2(CO_3)_2$$

Resin Stripping

$$R_2UO_2(CO_3)_2 + 2Na\ Cl \longrightarrow Na_2UO_2(CO_3)_2 + 2RCl$$

Acidification

$$Na_2UO_2(CO_3)_2 + 4H_2SO_4 \longrightarrow UO_2(SO_4)_3^{-4} + 2CO_2 + Na_2SO_4 + 4H^+ + 2H_2O$$

Precipitation

$$UO_2(SO_4)_3^{-4} + xH_2O_2 + H_2O \rightleftharpoons UO_3 - H_2O_2 - H_2O + H_2SO_4$$

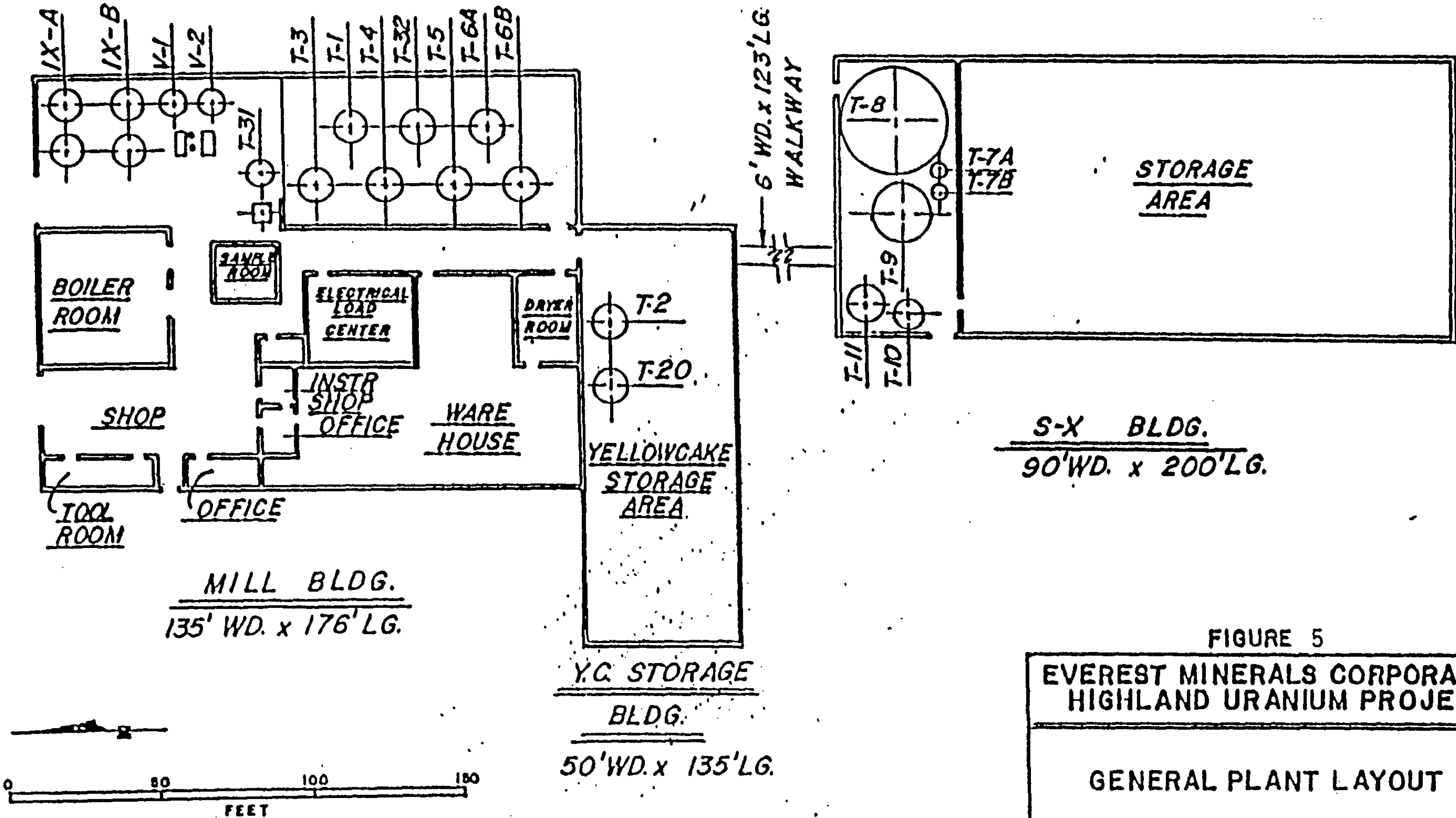
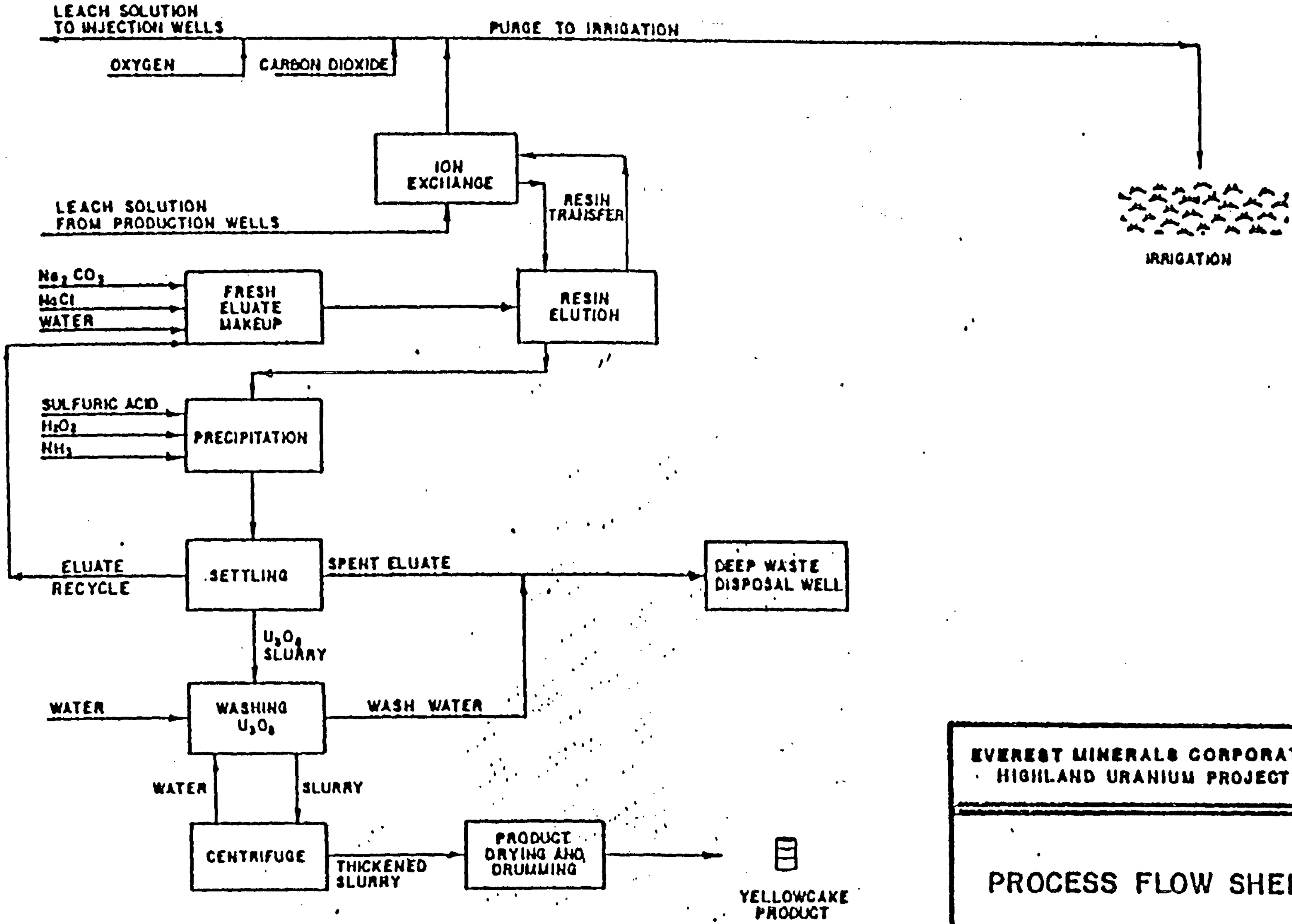


FIGURE 5

EVEREST MINERALS CORPORATION
HIGHLAND URANIUM PROJECT

GENERAL PLANT LAYOUT

SCALE: AS SHOWN	DATE:	DRWN BY
CHK'D BY	DRWG NO.	



EVEREST MINERALS CORPORATION
HIGHLAND URANIUM PROJECT

PROCESS FLOW SHEET

DATE	FIGURE 6

pipeline and are connected to the Purge Storage Reservoir by an 8-inch polyethylene pipeline.

The Radium Settling Basins are permitted by the WDEQ, WQD, under Permit 87-042RR. Detailed information on the ponds may be found in the original EA.

The Purge Storage Reservoir for the system described is located east of Satellite No. 1 and is used to store treated well-field purge water and treated water from well-field restoration activities. The reservoir contains 50 acre-feet when at full capacity. Water stored in the reservoir is periodically sprinkler irrigated on a 54-acre irrigation area during summer months. The Purge Storage Reservoir is also permitted by the WDEQ,WQD, under Permit 87-042RR.

The information concerning the location and design for the proposed Satellite No. 3 and associated settling basin and storage reservoir will be submitted to the NRC prior to construction. The proposed location of these facilities is contained in the revised license application. As with similar facilities already in place and operating, the appropriate permits will be acquired from the WDEQ, WQD, prior to construction.

3.6 Generation and Management of Wastes

3.6.1 Preoperational Wastes

Preoperational wastes generated during well-field development will include the solid debris from land clearing activity and small one-time quantities of solid and liquid wastes that will be produced during land and process plant construction. These will be nonradiological in nature and appropriately disposed of or stockpiled for future utilization. To assure that any radioactive wastes associated with the preoperation of the project are not improperly disposed of, the licensee will be required by license condition to designate an area within the restricted area boundary for storage of contaminated materials prior to their disposal.

3.6.2 Gaseous Effluents

Gaseous waste from the in situ mining operation will be in the form of radon-222. At the well field, the radon-222 will be vented directly from storage tanks and header houses to the atmosphere. Additionally, there will be small quantities of nontoxic gases (CO_2 and O_2) released from gas traps on the injection well pipelines.

3.6.3 Liquid Wastes

The licensee is required by license condition to direct all liquid wastes to an approved disposal location (land spreading or deep injection well) or return the liquid wastes to the process circuit.

At the HUP, liquid wastes from the operation consist of two types of waste water: (1) a fresh water stream, and (2) a salt water stream.

The fresh water stream consisting of well-field purge represents approximately 0.5 to 1.5 percent of the fluids produced at the satellites. This stream is removed from the process solution after pumping through the ion exchange system and ranges from 50 to 100 gpm. Other fresh water fluids are produced by ground-water sweep during the restoration process. The flow rate for these fluids will range from 90 to 360 gpm. These two liquid waste components are treated with barium chloride to remove radium-226 to less than 30 pCi/l, and comprise the irrigation water source. Details of the radium treatment system are included in the WDEQ,WQD, Permit No. 87-042RR.

The salt water wastes are produced from several sources in the uranium recovery and yellowcake production process. The sources that make up this waste stream include laundry and analytical laboratory wastes, elution agents decanted from the precipitation circuit, yellowcake wash water, reject solutions from the water treatment process, and process area runoff. These combined waste streams yield approximately 18.5 gpm (800,000 gallons per month). PRI stores these wastes in tanks at the main process facility until disposal is initiated through deep well injection. Salt water storage tanks are permitted through the WDEQ.

3.6.4 Solid Wastes

Solid waste that is contaminated with natural uranium and/or radioactive daughters are disposed of in an authorized waste disposal facility. Furthermore, by license condition, the release of equipment or packages from the restricted area will require appropriately documented radiation surveys be conducted. Noncontaminated solid waste is disposed of in a licensed municipal landfill offsite.

3.7 Proposed Waste Disposal Methods

3.7.1 Land Irrigation Disposal Wastes

The two major fresh water liquid waste streams disposed by land irrigation are the process purge and restoration waste water. Part of the purge stream is generated after the uranium has been removed by the ion exchange column. This stream is continuous throughout the production phase of the project and ranges from 50 to 100 gpm. Other purge water is from fluids associated with well cleanup operations.

The second waste stream which comprises restoration fluids is generated from activities associated with restoration of a depleted ore zone. Restoration begins with ground-water sweep. This process is followed by ground-water treatment (reverse osmosis) to reduce concentrations of contaminants including radium-226 and uranium, and reinjection of the treated water. In some cases, if restoration is not complete, a reductant will be injected to precipitate out the remaining contaminants.

3.7.1.1 Pretreatment Facility

Based on experience gained during the R&D ISL project and the current operations, it is necessary to pretreat the fresh water waste streams to ensure that the radium-226 concentrations are below 30 pCi/l prior to irrigation. The method of pretreatment proposed is coprecipitation of radium-226 with $BaSO_4$ and the removal of the $BaSO_4$ solid in settling ponds. The $BaSO_4$ precipitation process involves the addition of a small amount of $BaCL_2$ to the irrigation fluids. The soluble barium quickly forms an insoluble $BaSO_4$ compound which coprecipitates the radium-226. The barium chloride dehydrate, a soluble barium salt, will be utilized in granular form. A stock solution containing approximately 200 g/l of $BaCl_2$ will be prepared in a chemical mix tank and as soon as dissolution is complete, transferred to the chemical addition tank. The $BaCl_2$ will be metered into the irrigation fluid stream at a rate that will insure a barium concentration of between 50 and 100 ppm. Adequate mixing is provided by an in-line static mixer at the barium chloride injection point. The fluid is then pumped to settling ponds designed to allow the formed solid, $Ba(Ra)SO_4$, to settle.

Prior to introduction of $BaCl_2$, additional uranium is removed from the waste stream by passing the fluid through an ion exchange column. The column contains an anionic resin. This resin is eluted periodically to restore its full capacity. This process will maintain the average uranium concentrations in the irrigation fluid below 3 mg/l.

3.7.1.2 Settling Ponds

At both the in-place and proposed operations, the fluid from the barium pretreatment facility will be pumped to the first of two settling ponds after passing through a filter press which removes the majority of $Ba(Ra)SO_4$. The two-pond system will be operated in series with each basin providing sufficient retention time to allow the solids to settle. The fluid from the outlet of the second pond(s) can be pumped either to the appropriate irrigation site for immediate application or to the appropriate storage impoundment for application at a later time. When the barium sulfate solids accumulate in the first pond to the point that the efficiency of the settling basin is impaired, that pond will be taken out of service temporarily and the solids removed. For the system described, the operation of only one of the two ponds will not decrease the settling efficiency significantly and it will be possible to maintain the average radium concentration below 30 pCi/l. The solids precipitated from the irrigation fluid and settled in the process pond will be periodically removed and transported to a licensed low level radioactive waste facility or mill tailings impoundment.

3.7.1.3 Well Field Purge Storage Reservoir

During the winter months when irrigation is not feasible, the fluid from the outlet of the second pond will be pumped to the well-field purge storage reservoir (impoundment). It will be stored in this impoundment until spring when it can be pumped to the irrigation site for application.

The impoundment for Satellite Nos. 1 and 2 has a capacity of approximately 54 acre-feet. The fluid stored in the impoundment will have already been processed through the barium pretreatment facility and settling ponds and the radium-226 concentration reduced below 30 pCi/l. A fence is constructed around the impoundment to exclude livestock and wild game.

A new impoundment will service the proposed Satellite 3. The design will be submitted to the NRC for review and approval prior to construction.

3.7.1.4 Irrigation Area

The irrigation site for Satellite Nos. 1 and 2 is approximately 58 acres and is located in Section 21. the grade across the 1000-foot site diameter is 0.016. A small berm of 6 to 12 inches encircles the site to ensure that fluids applied cannot escape. The nearest resident is located approximately 1 mile to the northeast. A fence to restrict livestock is constructed around the site perimeter.

The irrigation area will be kept under vegetative cover except for those times required to perform necessary field cultivation and planting activities. Grasses grown primarily for cover will be clipped on a monthly basis, and the clippings returned to the irrigation area ground. In no case will foliage materials be released for consumption outside of the project area unless they meet required standards for unrestricted use.

Prior to construction, plans for the irrigation system for the proposed Satellite No. 3 will be submitted to the NRC for approval by license condition.

3.7.1.5 Application of Fluid

Application of the treated fluid to the soil in the irrigation area is by a center pivot irrigator. The irrigator is a low profile system with 42-inch drop pipes. This system, used in combination with low pressure 360-degree nozzles, minimizes overspray due to wind drift of the fluid. The system includes five 170-foot spans with a 16-foot overhand which results in an irrigator with a length of 865 feet.

The rotation time of the system is 21.8 hours. At the minimum flow rate of 300 gpm, this results in an application of 0.27 inches per complete revolution. The actual delivery rate is adjustable from the main control box which is equipped with a percentage timer that controls the percentage of time the end tower is allowed to run each minute. Total water delivery to any one irrigation area will depend upon loading requirements and hydraulic balance.

3.7.1.6 Irrigation Fluid Volumes

During the production phase of the project, the well-field purge and well workover fluids are disposed of at the irrigation facility. During the first 2 years of production, the well-field purge and well workover fluids for Satellite Nos. 1 and 2 comprised a waste stream estimated to flow at 35 gpm. Since then, the increase in production has resulted in a flow of approximately

60 gpm. During restoration activities, the operation irrigation system waste stream will periodically increase to 90 to 360 gpm. The proposed Satellite No. 3 will produce a 30 to 60 gpm waste stream which, during restoration, may also increase to 90 to 360 gpm.

For each mining unit, the waste stream from the well field under restoration only consists of fluids from restoration activities. Ground-water sweep, which will be employed as the first step in ground-water restoration, is the pumping of ground water from the well field. This creates a cone of depression to draw in fresh water. The withdrawn fluid is processed through the irrigation pretreatment facility before being stored or used for irrigation. The number of pore volumes (volume of water that occupies the pore space of the ore zone and host rock collectively) treated and used for irrigation will depend on the successive improvement in ground-water quality analyzed after treatment of each pore volume. The restoration program for the R&D ISL project (data for the HUP site is not available at this time) utilized approximately four and one-half pore volumes for ground-water sweep.

When it is determined that ground-water sweep alone is no longer improving water quality, the second phase of restoration, reverse osmosis (RO) and reinjection is employed. The number of pore volumes treated in this manner and the amount of treated fluid available for irrigation is, again, dependent upon water quality improvement with treatment of each successive pore volume. The RO process at the R&D ISL site required approximately seven pore volumes for the second phase of restoration.

During the restoration phase of the project, it is estimated that withdrawal of fluid from the well field will be conducted during 6 months of the year, and that the continuous withdrawal of 90 gpm for a 6-month period will produce one pore volume of restoration fluids. It follows that the withdrawal rate is approximately one pore volume per year. During the initial restoration, the ground-water sweep equivalent to the number of extracted pore volumes will be pumped from the well field to the barium pretreatment facility and settling ponds. The fluid will then be pumped to the storage impoundment. During the irrigation season, it will be applied to the irrigation site. During the second phase of restoration when the equivalent to the number of pore volumes withdrawn is treated by an RO unit, withdrawal from the well field is still anticipated to be 90 gpm. The reject (salt water) stream from the RO unit will be processed through the barium pretreatment facility to reduce the radium-226 concentration and then used for irrigation. Prior to application at the irrigation site, the fluid will be mixed with native ground water pumped from a nonmineralized aquifer zone within the Highland Sandstone group. The amount of native ground water that will be used will be equal to the volume necessary to dilute the total dissolved solids (TDS) to concentrations authorized for release. The net result will be a waste stream of 90 to 100 gpm. The water-bearing strata used may vary from well field to well field, but PRI will not use the most shallow aquifer in the HUP region which could provide water to privately owned wells.

3.7.1.7 Irrigation Fluid Quality

The licensee is required by license condition to sample the irrigation fluid discharge monthly and submit the results in the semiannual environmental monitoring reports. The quality of the irrigation fluid discharge from the existing facility which could impact the environment is listed in Table 4. A comparison of these values with the predicted water quality restoration concentrations included in Table 4 labeled, "NRC EA Estimates," indicates water quality is actually better than previously predicted for many restored ground-water constituents, including U_3O_8 and Ra-226. Restoration of the well field fluid after mining is complete should result in even higher quality ground water because any residual uranium in the mine will not be released by oxidation. Therefore, the quality of restoration fluid for HUP mine fields should be better than the estimation for the quality of restoration discussed in the original EA and referenced above.

During the commercial scale of operation, the relatively small amount of acid used to clean the wells will be partially neutralized by the calcium carbonate in the well bore and formation, and the bicarbonate in the solution. Any remaining acid will be neutralized with sodium hydroxide. The additional acid and base insignificantly increases the concentrations of chloride and sodium which are already present in the injection fluid.

3.7.1.8 Monitoring Program

In order to properly monitor the impacts of this project, samples are taken of the irrigation fluid, soil, and vegetation, on a regular basis. Results of the chemical analyses performed on the samples are used for management purposes and are submitted to the NRC as part of the semiannual monitoring reports. Table 5 details the monitoring program.

Samples of fluid taken after the barium pretreatment process are composited on a daily basis and analyzed monthly for the specified metals. A grab sample is collected and analyzed monthly. If the results of the analysis of this grab sample indicate any other parameters that may be potential problems, then these parameters are added to the list of analyses to be performed on the monthly composite sample.

Soil samples are collected toward the end of the irrigation season (September), although irrigation is year round when weather and soil conditions are appropriate. The results of the estimated rate of heavy metal and radionuclide buildup in the soils, addressed under Environmental Impacts, indicates very slow buildup of these elements and that more frequent sampling is not warranted.

Vegetation sampling is conducted during August of each year. Samples collected at soil sample stations are composite samples of the vegetation present at the particular location.

TABLE 4

Concentrations of Various Elements in the Well Field Purge
Irrigation Period

PARAMETER*	NOV 10-14, 1989	JUL 25-AUG 4, 1990	APR 28-MAY 14, 1991 MAY 31-JUN 4, 1991	JUN 4-10, 1991	JUL 3-16, 1991	MIN	MAX	AVG	NRC EA ESTIMATES
pH (units)	7.80	7.76	7.94	7.98	7.98	7.76	7.98	7.89	6.65
Cond (μmhos/cm)	7,432	6,369	4,000	3,848	3,927	3,848	7,432	5,115	3,675
TDS	4,337 calc	3,881	1,948	2,091	2,093	0	4,337	2,392	2,390
Na	720	397	162	150	139	139	720	314	392
Ca	274	346	241	273	249	241	346	277	391
Mg	105	112	85	76	78	76	112	91	10
K	470	527	65	61	111	61	527	247	33
Cl	1853	1506	693	668	587	587	1,853	1,061	565
SO4	710	801	613	618	874	613	874	723	203
HCO3	193	134	239	225	109	109	239	180	1,000
As	<0.001	<0.001	<0.001	<0.001	<0.001	NA	NA	<0.0001	0.018
B	0.17	0.18	0.14	0.13	0.15	0.13	0.18	0.15	0.654
Cr	<0.05	<0.05	<0.05	<0.05	<0.05	NA	NA	<0.05	0.001
Cu	<0.01	0.02	0.06	0.04	0.02	<0.01	0.06	0.03	0.001
Ni	<0.05	<0.05	0.06	<0.05	0.05	<0.05	0.06	0.05	0.05
Se	0.61	0.29	1.05	1.03	0.602	0.29	1.05	0.72	0.56
Zn	3.4	1.02	2.94	0.98	1.44	0.98	3.40	1.96	0.001
U3O8	1.99	5.58	2.27	1.79	2.53	1.79	5.58	2.83	3.6
Ra-226 (pCi/l)	1.7	2.5	3.5	2.7	7.2	1.70	7.20	3.52	30

* mg/l unless noted

TABLE 5

Highland Irrigation Project
Monitoring Program

SAMPLE	LOCATION	FREQUENCY	ANALYSES
Irrigation Fluid	After Barium Pretreatment Facility	Monthly-Composited Daily	Na, Ca, Mg, Cl, SO_4, As, Se, U, Ra-226
Irrigated Soil (Thoroughly blended composite 0-15 cm depth)	One per 4 acres	September of each year	Na, Ca, Mg, As, Se, B, Ra-226, U, Conductivity, SAR, pH
Irrigated Soil (Thoroughly blended compsite 15-30 cm depth)	One per 4 acres	September of each year	Na, Ca, Mg, As, Se, B, Ra-226, U, Electrical Conductivity, SAR, pH
Irrigated Vegetation	Composite from soil sampling locations	August of each year	As, Se, B, Ra-226, U
Visual Inspections	Irrigation Perimeter	Daily during irrigation season	Check for runoff

If the results of soil or vegetable analyses indicate unacceptable levels of contaminants, irrigation will be stopped and the contamination removed. If the contamination cannot be completely removed, operations will cease and decontamination will continue until such time as authorized contaminant concentrations are achieved.

3.8 Waste Disposal Injection Well

The underground injection control (UIC) well used by PRI to dispose of the salt water streams is located approximately 1 miles north of the CPF/office. This waste water well is permitted by the WDEQ, WQD through the UIC program, Permit No. UIC89-030. Waste stream samples are collected and composited daily with analytical results reported quarterly to the EPA and WDEQ.

3.8.1 Injection Waste Disposal Well Solution Zones

3.8.1.1 Regional Hydrogeologic Setting

The Powder River Basin is a large northwestward trending syncline formed during the Laramide Orogeny, which contains a sequence of Tertiary sedimentary rocks overlying Upper Cretaceous sedimentary rocks. The combined thickness of the Tertiary and Cretaceous strata is approximately 16,000 feet thick in the vicinity of the Highland Project (Figure 7). The Tertiary-age Fort Union formation includes the Highland Sand Group, the host for the uranium-bearing ore deposits.

Recognized aquifer systems in the Powder River Basin are presented in Figure 8. Recharge to these aquifers occurs principally along the basin flank with ground-water flow toward the center of the basin and northward. Upper Cretaceous shale formations, including the Lewis and Cody Shales, are effective aquitards separating the more shallow Fox Hills/Lance and Wasatch/Fort Union aquifer systems from the relatively deep Madison and Dakota aquifer systems.

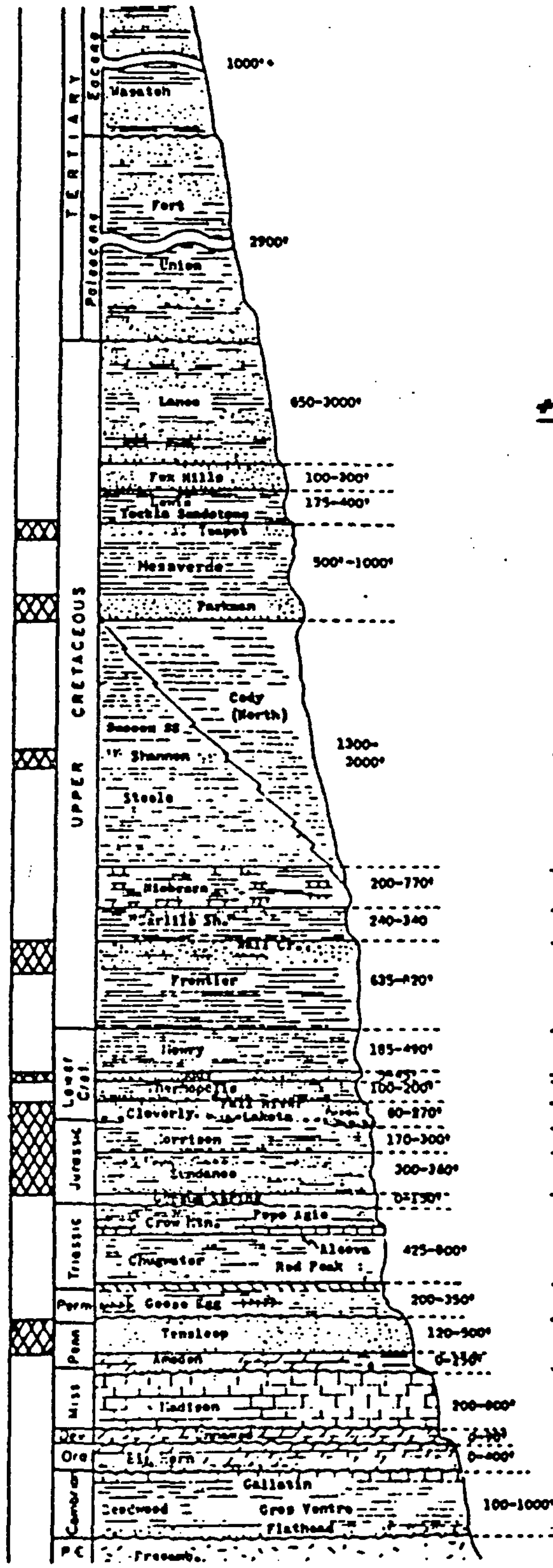
Suitable injection well receiver zones are limited by WDEQ regulations to formations containing Class VI ground water (known as exempted aquifers in the EPA UIC program). Class VI ground water is unusable or unsuitable for domestic and livestock use because of:

1. high total dissolved solids (TDS) concentrations (more than 10,000 mg/l).

2. contamination that is economically or technologically impractical to remove, or

3. location or depth that make use economically and technologically impractical.

Based on a review of the water quality data available from oil wells in the project vicinity, water with quality better than Class VI occurs in formations above the Lewis Shale, including the Fox Hills/Lance and Wasatch/Fort Union. These units, having an average TDS of 525 mg/l, are used for drinking water. Below the Lewis Shale water quality deteriorates, with most zones producing



Drilling Depths to Formation Tops (feet)

#1 Vollman Well	Morton #1-20 Well
7,450	
7,500	7,250
8,940 8,100	8,630
9,300	8,970
9,750	
10,730	
11,240	
12,250	
12,660	
12,950	
13,790	
13,960 14,000	
14,140	
14,230	
~14,350	
~14,600	
~15,150	
~15,650	
~16,150	

CROSS-HATCHING INDICATES OIL PRODUCING ZONES

ADAPTED FROM WYOMING GEOLOGICAL ASSOCIATION, 1964.

EVEREST MINERALS CORPORATION
HIGHLAND URANIUM PROJECT

GENERAL STRATIGRAPHY AT THE HIGHLAND PROJECT

DATE 2/25/85

FIGURE 7

Era	System	Series	Geologic Formations (W – E)	Total Dissolved Solids (TDS): Range (mg/l)	Total Dissolved Solids (TDS): Mean (mg/l) (0, 5,000, 10,000, 15,000, 20,000, 25,000)	Number of Samples	Data Source	Comments
Cenozoic	Quaternary		Flood plain alluvium, terrace deposits and eolian deposits	106- 9,300		-	1	Large local variations.
Cenozoic	Tertiary	Pliocene, Miocene, Oligocene	Arikaree Fm.; White River Fm.	-		-	-	Formations not present in Highland Mine area.
Cenozoic	Tertiary	Eocene, Paleocene	Wasatch Fm.; Fort Union Fm. (Tongue R. Mbr., Lebo Mbr., Tullock Mbr.)	232- 1,750	$\bar{x}$ = 525	13	1	Unsystematic geographic changes in TDS.
Mesozoic	Cretaceous	Upper	Lance Fm.; Fox Hills Ss.	1,000- 3,000		-	1	No analyses within 1,000 mi.^{2} of Highland Mine area. TDS estimates based on TDS trends reported from data source.
			Lewis Sh.	1,027- 5,618	$\bar{x}$= 2,820	5	2	Lewish Sh.
			Teckla Ss.	7,346-37,360	$\bar{x}$=12,463	19	2	Teckla Ss.
			Mesaverde Fm.: Teapot Ss.	9,450-19,954	$\bar{x}$=15,552	4	2	Teapot Ss.
			Parkman Ss.	12,230-17,830	$\bar{x}$=14,631	8	2	Parkman Ss.
			Sussex Ss.; Shannon Ss.; Pierre Sh.	2,132 - 14,694;50,198			1,2	"Cody Shale sands"
			Steele Sh.; Niobrara Sh.; Cody Sh.; "Carlile" Sh.	-		-	-	No data available
			Wall Cr. Ss.; Turner Ss.; Carlile Sh.; Greenhorn Ls.; Frontier Fm.; Belle Fourche Sh.	11,824-44,560	$\bar{x}$=21,602	4	2	Wall Creek Sandstone and Third Frontier Sandstone
		Lower	Mowry Sh.					
			Muddy Ss.; Newcastle Ss.	11,830-31,434	$\bar{x}$=24,833	3	2	
			Thermopolis Sh.; Skull Creek Sh.; Cloverly Fm.; Fall R. Fm.; Fuson Sh.; Lakota Fm.	>3,000		-	1	TDS estimates based on trends reported from data source.
	Jurassic		Morrison Fm.	8,671		1	2	
	Jurassic		Sundance Fm.; Hulett Ss.; Gypsum Spring Fm.	4,044-15,568		-	3	
	Triassic		Chugwater Fm.; Spearfish Fm.	650-30,000		-	3	Low TDS values are from shallow wells near outcrop.
Paleozoic	Permian		Goose Egg Fm.; Minnekahta Ls.					
	Pennsylvanian		"Converse" Ss.; "Leo" Ss.; Minnelusa Fm.; "Bell" Ss.; Tensleep Ss.; Amsden Fm.	>3,000		-	1	No analyses within 1000 mi.^{2} of Highland Mine area, TDS estimates based on TDS trends reported from data source.
	Mississippian		Madison Ls.; Pahasapa Ls.; Englewood Ls.	>3,000		-	1	Four analyses (1010, 7067 mg/l TDS) within 1000 mi^2 of Highland Mine area; TDS estimates based on TDS trends reported from data source.
	Devonian		Jefferson Fm.	-		-	-	Not present in Highland Mine area.
	Silurian							
	Ordovician		Bighorn Dol.; Whitewood Dol.; Winnipeg Fm.					
	Cambrian		Gallatin Fm.; Gros Ventre Fm.; Flathead Ss.; Deadwood Fm.					
Precambrian			Precambrian Rocks					

* 1. Feathers and others, 1981.
  2. Oil and Gas Commission, Various; U. S. Geological Survey, Various - See Appendix A.
  3. Crawford, 1940; Crawford and Davis, 1962; Hodson, 1971.

Note: Cross-Hatchures Indicate Major Aquifer Systems.

EVEREST MINERALS CORPORATION

HIGHLAND URANIUM PROJECT

GENERALIZED STRATIGRAPHY IN THE POWDER RIVER BASIN AND TOTAL DISSOLVED SOLIDS CONCENTRATIONS OF GROUND WATERS IN THE VICINITY OF THE HIGHLAND MINE

DATE 2/25/85

FIGURE 8

poor quality Class VI water. At the Highland site, the Teapot and Parkman Sandstones of the Mesa Verde Formation lying below the Lewis Shale have average TDS concentrations of 15,552 mg/l and 14,631 mg/l, respectively, and therefore, meet criteria for Class VI, exempted aquifer status.

The Cody Shale Sands which underlie the Mesa Verde Formation include the Sussex and Shannon Sandstones These units have reported TDS concentrations ranging from 2132 mg/l to 14,694 mg/l, and are not uniformly classified as Class VI. Geologic units below the Cody Shale, such as the Dakota and Madison Formation(s), are generally quite briny. However, because they occur at depths greater than 12,000 feet, they are too deep to be economically used as receivers. Based on the presence of Class VI ground water and on EPA exemption criteria, it is concluded that suitable receiver formations include all permeable zones below the top of the Lewis Shale. However, due to technical and economic constraints, the most suitable receivers are the Teapot and Parkman Sandstones.

3.8.1.2. Target Formations

In addition to containing Class VI ground water, the target receiver formations must meet the following WDEQ, WQD hydrogeologic criteria:

1) large areal extent of the receiver formation and absence of complex folding and faulting,

2) hydraulic separation from usable aquifers located above and below,

3) slow movement of ground water under natural conditions, and

4) located away from ground-water recharge and discharge areas for the receiver formation.

Based on the following hydrogeologic setting, the reworked Morton I-20 well which penetrates the upper 110 feet of the Parkman Sandstone was found suitable for use as the HUP underground injection well:

1) The Mesa Verde Formation which is approximately 100-feet thick and ranges in depth from 8600 to 9700 feet in the project area is a continental/marine unit having a large areal extent. The Teapot and Parkman Sandstone members can be found throughout the southern Powder River Basin.

   The regional strata gently dip 4 degrees to the west toward the axis of the Powder River Basin syncline which trends northwestward. There are no known faults or prominent fracture systems in this area.

2) The Mesa Verde Formation lies between the overlying Lewis Shale and the underlying Cody Shale. These shale formations provide the necessary isolation from adjacent, useable aquifers. Furthermore, the injection well is positioned in a sandstone bed underlain by a shale unit within the Parkman Sandstone member.

3) The Teapot and Parkman Sanstone(s) comprise silty, very fine- to fine-gained, subangular to subrounded, moderately sorted, glauconitic sandstone with thin siltstone and bentonite shale beds. The lateral flow velocity in these strata is estimated to be about 0.5 feet per year. This meets the slow ground-water velocity criteria.

4) Recharge of the Mesa Verde Formation occurs along the Powder River Basin flanks, 50 to 200 miles from the HUP. The discharge area for this formation in unknown, but is assumed to be in the northern part of the basin, probably in the direction of the syncline trend.

3.8.2 Injection Waste Water Fluid Characteristics

The injection waste water is a salt water waste stream produced at the CPF. This high TDS-bearing fluid results from laboratory liquid wastes, elution agents decanted from the precipitation circuit, yellowcake wash water, reject makeup solutions, and CPF washdown water. Because of their high TDS, these wastes are considered appropriate for deep well injection.

The salt water waste stream is accumulated at the CPF in two 20,000 gallon fiberglass tanks and periodically pumped to the waste disposal well for injection. The waste disposal well is permitted for, and has the capability of injecting 185 gpm, although currently the average injection rate is 47 gpm. As of January 1991, approximately 800,000 gallons per month are disposed of in the waste disposal well. The salt water waste stream varies in composition, but typically contains the following concentrations.

HCO_3 - 150-500 mg/l
NH_4 (as N) - 1000-1700 mg/l
TDS 40,000-60,000 mg/l
pH - 7-8
Uranium (as U_3O_8) - 10-30 mg/l
Radium-226 - 50-100 pCi/l

Mixing of waste water with water of either receiver (Teapot or Parkman Sanstone(s)) formation should cause no significant mineral precipitation near the point of injection.

Please refer to the original EA dated July 1985, for specific information regarding injection rate analyses and radius of injection and influence. The reader is also referred to the original EA for a detailed description of the injection well history, integrity analyses, and closure. Maintenance records for the operation of the UIC well are maintained onsite and are available to the NRC and WDEQ, WQD.

4.0 GROUND-WATER RESTORATION, RECLAMATION, AND DECOMMISSIONING

4.1 Ground-Water Restoration and Technology

The three basic methods of ground-water restoration applicable to in situ mining are listed below:

A. Ground-water Sweep: Native ground water is drawn into the mined out area by pumping the production wells within the mining zone.

B. Reverse Osmosis: Water from the production zone is pumped, treating by reverse osmosis it to improve its quality, and reinjected into the formation.

C. Chemical Treatment: Introduction of a chemical reductant into the formation to immobilize contaminants released by the in situ leach process.

Each of these methods has advantages and disadvantages which are summarized in Table 6.

The R&D ISL Pilot of the Highlands site was operated from December 16, 1978, to September 30, 1981, during which time 60.5 million gallons were injected into the aquifer and 67.1 million gallons were produced. Sodium carbonate-sodium bicarbonate, hydrogen peroxide, and gaseous oxygen were tested as lixiviants. The R&D Pilot consisted of four 100 X 100-foot patterns which, over the 3-year life, produced 74,600 pounds of U_3O_8. Restoration began in October 1981, and actively progressed through May 1984.

Beginning in October 1981, through may 1982, a 60 gpm reverse osmosis (RO) unit which would most effectively treat the withdrawn wastes was developed. During this time period, produced water was treated for uranium removal through the ion exchange (IX) facility and reinjected. A total of approximately 4.5 pore volumes (PV) were produced. Close to 85 percent of this volume was run through an IX and reinjected. The remaining 15 percent of the produced fluid was discharged to the evaporation pond.

A combination of the RO and IX form of restoration was utilized from June 1982, through May 1983. Designed to return 80 percent of the feed water (20 percent RO bleed) with 90 percent of the dissolved constituents removed, the RO unit was never fully functional, but operated approximately half of the time during this period. There were 6.2 PV's produced, treated through IX for uranium removal, routed through RO for all other contaminant removal, and reinjected.

Restoration using the RO and IX methods left a "bubble" of very clean water between the injection and production wells where most of the flow was concentrated because of the higher pressure gradient between these two points. However, water between these flowlines was not being adequately cleaned. Ground-water sweep was then initiated to draw water uniformly from the ore zone around the pumped wells, providing a more thorough aquifer cleanup.

The original agreement between Exxon, the WDEQ, and the NRC indicated that the objective of successful restoration and stability was to restore all ground water to baseline levels or Wyoming Class I Water Quality Standards based on a well-field average. These values were derived from water quality data collected from the injection and production wells (Figure 9). Table 7 shows the baseline (restoration) values by parameter for the well field through July 1985. Table 7 also includes the comparison of those constituents which

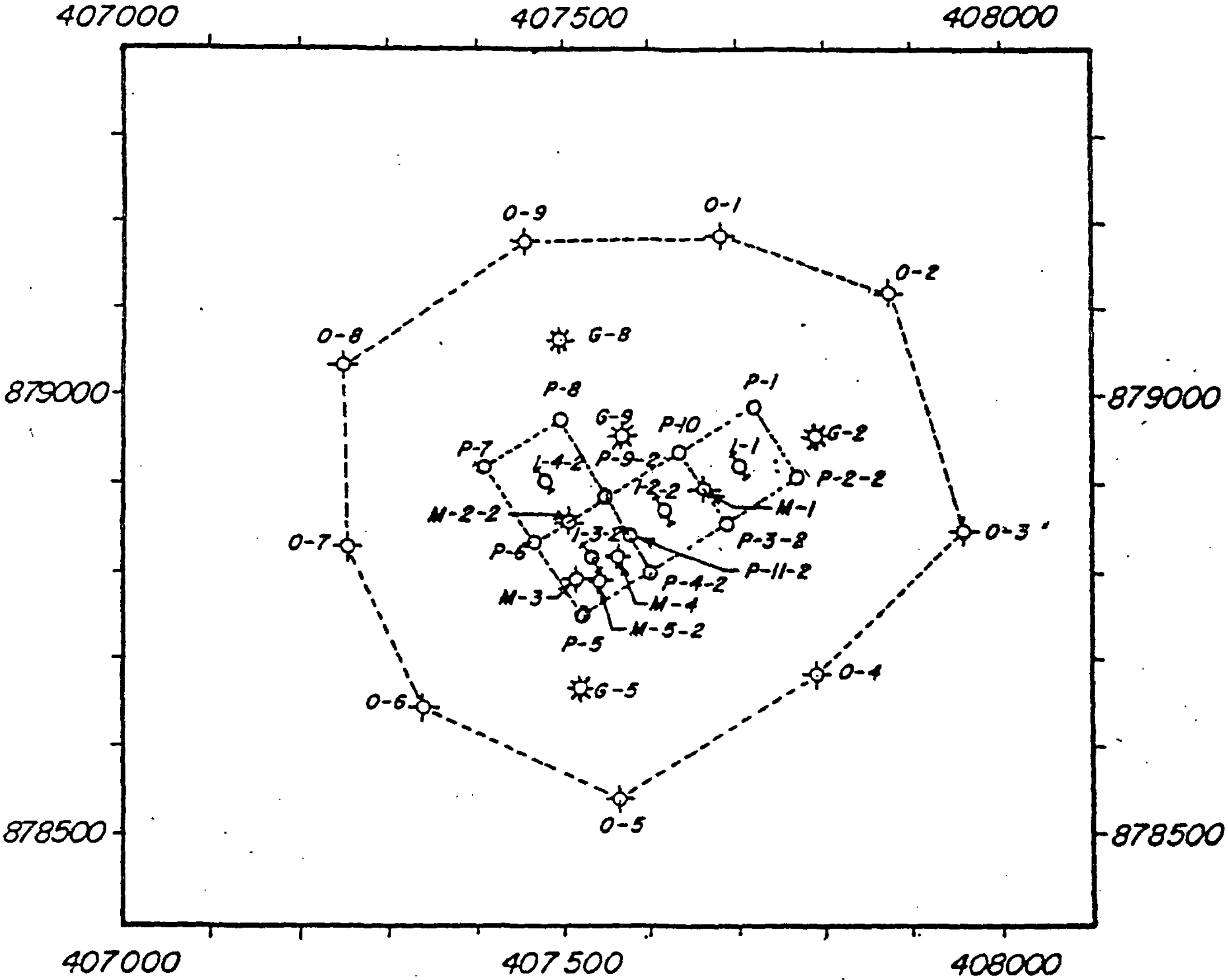
Table 6

Comparison of Ground-Water
Restoration Technologies

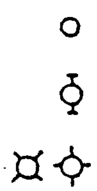
Method	Advantages	Disadvantages
1. Ground-Water Sweep	1. Allows beneficial use of restoration fluids for irrigation 2. Utilizes native ground water to reduce formation 3. Does not introduct oxygenated water 4. Proeuces more uniform pattern of restoration 5. Most cost-effective method	1. Higher consumption of ground water
2. Treatment and Reinjection	1. Lower ground water consumption	1. Requires significant energy input 2. High capital costs 3. Generates concentrated waste stream 4. Re-injection of pure water 5. Introduces oxygenated water 6. Results in clean water between injection and production wells with contaminated water outside this zone
3. Chemical	1. Returns formation to a reduced condition, thereby immobilizing redox-sensitive parameters 2. Can be used to treat isolated "hot spots"	1. High cost for chemicals 2. Requires inherently hazardous chemicals in an otherwise safe process 3. Increases TDS and lowers pH of ground water

FIGURE 9

SOLUTION MINE WELL PATTERN
HIGHLAND R&D PROGRAM
CONVERSE COUNTY, WYOMING



LEGEND



Production well

Injection well

Monitor well

TABLE 7

Comparison of Elevated Constituents with Baseline Concentrations and Class I Water Quality Standards

	Baseline	WDEQ Drinking Water Standard (Class I)	End Restoration May 1984		Post Restoration December 1984		Post Restoration July 1985	
			Wellfield	Observation Wells	Wellfield	Observation Wells	Wellfield	Observation Wells
Bicarbonate	165	*	228	140	344	191.2	349.3	190.1
Calcium	32	*	51	42	59.2	43.2	60.1	46.5
Chloride	21	250	19.7	10.2	34.5	9.8	24.2	5.2
Fluoride	<0.15	1.4 to 2.4	0.61	0.46	0.55	0.32	0.58	0.47
Iron	0.09	0.3	0.01	0.01	1.8	0.96	1.1	0.35
Manganese	0.03	0.05	0.25	0.03	0.13	0.04	0.08	0.04
Magnesium	7.0	*	13.3	10.2	14.5	11.3	12.6	9.5
Nitrate	<0.04	10.0	0.16	0.16	0.20	0.06	0.19	0.05
Selenium	<0.01	.01	0.06	<0.001	0.01	<0.001	0.02	<0.001
Sodium	87	*	98	57.5	121.2	57.8	115.1	57.3
Sulfate	124	250	137	119.2	133.2	109.3	132.3	117.7
Uranium	0.33	5	2.3	<0.9	1.52	0.02	4.47	0.02
Radium-226 (pCi/l)	73.8	5	460	25.2	162.2	23.8	291.2	24.8
TDS	370	500	448	331.7	548.3	342.7	532.7	362
Conductivity (umhos/cm)	437	*	895	486.7	800	513.3	788	521.7

All units in mg/l except as noted

* no value established

appear to be elevated with the baseline concentrations following the first 3 year period of restoration (through July 1985). The details of the initial restoration work, including extensive analytical data, are given in "Restoration Achievement at Exxon's Expanded R&D Pilot, July 3, 1984," and "Supplemental Report to Restoration Achievement, August 19, 1985."

To enhance the restoration work, PRI employed the third restoration method, introduction of a chemical reductant, H_2S. The chemical reductant method involved injection of H_2S and circulation of three PVs through the well field to immobilize contaminants and stabilize the well-field water quality. The analytical results are presented in Table 8. These restoration results indicated that the well field was restored to baseline with the exception of wells P-3, P-5, and P-7. WQ analyses for these wells showed slightly elevated concentrations of iron and manganese. All indications, as shown by other monitoring wells within the well field, were that the iron and manganese would reduce (immobilize) so that concentrations in ground water would stabilize at baseline conditions. The source of iron and manganese is thought to be remnant metals dissolved from old steel well casings and screens previously used in the well field.

4.2 Ground-Water Restoration Plan

The restoration work done at the R&D ISL pilot indicates that potential ground-water contaminants can be effectively reduced to baseline concentrations or class-of-use standards. At the conclusion of each well-field production period at the HUP, PRI is committed to begin a ground-water restoration program modeled after this successful R&D restoration project. Restoration goals will be established for each mining area based on premining samples. To assure that restoration goals are met, the licensee will be required by license condition to submit for approval a schedule for ground-water restoration and post-restoration monitoring at least 2 months prior to termination of uranium recovery activities in a mining area.

PRI will conduct ground-water restoration programs initially making use of both ground-water sweep, and ground-water treatment (RO) and reinjection. If necessary, treatment of elevated "hot spots" with a chemical reductant may be employed. Injection of a reductant will immobilize those formation constituents that are released and transported by circulating ground water due to oxidation of the formation during mine production. Iron, manganese, selenium, and radium-226 are particularly sensitive to oxidation. Water treated with the chemical reductant will be withdrawn and treated with barium chloride to further reduce the radium concentrations. Ground water will be withdrawn at the maximum achievable rate which allows the ore zone to remain fully saturated to prevent oxidation of the formation. PRI has recently begun using a restoration program in the Section 21 mining fields where production operations are completed.

4.2.1 Water Use

Over the life of the existing and proposed WHA project, approximately 3110 to 4650 acre-feet of water will be employed for ground-water restoration. PRI

Table 8

SPM/1-06-87
filename FINREST

Wellfield Data After 1986 Active Restoration Program Everest Minerals Corporation
Sample date 1 Oct 1986

Well Number	I-1	I-2	I-3	I-4	P-1	P-2	P-3	P-4	P-5	P-6	P-7	P-8
I=east	407,700	407,612	407,526	407,489	407,719	407,742	407,686	407,584	407,516	407,463	407,407	407,497
Y=north	878,920	878,871	878,840	878,892	878,988	878,905	878,853	878,811	878,759	878,834	878,919	878,972
Aluminum	-0.1	-0.1	-0.1	0.2	-0.1	-0.1	-0.1	-0.1	0.2	-0.1	-0.1	0.3
Arsenic	-0.004	-0.004	0.004	-0.004	-0.004	0.005	0.004	0.006	0.005	-0.004	0.007	-0.004
Bicarb	268	249	220	176	46	220	116	18	40	20	48	20
Boron	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	0.1	-0.1	0.1	-0.1	0.1	-0.1
Cadmium	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Calcium	53		62				37		21		17	
Carbonate	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
Chloride	7	8	5	8	3	3	3	4	3	3	3	9
Chromium	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05
Copper	0.02	-0.01	0.02	-0.01	-0.01	-0.01	-0.01	-0.01	0.02	-0.01	-0.01	-0.01
Fluoride	0.40	0.40	0.20	0.20	-0.10	-0.01	0.60	-0.10	-0.10	-0.10	-0.10	-0.10
Iron	0.45	-0.05	0.25	-0.05	0.44	-0.05	10.80	0.67	10.00	0.12	5.40	-0.05
Lead	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05
Manganese	0.13	0.06	0.19	0.21	0.04	0.47	0.51	-0.01	0.32	0.02	0.17	-0.01
Mercury	-0.0004	-0.0004	-0.0004	-0.0004	-0.0004	-0.0004	-0.0004	-0.0004	-0.0004	-0.0004	-0.0004	-0.0004
Ra-226	83	106	84	13	46	64	142	19	231	49	86	25
Ra-226 error	4.1	2.2	3.0	1.1	1.3	2.7	3.9	0.8	5	1.9	4.1	1.0
Ra-226 LLD	1.3	0.4	0.7	0.8	0.2	0.8	0.7	0.2	0.7	0.5	1.3	0.2
Selenium	-0.001	-0.001	-0.001	-0.001	-0.001	0.002	-0.001	0.002	0.001	-0.001	-0.001	0.006
Sodium	76		54				20		13		17	
SO4	96	74	90	123	14	74	55	-2	52	18	49	96
TDS	422	378	394	438	70	266	240	22	184	56	162	198
U(nat)	0.23	0.59	0.14	0.56	0.08	0.62	0.70	0.61	0.23	0.08	0.25	0.05
Zinc	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	0.71
pH	7.2	8.2	7.3	7.5	6.3	7.3	7.2	6.0	7.1	6.5	7.0	7.1

Well Number	P-9	P-10	P-11	M-1	M-2	M-3	M-4	M-5	6-5	6-2	6-8	6-9
I=east	407,554	407,633	407,569	407,655	407,501	407,532	407,544	407,534	407,497	407,786	407,496	407,565
Y=north	878,890	878,938	878,857	878,898	878,855	878,822	878,827	878,816	878,682	878,953	879,065	878,950
Aluminum	-0.1	0.4	-0.1	0.2	0.2	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	0.1
Arsenic	0.005	-0.004	-0.004	-0.004	-0.004	-0.004	-0.004	-0.004	-0.004	-0.004	-0.004	-0.004
Bicarb	55	78	128	176	161	171	176	177	165	201	238	295
Boron	-0.1	-0.1	0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
Cadmium	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Calcium	14		29									
Carbonate	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	2	2
Chloride	3	5	5	5	12	7	10	9	5	2	3	6
Chromium	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05
Copper	0.02	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Fluoride	-0.10	-0.10	0.10	0.20	8.80	0.20	0.20	0.10	0.39	0.20	0.20	0.30
Iron	1.80	0.47	-0.05	-0.05	0.67	-0.05	-0.03	-0.05	-0.05	-0.05	-0.05	-0.05
Lead	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05
Manganese	0.07	0.04	0.10	0.02	0.23	-0.01	-0.01	0.02	0.06	0.02	0.02	0.01
Mercury	-0.0004	-0.0004	-0.0004	-0.0004	-0.0004	-0.0004	-0.0004	-0.0004	-0.0004	-0.0004	-0.0004	-0.0004
Ra-226	9	46	7	1.7	0.9	7	11.8	7.6	399	199	16	64
Ra-226 error	1.0	1.3	0.9	0.3	0.2	0.6	0.7	0.6	4	3.0	1.1	1.6
Ra-226 LLD	0.7	0.2	0.7	0.2	0.2	0.4	0.4	0.4	0.2	0.2	0.5	0.2
Selenium	-0.001	0.001	-0.001	-0.001	-0.001	0.002	-0.001	-0.001	-0.001	0.002	-0.001	0.168
Sodium	18		33									
SO4	44	22	44	198	76	268	230	348	114	98	84	87
TDS	184	108	275	442	306	578	492	658	440	332	330	404
U(nat)	0.26	1.30	0.12	0.001	-0.001	0.090	0.150	0.014	0.062	0.470	0.24	0.800
Zinc	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
pH	6.7	6.7	6.9	8.2	8.8	8.2	8.0	8.2	8.4	8.3	8.4	8.4

Notes:

1. a minus sign indicates the constituent is present in concentrations below the lower detection limit
2. units are mg/l except Ra-226 in pCi/l and pH in standard units

will utilize part of this restoration water to irrigate crops. Prior to application, the water will be treated to reduce potentially elevated radium concentrations.

4.2.2 Ground-Water Restoration Stability

After a volume of affected water has been returned to its premining baseline average quality or use-suitability, a monitoring program in which restoration verification wells are sampled every 2 months will be initiated to ensure stability of water quality conditions. If water quality has not stabilized, further restoration work may be required.

4.2.3 Surface Reclamation

Surface reclamation of an area will be initiated after the aquifer cleanup has been completed and aquifer stabilization is verified. All wells will be plugged in accordance with State of Wyoming regulations, with records of hole plugging and abandonment procedures maintained at the project site.

In situ mining does not require extensive excavation for well field installation. Therefore, postmining contours will be very much like the preexisting contours.

Impoundments will be required for the radium treatment system and to store well field bleed fluids in each of the well field areas. During reclamation, the radioactive wastes within these impoundments and any contaminated soil in the well field will be removed to a licensed low-level radioactive waste disposal site. The impoundments will be removed or backfilled, topsoiled, and revegetated in accordance with State of Wyoming requirements.

The areas from which topsoil has been removed will be ripped where compacted, contoured to blend with the surrounding topography and covered with at least 12 inches of topsoil, where available. After topsoil placement, the ground will be prepared for reseeding by discing and mulching, where needed.

Currently, final reclamation of the site can only be estimated. The extent of land disturbance, volumes of materials to be moved, and actual well abandonment procedures at each individual mining unit are subject to change. Therefore, the licensee will be required by license condition to submit for approval a detailed final decommissioning plan at least 12 months prior to shutdown of the facility. This plan will be reviewed and incorporated as a part of the source material license.

4.2.4 Plant Site Reclamation

After the well field areas have been reclaimed, the plant site reclamation program will be initiated. This will include pumping all liquid wastes down the waste disposal well and decommissioning of the plant by decontaminating all buildings, process vessels, and other structures. Equipment which cannot be decontaminated will be dismantled and disposed of in a licensed low-level waste disposal facility or utilized at another licensed uranium facility. Chemicals will be removed or neutralized. All contaminated foundations will be removed or broken up and buried. Facilities which are found to be beneficial to the future landowner may be left after verification that levels of radioactivity are below levels which meet NRC criteria for unrestricted release.

5.0 EVALUATION OF ENVIRONMENTAL IMPACTS

5.1 Introduction

The previous uranium recovery operations which were active in this area included (1) an underground uranium mine, (2) open-pit mining operations, and (3) a uranium mill. The environmental impacts of these activities were addressed in the "Final Environmental Statement for the Highland Uranium Mill," and included (1) temporary change in land use of 3200 acres, (2) a change in local topography involving about 830 acres, (3) removal of approximately 1000 gpm of local ground water from the mine, (4) creation of a tailings pile covering about 250 acres and involving 11 million tons of tailings, and (5) atmospheric discharge of small quantities of chemicals and radioactive materials into the local environment.

Major human health and environmental concerns with in situ leaching of uranium include the potential impacts of mining on ground-water quality in the ore zone area, the impacts of potential storage and settling pond leakage, radiological impacts, and disposal of wastes. PRI is committed by license condition to monitor all process streams and all environmental factors which could possibly be affected. Furthermore, the licensee is required to submit this monitoring data for review on a semiannual frequency.

The proposed in situ mining activities for the WHA area will include (1) the temporary change in land use of about 1550 acres (the total existing and proposed area for the life of the project), (2) the removal of approximately 50 to 360 gpm of local ground water during operation and concurrent restoration activities, and (3) the temporary contamination of about 300 to 900 acre-feet of local ground water. To assure that all activities associated with the project are assessed for potential impact to the environment, the licensee will be required by license condition to conduct an environmental appraisal of any proposed site or operation changes.

Environmental reports (and supplements) pertaining to operations of the previous R&D uranium recovery, as well as commercial scale in situ uranium mining, have previously been prepared and submitted to the NRC. Subsequently, the NRC issued final environmental statements for those operations. The following is a list of published documents which discusses the environmental impacts associated with these activities:

A. "Final Environmental Statement Related to Operation of the Highland Uranium Mill by the Exxon Company, U.S.A.," March 1983, along with the base documents referred to in the Forward of the FES,

B. "Supplemental Environmental Report, Application for Amendment to Source Material License SUA-1139 for Solution Mining of Uranium, Highland Uranium Mill, Docket No. 40-8102," August 1977,

C. "Final Environmental Statement (NUREG-0489) Related to Operation of Highland Uranium Solution Mining Project, Exxon Minerals Company, U.S.A.," November 1978, along with the base documents referred to in the Forward of the FES.

D. "Environmental Assessment for Everest Minerals Corporation, Highland Uranium Project, Converse County, Wyoming," July 1987.

5.2 Air Quality Impacts

5.2.1 Construction-Related

Construction and development of the proposed project could affect air quality by the release of diesel emissions from drilling and construction equipment and by release of dust. Diesel emissions are considered minor and will be readily dispersed. Dust generated from construction and development of the project will be insignificant.

5.2.2 Operation-Related

The main nonradiologic gaseous effluent to be released from operation of the uranium recovery plant will be ammonia, used for yellowcake precipitation. Ammonia vapors or hydrogen peroxide will be passed through a fresh water scrubbing system before being vented to the atmosphere.

5.3 Land Use Impacts

5.3.1 Range Management

The major impact on land use from the proposed project will be the removal of land from grazing. To protect both equipment and livestock, the area surrounding all of the in situ mining activities will be fenced to prevent livestock access. Thus, an estimated total of 1550 acres that are available for grazing will be removed from grazing for approximately 5 to 8 years.

The in situ mining project will not result in a significant increase in traffic. Utilities required for the proposed uranium recovery plant are available from existing facilities and are currently in place.

5.3.2 Cultural and Historic Resoruces

5.3.2.1 Impact Significance Criteria

Cultural resources are considered significant if they meet the criteria outlined in 36 CFR 60.4. Disturbance to sites not meeting these criteria does not constitute a significant impact. Disturbance to those sites which <u>do</u> meet the criteria, however, would be considered significant impacts according to the criteria of effect and adverse effect (36 CFR 800.9), and mitigative measures must be taken. Known sites which are of unknown significance must have a complete evaluation prior to any disturbances.

Impacts to cultural resources located within the Highland Uranium Project permit area may be both direct and indirect. Direct impacts will occur through physical disturbance from construction (roads, wells, pipelines, and other facilities), erosion (natural and construction related), and visual intrusions which may alter the setting of prehistoric and historic properties. Indirect impacts may occur through increased access to the area, resulting in possible vandalism and unauthorized collection of artifacts. If direct impacts due to construction activities or indirect effects resulting from erosion or an increased public presence in the study area should occur, said impacts will require some means of mitigation to prevent or minimize degradation of cultural values.

Direct effects on cultural resources from construction activities will create no cumulative impact. Activities that directly affect cultural resource sites will do so at the time that activity takes place. Indirect impacts such as erosion, increased visitation, vandalism, and unauthorized artifact collecting could have a cumulative effect of causing a gradual degradation of site integrity and resulting diminishment of cultural values.

Unavoidable adverse impacts to cultural resources located within the mining area may take two forms. Drilling, facilities and access road construction may be constrained to specific locations by topographic or geological variables. If a cultural resource eligible for nomination to or listed on the National Register of Historical Places (NRHP) is present and the development cannot be moved, mitigative action will be required. Sites which the State Historic Preservation Office concurs with an evalaution as ineligible require no further action. Unavoidable adverse impacts also occur when buried cultural resources are encountered during construction. In such cases, ground disturbing work in that vicinity should be halted and the BLM Platte River Resource Area Manager notified immediately. A full evalaution by a qualified archaeologist of the materials will be required and mitigative action, if necessary, completed prior to resuming construction.

5.3.2.2 Land Surveys and Operator Compliance

There is a potential for discovering unidentified significant cultural resources in the proposed solution mining area. Therefore, Federal land scheduled for disturbance shall be surveyed; it is recommended that all other land scheduled for disturbance be surveyed. In the event that previously unknown cultural resources are discovered prior to or during construction, ground disturbing activities in that vicinity shall be halted and the BLM Platte River Resource Area Manager notified immediately. Construction work may not commence until cultural resources have been fully evaluated by a qualified archaeologist and any necessary mitigative measures carried out. In some cases, it may be necessary for a qualified archaeologist to monitor ground disturbing activities for some proposed actions.

With regards to Federally-owned lands, in reviewing the BLM records for the mine permit area, it was found that only part of the Federally-administered surface within the permit area has been surveyed at the Class III level. Significant cultural resource values may occur within the unsurveyed areas. Therefore, no surface disturbance shall occur within those areas which have not been examined until a Class III cultural resource inventory has been made and approved by the BLM-PRRA.

A large portion of the inventory work at the Highland Uranium Project was conducted prior to 1980. Due to improvements in field techniques, more stringent survey, recording, and reporting requirements, and increased understanding of regional prehistory, BLM guidelines indicate cultural resource surveys undertaken prior to 1980 are no longer valid. The high number of sites reported in later surveys indicates that prehistoric use of the area was more prevalent than suggested by the three pre-1980 inventories, and that the areas covered by earlier surveys will contain surface cultural resources that were not previously identified. It is recommended that the privately owned land areas within the proposed mine permit application area be resurveyed for cultural resources prior to implementing ground disturbing activities if the pertinent cultural resource inventory was conducted before 1980. Federal surface within the permit area that falls into this category shall be inventoried prior to disturbance.

All actions associated with the proposed development will be completed in compliance with the National Historic Preservation Act (as amended) and its implementing regulations (36 CFR 800), the archaeological Resources Protection Act (as amended) and its implementing regulations (43 CFR 7). Further, guidelines such as the Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation, and the Bureau of Land Management 8100 manual series will be followed where appropriate.

5.3.2.3 Archaeological Findings

Class III cultural resource inventories performed for sites within the WHA area have located a total of 42 sites and 24 isolated artifacts. Four sites were of historic origin, of which none has been determined to be eligible for nomination to the NRHP, one is presently unevaluated (trail segment 48C01281), and three were found to be nonsignificant. Thirty-seven prehistoric sites were present, of which none were eligible for nomination to the NRHP, three were of unknown eligibility (48C0218, 48C0272, 48C0276), and thirty-four were ineligible. None of the isolated artifacts are eligible for nomination to the NRHP.

The prehistoric sites found in the permit application area consist largely of small open lithic scatters (a total of 31) containing a very few waste flakes from stone tool manufacture, and occasionally, tools or tool fragments. Diagnostic artifacts which would aid in defining cultural or temporal affiliation are not commonly found. Seven open camps were recorded. These are defined by the presence of hearths or hearth-related materials (burned rock fragments resulting from roasting) found in association with lithic debris and stone tools. One fragment of a grinding stone was found. Judging from their size, most of the sites in the permit application area are single-use activity areas resulting from a casual hunting and gathering subsistence pattern.

The historic debris (three sites) are evidence of the homestead era, and consist primarily of scatters of tins, glass, fragments of milled lumber, and in one case, structural remains. Historic site condition in all three cases is poor. Such sites are remnants of the early settlement of central Converse County and are generally not significant cultural resources.

5.4 Water Impacts

5.4.1 Surface Water Impacts

Vegetation removal is not expected to significantly change peak surface-water flows because of the relatively flat topography of the area, the low regional precipitation, the absorptive capacity of the soils, and the small area of disturbance relative to the total drainage area. For the same reasons, increased suspended sediment during periods of runoff is expected to be slight. Therefore, surface-related construction activities for the proposed mining project will not result in significant long-term impact to the surface water.

Spills from the purge storage reservoir and settling basins resulting from dam failure could result in unacceptable contamination of surface and ground water. However, the purge storage reservoir and settling basin effluent water levels will be controlled with adequate freeboard requirements so that the likelihood of a dam failure is very remote. Furthermore, design and construction criteria for the reservoir and basin embankments preclude failure of the embankments and potential transport of contaminants.

There are no perennial or frequently-flowing intermittent streams within the proposed project area. The probability of surface water contamination is extremely remote.

5.4.2 Ground-Water Impacts

5.4.2.1 Excursions

Excursions of contaminated ground water in a well field can be caused by improper balances between injection/extraction rates, undetected high permeability strata, faults, improperly abandoned exploration drill holes, discontinuity and unsuitability of the confining units to prevent movement of lixiviant out of the ore zone, cracked well casings and faulty well construction, and hydrofracturing of the ore zone or surrounding units. Quality control of the well field at the HUP reduces the probability of these situations occurring.

The ground-water monitoring well network required for all well fields provides the mechanism for detecting those excursions associated with well-field production and for detecting potential excursions during well-field restoration. Should an excursion be detected, the licensee is required to take remedial actions, as described in SUA-1511, License Condition No. 49. Remedial actions are conducted and reported until such time that excursion element concentrations stabilize at or below upper control limits (refer to Section 7.0). A detailed description of the hydrologic monitoring program at the HUP may be found in Section 7.1.

5.4.2.2 Purge Storage Reservoir and Settling Pond Seepage

Accidental leaks from the purge storage reservoir and settling ponds can, if uncontrolled, contaminate shallow aquifers and locally reduce ground-water quality. The quality control and the maintenance programs associated with the installation of the impermeable bottom liners in the previously described impoundments should minimize or eliminate such seepage. Furthermore, if an impoundment leak were to develop, the monitoring program described in Section 7.2 would allow for early detection and repair of the leak, thereby minimizing the impacts due to leakage.

5.4.3 Ground Water

Approximately 300 to 900 acre-feet of ground water in the ore sand aquifer will be affected by the proposed operation. During mining, the affected ground water in the mining zone will contain elevated concentrations of mobilized metals and radioactive elements. Small areas of the surrounding ground water may also be occasionally affected by local contaminant-bearing ground-water migration. In addition, the quality of the water that remains in the leach area at the completion of ground-water restoration may be impacted.

Native formation water in the ore zones of the Highland aquifers is not suitable for human consumption because of naturally high levels of dissolved radioactive materials and metals. Radium-226 and thorium-230 levels in the HUP area prior to solution mining were 120 pCi/l and 86 pCi/l, respectively. Furthermore, the pilot restoration data indicate the effected aquifer can be returned to acceptable conditions utilizing ground-water sweep, RO and reinjection, and chemical reductant technology. Because the native water within the ore zones is unsuitable for human consumption and because elevated concentrations of potential ground-water contaminants can be reduced to acceptable levels before ground-water restoration is terminated, the potential hazard to any future water use is negligible.

5.4.3.1 Ground-Water Use

During the mining phase, water consumption will be about 50 to 100 gpm due to well-field bleed. During ground-water restoration, the applicant anticipates consumption of an estimated 90 to 360 gpm for 6 months of the year over a 22-year period. The volume of ground water to be extracted during the combined existing and proposed in situ mining activities, from both well-field bleed and ground-water restoration, is estimated to be about 6900 to 9200 acre-feet over the life of the project. The impact to ground-water use is considered negligible.

5.5 Impacts on Soils

The mining operation will require minimal disturbance of soils. The soil horizon will be disrupted locally as a result of excavation of about 4 to 6 miles of pipeline, depending on optimum well-field placement. Soil disturbance in well fields is limited to excavation of small drilling pits and permanent access roads. The total area affected is expected to be less than 50 percent of the proposed pattern areas. Additionally, the irrigation project is monitored and controlled to maintain levels of toxic and radioactive constituents below allowable release standards. As previously noted (Section 3.7.1.9), any detected soil contamination calls for implementing site cleanup until such time as authorized levels of toxic and radioactive constituents are achieved.

5.6 Impacts on Ecological Systems

Vegetation covering about 500 to 800 acres will be temporarily disturbed as a result of drilling activities, and construction of header houses, plant, roads, and pipelines. All of the land to be disturbed by the project is within the sagebrush/grassland vegetation type, which is widely distributed over the region surrounding the site. The disturbance does not occur in one block, but as a number of small cleared parcels surrounded by undisturbed land. The disturbed areas are temporarily revegetated soon after construction activities are complete. Reclamation and reseeding of all disturbed land will occur after the mining operation is complete, sooner when possible. The undisturbed land surrounding the cleared parcels will serve as an additional source for recolonization of the reclaimed land. Temporary alteration of 500 to 800 acres of this vegetation type should not constitute a significant long-term adverse impact.

5.6.1 Endangered Species

There are no identified endangered plant or animal species that occur on or near the PRI site.

5.6.2 Aquatic Biota

The North Fork of Box Creek is located approximately ½ mile south of the PRI facility. There will be no significant adverse impact to the water quality of the North Fork of Box Creek due to either construction activities or mining operations. Because streams at the HUP are ephemeral, suitable habitat for sensitive aquatic biota is lacking. Therefore, no significant impacts to aquatic ecological systems associated with mining activities are anticipated.

5.6.3 Wetlands

A study conducted by Applied Ecosystems and Beartooth Environmental in 1989, for the entire existing permit area lands included in the West Highland Amendment and adjacent lands reported the presence of ponds and playas within the existing permit area and the proposed West Highland Amendment expansion. This study, which is included as an addendum to the revised license application, did not include an analysis to determine if the ponds and playas are wetlands as defined in the "Federal Manual for Identifying and Delineating

Jurisdiction Wetlands" (1989). A later field investigation based on the initial delineation of pond and playa areas revealed that potential jurisdictional wetland areas, as defined in the Federal manual referenced above, were limited to several small stock ponds and a marginal playa area located in Sections 27 and 28, T36N, R73W. However, it was found that the ephemeral nature of the streams in the area precluded the classification of these sites as wetlands. Additionally, although there are some soils and vegetation which meet the criteria for a jurisdictional wetland, it was found that most of the drainage areas supporting these resources are too small to produce enough runoff to meet the wetland hydrology criteria.

PRI is committed to protecting any wildlife areas, including potential wetlands, as part of the operation plan described in the revised license application which is incorporated into their NRC license by reference. The WDEQ permit to operate is conditional upon PRI obtaining a Nationwide Permit as defined in 33 CFR Part 330.5(a)(14) and (26). This permit, granted by the Army Corps of Engineers, will require PRI to mitigate any impacts to wetlands. The WDEQ, Land Quality Division, also requires a reclamation plan for playas, impoundments, and other wet areas.

5.7 Radiological Impacts

5.7.1 Introduction

Estimates of radiation doses from the operation and the steps taken by the licensee to maintain doses are considered in this section. Individuals living in the area may be potentially exposed to minor amounts of airborne radionuclides or radioactive material on the land surface or in the ground water. During the environmental assessment that accompanied the initial licensing of the site, the licensee considered radiological releases associated with an additional satellite facility that was not placed into operation. This facility is located in the approximate areas proposed for the West Highland expansion described in the revised license application, and therefore, reasonably predicts the effluents likely to be expected from the proposed expansion.

5.7.2 Offsite Impacts

The release of airborne radioactive particles to the atmosphere from the existing in situ operation and proposed expansion are substantially lower than those occurring at a conventional uranium mining/milling operation because only solutions are brought to the surface during mining, and there is a lesser amount of product drying. Radon will be released from leach solutions and vented from the satellite building to the atmosphere. These releases will be small, and there will no significant radiological impacts offsite. More specifically, based on the MILDOS computer program and its associated calculated exposures, the effluent limits specified in 10 CFR 20 and 40 CFR 190 will not be exceeded. A detailed discussion on radiological impacts is contained in Appendix B of the original EA.

The estimation of radiation doses resulting from operation of the PRI facility are based on operational data supplied by PRI. Table 1 of Appendix B of the original EA lists the parameters and conditions used in the radiological assessment of the solution mining project. Estimates of doses assumed exposure to contaminated air and ground 100 percent of the time. A similar situation was considered in the food pathway.

The radiological impact of the routine releases of radionuclides was assessed by estimating radiation dose commitments to individuals and to the surrounding population from the radioactivity released from the site. Since radioactive materials taken into the body by inhalation and ingestion continuously irradiate the body until removed, the estimate of the total dose an individual will receive from 1 year's intake is integrated over 50 years (remaining lifetime of the individual) and is called a dose commitment. All of the internal doses estimated represent 50-year dose commitments. For those materials which have a short radioactive half-life or those such as uranium, which are eliminated rapidly from the body, essentially all of the dose is received in the year in which the radionuclide enters the body. Therefore, the annual dose rate is about the same as the dose commitment.

The primary sources of radiological impact to the environment in the vicinity of the plant are naturally occurring cosmic and terrestrial radiation and naturally occurring radon-222. The average annual whole body dose rate from natural background radiation to the population in the site vicinity is estimated to be about 174 millirems. The average annual background dose to the bronchial epithelium of the population is 560 mrem/person.

The release of radon gas and uranium particulates to the atmosphere is assumed to be the primary mode of environmental contamination. The estimated annual releases are shown in Table 9. Radiological monitoring data collected by PRI at the various measuring points indicated that during operations radiological effluents are fractions of maximum permissible concentrations specified in 10 CFR Part 20. Furthermore, measured releases verify that the computer simulated releases have not been exceeded. The production represented by the additional satellite facility can be expected to release more radon gas to the atmosphere. However, based on previous operational monitoring, it will be a small portion of the allowable release.

The release estimates are based on maximum operational parameters which include the concurrent operation of three well fields, three satellite ion exchange facilities and two radium settling ponds. A maximum flow rate of 3000 gallons per minute from the HUP well fields is assumed for calculation of the release rates presented in Table 9. This volume is part of the total 7500 gallons per minute approved for the entire operation.

The estimated radiation dose at a reference point depends on the distance and direction of the point with respect to the source and the wind direction. Doses are higher at locations downwind from the plant since radon progeny ingrow as the radon gas released from the site decays.

Table 9

Release rates of Radionuclides from the
PRI Well Field and Recovery Plant

	Estimated Releases (Curies/year)				
Source Name	U-238	Th-230	Ra-226	Pb-210	Rn-222
Yellowcake Dryer Stack	3.20E-01	1.67E-04	9.80E-05	9.80E-05	0.
Yellowcake Pkg. Stack	5.00E-03	8.00E-06	1.60E-06	1.60E-06	0.
Satellite #1	0.	0.	0.	0.	1.28E+03
Well Field #2	0.	0.	0.	0.	1.24E+03
Ra Settling Basin (21)	0.	0.	0.	0.	9.70E+01
Satellite #2	0.	0.	0.	0.	2.07E+03
Well Field #24	0.	0.	0.	0.	2.00E+03
Ra Settling Basin (24)	0.	0.	0.	0.	9.80E+01
Satellite #3	0.	0.	0.	0.	1.21E+03
Well Field Nos. 19, 29, & 30	0.	0.	0.	0.	1.17E+03

The maximum annual dose commitments would be received by individuals living at the Fowler Ranch, the nearest residence to the plant site. The ranch is 4.4 km northeast of the PRI site.

The highest organ dose is estimated to be 4.29 mRem per year to the lung, resulting from uranium releases associated with yellowcake drying and packaging, and 40.0 mRem per year to the bronchi from radon progeny. Other organ doses and the whole body dose are much lower (people actually occupy this ranch site less than 6 months of each year). A realistic estimate of this exposure would include residency time and, therefore, actual doses would be approximately 50 percent of those noted above.

These predicted annual individual dose commitments (utilizing 100 percent occupancy time), as shown in Table 2, Appendix B of the original EA, are only a small fraction of the present dose limits for members of the public as specified in 40 CFR Part 190. An estimate of the annual dose commitments to individuals from full operation of the PRI plant is presented in Table 3 of Appendix B in the original EA. Because this dose considered an additional satellite facility, the values are appropriate for the planned operations.

The maximum annual dose commitments are also shown for individuals living at the Vollman Ranch which is 6.4 km northwest of the PRI facility. The maximum organ dose is estimated to be 1.44 mrem per year to the lung. Whole body doses did not exceed 61 percent of the doses estimated for the Fowler Ranch.

5.7.3 Dose to the Population

The annual dose commitments from the airborne effluents to the population living within 80 km (50 miles) of the facility are summarized in Table 4, Appendix B of the original EA. The whole body dose commitment calculated was 1.26 person-rem/year. The comparable dose from natural background in the same area is 13,162 person-rem/year. The highest population organ dose was 5.1 person-rem per year to the bone. This person-rem dose is 3.2E-4 percent of the natural background dose to the bone for the area (15,809 person-rem/year to the bone from natural background radiation which is based on 209 mrem/year to a population of 75,641 people). Except for the nearest residences, population doses are low due to the relative isolation of the project and because the population density for the area is low.

Doses to people living within 80 km and beyond 80 km of the project site are contained in Table 5, Appendix B of the original EA. These totals are compared to the natural background doses for the respective areas. As can be seen, doses resulting from operation of the existing and proposed facility are only very small fractions of the natural background dose contribution.

Table 6 in Appendix B of the original EA presents the airborne concentrations of radionuclides at eight restricted area boundary locations from 0.2 to 5.6 km from the yellowcake dryer stack. The restricted area air concentrations are compared to the maximum permissible concentrations (MPCs) for each radionuclide. Additionally, the sum of the fractions of MPCs are presented for each location. In no case did the sum of the radionuclide concentrations exceed 1 MPC. Therefore, the model indicates an acceptable restricted area boundary of at least 217 feet from the yellowcake dryer stack in any direction. Actual air monitoring associated with operation of the facility indicates MPCs for each measured radionuclide were less than one-half of the predicted concentrations.

5.7.4 Radiological Impact on Biota Other than Man

Although no guidelines concerning acceptable limits of radiation exposure have been established for the protection of species other than man, it is generally agreed that the limits for humans are also conservative for other species. Doses from gaseous effluents to terrestrial biota (such as birds and mammals) are quite similar to those calculated for man and arise from the same dispersion pathways and considerations. Because the effluents of the facility will be monitored and maintained within safe radiological protection limits for man, no adverse radiological impact is expected for resident animals.

The licensee will conduct an environmental monitoring program that will evaluate the concentrations of radionuclides in the environment that could lead to offsite exposures (see Section 7.3). The environmental monitoring program is considered to be sufficient to evaluate the radiological impact of the in situ leaching operations at the PRI site.

The potential impacts of two grazing areas specified by PRI were also reviewed. One grazing area was proposed near well field Nos. 19, 29, and 30. The environmental dose rates estimated for this location were significantly above the limits prescribed for an unrestricted area. Also, the population within a 50-mile radius of the mine generally consumes locally-grown beef more than beef raised elsewhere. Therefore, PRI will not be permitted to allow cattle grazing in this part of the restricted area. In the expanded operation, no grazing within the restricted area has been proposed. Additionally, the computer simulation performed indicated no other areas where dose rates would be increased due to grazing.

5.8 In-Plant Safety

The licensee has established and conducts an in-plant radiation safety program. The NRC, through license conditions, requires a program that contains the basic elements required for and found to be effective at other uranium recovery operations, to assure that exposures are kept as low as reasonably achievable (ALARA). Therefore, an in-plant radiation safety program including the following is currently required:

- airborne and surface contamination sampling and monitoring,
- qualified management of the radiation safety program and appropriate training of personnel,
- written radiation protection procedures, and

- periodic audits by individuals meeting certain qualifications and frequent inspections to assure the program is being conducted in a manner consistent with the ALARA philosophy.

The NRC considers the program of in-plant safety, as required by license conditions, sufficient to protect in-plant personnel by keeping radiation exposures as low as reasonably achievable. NRC evaluation of this program and the associated license conditions are discussed in the Safety Evaluation Report (SER).

5.9 Waste Disposal

10 CFR 40, Criteria 2 of Appendix A, states that the small volume of wastes generated at in situ operations should preferably be disposed of at existing tailings disposal sites or other licensed burial grounds to avoid proliferation of waste sites. The NRC will require that the solid wastes generated at the PRI site, as described in Section 8.5, be disposed of at an existing licensed tailings disposal site or other appropriately licensed disposal facility.

5.10 Surface Discharges

No surface-water discharges are currently planned for the PRI site.

6.0 ENVIRONMENTAL EFFECTS OF ACCIDENTS

6.1 Failure of Chemical Storage Tanks

The largest storage tank will have a 9000-barrel capacity, and this would be the maximum volume that would reasonably be expected to be lost to the surface. The probability that a tank which is vented to the atmosphere would rupture is considered very small. A much more likely accident would be for the tank to develop a small leak. In either case, the environmental consequence of such a failure is considered to be minor, as all fluids from the plant site will be diverted to the existing lined pit where such fluids would be contained. The contingency plans for the plant also include automatic shutdown controls on critical levels and equipment which will further reduce the potential impact of a failure of this type.

6.2 Pipeline Failure

The rupture of a pipeline between the main process facility and the well field could result in a loss of either pregnant or barren solutions on the surface. If such a failure occurs, the operator shall take all necessary actions to correct the malfunction. Because pipelines are continuously monitored, a failure would be detected very shortly. Flow to the pipeline would be shut off, thereby minimizing the volume of the leak. Furthermore, PRI is required by license condition to perform an environmental assessment, should a significant impact be anticipated. The environmental assessment shall include appropriate soil and fluid analyses.

6.3 Fires and Explosions

The fire and explosion hazard of the uranium recovery plant will be minimal. The plant will not use flammable liquids in the uranium sorption, elution, or precipitation processes. Gases such as ammonia and propane will be stored in pressure tanks, a safe distance away from the process building. In the uranium recovery plant (except in the drying facilities), the uranium will be in solution, absorbed on ion exchange resin or in the form of a yellowcake slurry. An explosion would not appreciably disperse the uranium to the environment. Spilled liquids or slurries would be confined to the building sump or to the runoff pond.

6.4 Injection Well Failure

A casing failure would be most significant in the injection wells where the leach fluid is being injected under pressure. It is possible that this type failure in a well could occur and continue for several days before being detected. A very conservative estimate, assuming the failure was not detected for 30 days, could result in 380,000 gallons of fluid lost to another formation. As of July 1991, 667 injection wells have been installed at the Highland Uranium Project. A total of six casing failures (detected during well integrity testing) have occurred. These wells were plugged and abandoned.

If failure of a well does occur, the defective well is either repaired or plugged. If contamination of another aquifer is indicated, additional wells will be drilled in the contaminated aquifer and produced until concentrations of leach solution constituents are reduced to acceptable levels.

To minimize the risk of such a failure, monitor wells are completed in the aquifers above and below the ore zone of interest. The hydrostatic pressure and chemical composition of the water in the adjacent aquifers is analyzed periodically to check for fluid movement into the aquifers. In addition, casing integrity tests are performed on all production and injection wells after completion and after any work that includes entering the well with a cutting tool such as a drill bit or under-reamer.

6.5 Production Well Failure

Failure of a production well could not cause an excursion because production wells operate at negative pressures. If a failure were to occur, fluid would be contained in the well area until such time as failure is detected. Since well-field pressures are monitored continuously, failures will be detected in a very short time after occurrence. At that time, the failed well will be repaired.

6.6 Hydraulic Fracturing

If the injection pressure exceeds the fracturing pressure of the formation, fractures could be produced and they could result in undetected excursions or loss of leach solution to overlying units. Such an event is highly unlikely because injection pressures are maintained at levels well below the formation fracturing pressure.

7.0 ENVIRONMENTAL MONITORING

7.1 Water Quality Monitoring

7.1.1 Baseline Water Quality

Baseline water quality samples are collected from ore zone monitor wells, the overlying and underlying aquifer monitor wells, and the mineralized zone wells. Collected ground-water samples are analyzed for the following listed parameters: alkalinity, ammonia, arsenic, barium, bicarbonate, cadmium, calcium, carbonate, chloride, chromium, copper, electrical conductivity, fluoride, iron, lead, magnesium, manganese, mercury, molybdenum, nickel, nitrate, pH, potassium, radium-226, selenium, sodium, sulfate, total dissolved solids, uranium, and vanadium, In addition, each of these wells are sampled additional times and analyzed for conductivity, sulfate, chloride, bicarbonate, radium-226, total dissolved solids, and selenium. The additional data are used to confirm the first analysis, to minimize errors, and to provide a larger data set for selecting upper control limits (UCLs).

To determine background (baseline) for definition of restoration and UCLs, a minimum of five mineralized zone (pattern area) wells are installed, uniformly spaced in the ore body with a minimum density of one well per each acre of area under production patterns. Baseline for the ore zone aquifer is determined from water quality samples collected from the ore zone monitor wells and the five or more mineralized zone production area wells. Well water samples are collected, preserved, and analyzed in accordance with accepted methods.

The licensee is required by license condition to set upper control limits (UCLs) for each individual mining area. Bicarbonate and chloride anions, as well as electrical conductivity, are the UCL elements selected to serve as indicators of potential contaminant migration. The UCLs for bicarbonate and electrical conductivity are defined as the mining unit baseline mean plus five standard deviations. The UCL for chloride is defined as the mining unit baseline plus five standard deviations, or the mining unit baseline mean plus 15 mg/l, whichever is greater.

During operation, all ore zone monitor wells and overlying aquifer and underlying aquifer monitor wells are sampled twice every month. An excursion will be assumed if the UCLs are exceeded in any two of the excursion control elements. Once an excursion is confirmed, the NRC is to be notified within 24 hours and corrective action undertaken. Sampling is conducted at least every 7 days for UCL elements and uranium at all affected monitoring wells until sampling indicates element concentrations are below UCL.

Changes in potentiometric levels in the monitor wells and ore zone perimeter monitor wells may be an early indication of an excursion leading to water quality degradation. A significant rise or fall above or below the natural premining baseline levels for an extended time period, also indicates inefficiency in adjustment of well-field flow rates, insufficient geologic confinement, or a seasonal variation in ground water levels. To clarify the cause of a water level change, water quality analyses should be evaluated in conjunction with water level data.

7.1.2 Hydrologic Monitoring in Well Fields

PRI began to develop the Highland Uranium Project well fields starting in the Section 21 area in late 1987, with mining of these well field areas proposed to extend through 1993. Prior to initiating well-field development activities in a new well field, PRI drills delineation holes in a uniform pattern over the prospective ore bodies to determine the economic mining limits of the ore body and the detailed geologic information necessary for excursion monitoring and pattern emplacement. Following ore body delineation and assessment of geologic information, PRI prepares a plan view map outlining the proposed production area which will include the ore zone, and overlying and underlying aquifer, monitor well locations.

Ore zone monitor wells are located based on hydrologic conditions in conjunction with accepted methods for determining optimum placement. These monitoring wells are typically positioned 250 to 600 feet from the production area and spaced 300 to 800 feet apart. Additional monitor wells are completed in the aquifers directly above and below the mined aquifer. These wells are completed near the centerline through the proposed production area with one well installed for each 2 acres of well field. Where the aquitard between the ore zone and the overlying or underlying aquifer is thin (less than 5 feet thick) or absent over a small area, monitor wells are completed at the top or bottom of the ore sand aquifer to verify that no lixiviant is moving up or down from the ore zone. Such monitor wells are in addition to the normal overlying or underlying aquifer monitor wells. Where the aquitard is absent over extensive areas, it is not considered an effective aquitard, and the next overlying/underlying aquitard is used, subject to NRC approval. Finally, aquitard monitor wells are completed in each aquitard which has not previously been tested to allow Neuman-Witherspoon analysis of the aquitard hydraulic characteristics.

After monitor well completion, at least five mineralized zone wells, with one well per acre of well-field area, are completed uniformly spaced in the orebody. Antecedent water levels are monitored in each aquifer prior to aquifer testing. The purpose of the test is to verify hydraulic communications between the ore zone and wells installed to monitor the ore zone, determine the hydraulic gradient and ground-water velocity of the aquifer, develop transmissivity and storage coefficients representative of the aquifer, verify hydraulic isolation of the production zone from overlying and underlying aquifers, and evaluate the hydraulic characteristics of the aquitards.

7.1.3 Settling Pond and Purge Reservoir Leak Detection System

PRI uses underdrain leak detection monitoring at the radium settling ponds. The underdrain leak detection system(s) consists of four underdrains which will run the length of the ponds. Sumps are incorporated at the drainage end points so that if any fluid is detected in the drainage system, it can be pumped out.

The purge reservoir utilized a leak detection monitoring well. This well is located in an unsaturated zone adjacent to the reservoir, so that leaks can be readily detected.

7.2 Radiological Monitoring

The radiological environmental monitoring program proposed by PRI is outlined below.

Environmental Element	Sampling Location	Sampling Frequency	Type of Measurement
Gaseous Effluent	Yellowcake dryer and Packaging room exhaust air stacks	Quarterly	Ra-226, Th-230 U-nat
Surface Water	Surface impoundments and affected drainage	Quarterly	Ra-226, U-nat
Ground Water	Mill water well No. 11	Quarterly	Ra-226, U-nat
Soil	Irrigation site	Seasonal	Ph, conductivity, Cl, SO_4, Co_3, B, U, Ra-226
Vegetation	At soil sites	Seasonal	As, Se, B, Ra-226, U

8.0 ALTERNATIVES

8.1 Mining Alternatives

Conventional surface and/or underground mining of the ore deposits in the initial in situ mining areas are not economically feasible due to the depth, size, and shape of the deposits. Development costs for both surface and underground mines make these methods uneconomical for small (1 to 2 million pound) deposits. A surface mine for the deposit would incur an overburden removal ratio of about 75 cubic yards of earth per pound of uranium produced. With a $1.50 per cubic yard removal cost, this would make the total project uneconomical without even considering the mining and milling costs.

For an underground mine, the physical characteristics of the deposit would require extensive drifting. A preliminary evaluation of the development costs of an underground mine for this deposit including the surface facilities, shaft, subsurface station development, ventilation system, and drifting indicate the cost would be $45 to $50 per pound of uranium produced. Again, these costs do not include the mining or milling costs.

8.2 Process Alternatives

To date, most uranium in situ mine pilot programs and all known commercial projects have used an alkaline leach solution comprised of various combinations of carbonates, bicarbonates, and oxidizers. An acidic leach solution could be used in place of the alkaline solution, but the limited data available on pilot programs using acidic solutions indicates only limited success. PRI's initial decision to utilize an alkaline leach solution containing carbon dioxide and oxygen was based on the favorable results obtained in the operation of the Pilot ISL. PRI's continued practice of the alkaline leach solution technique is a result of successful mining production at the HUP.

8.3 Ground-Water Restoration Alternative

PRI's approved ground-water restoration program for the HUP utilizes ground-water sweep, followed by water treatment and reinjection. If necessary, final treatment of elevated "hot spots" with a chemical reductant may be done. This ground-water restoration program is expected to withdraw approximately 3110 to 4650 acre-feet of water from the Highland aquifers. Surface or underground mining of these deposits, if economically feasible, would require three to five times these water withdrawals.

Feasible alternatives to the program for ground-water restoration consist of varying the extent of use for each method described above. The best alternative for minimizing impacts to ground water would be to employ the treatment and reinjection method as long as possible because increased use of this method would mean a decrease in consumption of ground water. However, the consumption of ground water for restoration is already quite conservative relative to conventional mining ground-water demands, and the ground-water restoration utilized by PRI is considered to have an insignificant impact.

8.4 Waste Management Alternatives

Two liquid waste streams are generated by the in situ mining project: (1) a fresh water waste stream comprised initially of 50 to 100 gpm well-field purge and eventually including up to 360 gpm restoration fluids, and (2) a salt water waste stream of up to 50 gpm of spent eluate, yellowcake wash, and miscellaneous process wastes.

The fresh water waste stream is utilized in a controlled irrigation project. The two alternative waste management methods would be natural evaporation in ponds or deep well disposal. Evaporation of up to 360 gpm would require approximately 70 acres of evaporative surface, more than is required for the irrigation project. In addition, evaporation would result in loss of the water resource, whereas irrigation will provide a beneficial use for this fresh water stream. Disposal into deep wells would require six to eight disposal wells of 9000-foot depth, based upon injectivity analyses for the most shallow suitable receiver formations (Wyoming Ground Water Pollution Control Permit Application, December 1985). Because these disposal wells would cost approximately $750,000 each (based on 1987 costs), this alternative is not economically feasible.

The salt water waste stream is injected into a disposal well completed in the Teapot and Parkman members of the Mesa Verde Formation at a depth of 8600 to 9100 feet. Alternative disposal practices for this waste stream include natural evaporation in ponds, process evaporation, reverse osmosis, or repeated precipitation. Natural evaporation would require a 20- to 30-acre evaporation pond and would result in a concentrated sludge. This waste would need to be stored indefinitely. In addition, an 11 million-gallon storage pond would be required to hold process wastes accumulated from November through March of each year, when evaporation is not effective due to weather conditions. Process evaporation is similar to natural evaporation except that water removal is accomplished by process heat input into multi-effect evaporators. This has the disadvantage of high energy input and the same resultant slurry as natural evaporation. Reverse osmosis is sensitive to input stream quality, costly to operate, and also results in a concentrated waste product requiring ultimate disposal. Repeated precipitation is accomplished by the addition of selected metal salts which precipitate with radionuclides to form solid radioactive salts. This process has a high cost and results in a concentrated radioactive waste. Based on the waste disposal alternatives which are available, the preferred method of disposal is injection into a subsurface brine-bearing formation.

8.5 Solid Waste Disposal Alternatives

Radioactive solid wastes are limited to scale and other solid material cleaned from process vessels, spent ion-exchange resin, and equipment/parts which have become coated with deposits of radioactive materials. Disposal is in an NRC-licensed low-level radioactive waste disposal site. There are no disposal alternatives for such material at this time.

Nonradioactive solid wastes are limited to paper, trash, rags, packing materials, etc., and is of limited volume due to the small size of the operation. Disposal of such waste is by a commercial waste disposal operation. Waste oil from vehicle oil changes and hydraulic equipment is stored in above-ground tanks and is periodically collected by a commercial used oil recycler. Alternative waste disposal would be in a licensed onsite landfill. The small volume of the nonradioactive solid wastes make this alternative uneconomic.

9.0 FINANCIAL SURETY

10 CFR 40, Appendix A, Criterion 9, requires that the licensee establish financial surety for above-ground decommissioning and decontamination, the cost of offsite disposal of radioactive solid process or evaporation pond residues, and ground-water restoration of the site. The amount of funds must be based on a NRC-approved plan in conformance with 10 CFR Part 40 and be in the form of a surety instrument acceptable to the NRC. The funds must be sufficient to cover the costs that would be incurred if an independent contractor was hired to perform the work upon closure or abandonment of the facility. The NRC reviews the decommissioning/restoration plan and cost estimate submitted by PRI to determine the required amount of the surety. PRI is required annually to adjust their surety to recognize any increases or decreases resulting from

inflation, changes in engineering plans, activities performed, and any other conditions affecting costs. Surety requirements will be reviewed at least annually by the NRC to ensure that funds and the surety instrument are adequate.

10.0 FINDING OF NO SIGNIFICANT IMPACT

PRI has applied to the NRC to obtain an amended and revised source material license permitting in situ leach uranium mining at the Highland site in Converse County, Wyoming.

The NRC has previously examined actual and potential environmental impacts associated with the existing project. Based on the previous assessment site data and the comparable site and operation characteristics of the proposed mine expansion area, the NRC has determined that issuance of an amended source material license (2) will be consistent with requirements of 10 CFR Part 40, (2) will not be inimical to the public health and safety, or (3) have long-term detrimental impacts on the environment. Specific reasons for drawing this conclusion with reference to the proposed West Highland Amendment are:

- The proposed control and monitoring program for ground water is sufficient for detecting any excursion, either vertical or horizontal;

- The purge storage reservoir and settling ponds are clay lined to minimize seepage of waste solutions. A monitoring system below the liner should detect any leakage which may occur;

- Radiological releases from the uranium extraction operations will be very small (exposures which are small fractions of radiological exposure standards will result) and will be closely monitored to detect any problems;

- All radioactive wastes will be disposed of at an existing NRC-licensed tailings disposal site; and

- The proposed restoration plan as demonstrated by the R&D ISL should be sufficient to return the ground water to its premining use (or potential use). On a parameter-by-parameter basis, ground-water quality will be returned to as close to baseline as reasonably achievable or to same class-of-use.

Based on this finding, it is recommended that PRI's license be amended for commercial scale operation of the Highland site to include the area incorporated in the WHA. The source material license is based upon the licensee's revised application, the Environmental Assessment, and the Safety Evaluation Report. The Safety Evaluation Report (SER) was developed to address radiation safety issues; license conditions which are a result of the safety evaluation may be found in the SER. With reference to this EA, the licensee will be required to operate as proposed in the revised license application and with the following license conditions:

1. The authorized place of use shall be the licensee's Highland project facilities in Converse County, Wyoming.

2. For use in accordance with statements, representations, and conditions contained in Volume 6 of the licensee's revised licensee application dated March 20, 1991, and the licensee's submittal dated March 22, 1988.

3. The total satellite facilities' throughput shall not exceed a flow rate of 7500 gallons per minute.

4. The licensee shall implement the effluent and environmental monitoring program specified in Sections 9.7 and 9.8 of the March 20, 1991, revised license application, the submittal dated March 16, 1989, Section 2 of the July 1986, Wastewater Land Disposal Application, and Section No. 7 of the April 1986, Wyoming Groundwater Pollution Control Permit for Subsurface Injection of Mineral Processing Waste. The licensee shall also implement an air particulate monitoring program external to the main processing facility in accordance with 10 CFR Part 20.

   In addition to the effluent and environmental monitoring submitted in accordance with 10 CFR Section 40.65, the semiannual report shall include the following:

   - Results of the ground-water monitoring program described in Section 8.2 of the revised license application.

   - Injection rates, recovery rates, and injection manifold pressures.

   - Notwithstanding the stack sampling specified above, the licensee shall include the semiannual monitor data for the drying and packaging stacks.

   - Results of monthly irrigation fluid water quality sample analyses for pH, conductivity, TDS, Na, Ca, Mg, K, Cl, SO_4, HCO_2, As, B, Cr, Cu, Ni, Se, An, U_3O_8, and Ra-226.

   Monitoring data shall be reported in the format shown in the attachment to this license entitled, "Sample Format for Reporting Monitoring Data."

5. Before engaging in any activity not previously assessed by the NRC, the licensee shall prepare and record an environmental evaluation of such activity. When the evaluation indicates that such activity may result in a significant adverse environmental impact that was not previously assessed or that is greater than that previously assessed, the licensee shall provide a written evaluation of such activities and obtain approval of the NRC in the form of a license amendment prior to initiation of the activity.

6. All liquid effluents from process buildings and other process waste streams, with the exception of sanitary wastes, shall be returned to the process circuit or discharged to the solution disposal system.

7. Baseline water quality sampling shall conform with the program described in the submittal dated October 7, 1987, such that baseline water quality for all new mining units shall be submitted 2 months prior to lixiviant injection. The data shall, at a minimum, consist of:

   A. One sample analyzed for the State of Wyoming, Department of Environmental Quality, Guideline 8, Appendix A, parameters per individual well.

   B. Two separate samples analyzed for bicarbonate, chloride, electrical conductivity, radium, selenium, total dissolved solids, uranium, iron, pH, arsenic, and fluoride, per individual well.

8. One month prior to conducting any mining activities for a new mining unit, the licensee shall submit hydrologic test results depicting hydrologic properties controlling ground-water flow, baseline water quality data, and proposed upper control limits (UCLs) for that mine unit to the NRC for review and approval. Approval shall be in the form of a license amendment to allow lixiviant injection and other mining processes to begin.

9. A. Upper Control Limits (UCLs) and baseline water quality data for all monitor wells to be utilized for operational and restoration monitoring shall be derived for each individual mining unit. The UCLs for bicarbonate and electrical conductivity will be defined as the mining unit baseline mean plus five standard deviations. The UCL for chloride will be defined as the mining unit baseline mean plus five standard deviations or the mining unit baseline mean plus 15 mg/l, whichever is greater.

   B. For the following mining units, UCLs are approved as delineated in the licensee's referenced submittals:

Mining Unit	Submittal Date
Section 21:20-Sand	November 30, 1987, and November 2, 1988
Section 21:30-Sand	November 2, 1988
Section 14:50-Sand (North)	February 13, 1989
Section 14:50-Sand (South)	April 2, 1990
Section 22/23:40-Sand	March 12, 1991
Section 15/22/23:50-Sand	September 5, 1991

   C. The licensee shall implement monitoring well modifications to the mining unit denoted as Section 21, 20- and 30-Sand as outlined in their submittal of May 19, 1988. Monitoring wells M-40, M-41, M-42, and M-43 shall be monitored once every 2 weeks until such time as excursion status is removed and a request to revise sampling frequency is submitted, or unless there is a reversal in the trend towards water quality improvement as described in the submittal dated August 19, 1991. Additionally, routine monitoring for wells CMO-1, CMO-11, CMO-18, CMU-7, and DMU-1 shall consist of water levels only.

D. The licensee shall monitor Section 14:50-Sand (South) trend wells CRMW-1, COW-1, CPTW14-2, and CRMW-6 for bicarbonate, chloride, and conductivity on the frequency specified for the monitor wells.

E. No uranium recovery shall be allowed in the "potential pattern area" shown on the Section 14 ISL pattern map submitted by cover letter dated April 23, 1990.

10. The licensee shall utilize a carbon dioxide solution with an oxygen or hydrogen peroxide oxidant for well-field purge treatment prior to reinjection. Any variation from this combination shall require a license amendment.

11. Each radium settling pond shall have 3 feet of freeboard. The storage reservoir shall have 4 feet of freeboard.

12. The licensee shall perform and document a daily visual inspection of the radium settling ponds and the storage reservoir embankments, fences, and liners, as well as measurements of pond freeboard and checks of the leak detection system. Should analyses indicate that the pond is leaking, the NRC, Uranium Recovery Field Office, shall be notified by telephone within 24 hours of verification and the pond level shall be lowered by transferring its contents into the other cell. Water quality samples taken at the standpipe shall be analyzed for chloride and conductivity once every 7 days during the leak period for at least 2 weeks following repairs. Additionally, water samples collected at the settling basin standpipes shall be analyzed for the full suite of parameters as defined in WDEQ/LQD Guideline 8, Appendix 1, at least once per month during the leak period.

    A written report shall be filed with the NRC, Uranium Recovery Field Office, within 30 days of first notifying the NRC that a leak exists. This report shall include analytical data and describe the mitigative actions and the results of that action.

13. At least 2 months prior to termination of uranium recovery in a mining area, the licensee shall submit to the NRC, Uranium Recovery Field Office, a schedule for ground-water restoration and post-restoration monitoring. Any deviation from the restoration methodology described in the June 26, 1991, submittal for Section 21, 20- and 30-Sand mine units for any subsequent mining units shall require NRC review and approval in the form of a license amendment. The goal of restoration shall be to return the ground-water quality, on a mining unit average, to baseline concentrations. Additionally, failure to restore ground-water quality to baseline concentrations shall require the licensee to submit a report describing the methodology actually implemented during the restoration attempt, predicted results of any subsequent restoration efforts to further improve ground-water quality, and an evaluation of the impacts to the ground-water resource.

14. In the event that previously unknown cultural resources are discovered during construction, ground disturbing activities in that vicinity shall be halted and the Platte River Resource Area Manager notified immediately. Construction work may not resume until the cultural resource has been fully evaluated by a qualified archaeologist and any necessary mitigative measures carried out. In some cases, it may be necessary for a qualified archaeologist to monitor ground disturbing activities for some proposed actions.

Surface disturbance shall not occur within those Federally-administered surface areas which have not been examined at the Class III survey level until a Class III cultural resource inventory has been made and approved by the BLM-PRRA.

It is recommended that the privately-owned areas within the proposed mine permit application area be resurveyed for cultural resources prior to implementing ground disturbing activiites if the pertinent cultural resource inventory was conducted before 1980. Federal surface within the permit area that falls into this category shall be inventoried prior to disturbance.

All actions associated with the proposed development will be completed in compliance with the National Historic Preservation Act (as amended) and its implementing regulations (36 CFR 800), the Archaeological Resources Protection Act (as amended) and its implementing regulations (43 CFR &0. Further, guidelines such as the Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation, and the Bureau of Land Management 8100 manual series will be followed where appropriate.

Cynthia D. Miller-Corbett

Cynthia D. Miller-Corbett
Project Manager

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ATTACHMENT

SAMPLE FORMAT FOR REPORTING MONITORING DATA

1. STACK SAMPLES

For each sample analyzed, report the following information:

a. Date sample was collected
b. Location of sample collection
c. Stack flow rate (m^3/sec)

Radionuclide	Concentration (µCi/ml)	Error Estimate[b] (µCi/ml)	Release Rate (Ci/qr)	Error Estimate (Ci/qr)	LLD[c] (µCi/ml)	% MPC[c]
U-nat						
Th-230						
Ra-226						
Pb-210						

2. AIR SAMPLES

For each sample analyzed, report the following information:

a. Date sample was collected
b. Location of sample collection

Radionuclide	Concentration (µCi/ml)	Error Estimate (µCi/ml)	LLD (µCi/ml)	% MPC
U-nat				
Th-230				
Ra-226				
Pb-210				
Rn-222				

[a] This table illustrates format only. It is not a complete list of data to be reported. (See text of guide and Tables 1 and 2.)

[b] Error estimate should be calculated at 95% uncertainty level, based on all sources of random error, not merely counting error. Significant systematic error should be reported separately. See Sections 6.1, 7.1.4, and 7.3.

[c] All calculations of lower limits of detection (LLD) and percentages of maximum permissible concentration (MPC) should be included as supplemental information.

SAMPLE FORMAT FOR REPORTING MONITORING DATA

3. LIQUID SAMPLES

For each sample analyzed, report the following information:

a. Date sample was collected
b. Location of sample collection
c. Type of sample (for example: surface, ground, drinking, stock, or irrigation)

Radionuclide	Concentration (μCi/ml)	Error Estimate (μCi/ml)	LLD (μCi/ml)
U-nat (dissolved)			
U-nat (suspended)[d]			
Th-230 (dissolved)			
Th-230 (suspended)[d]			
Ra-226 (dissolved)			
Ra-226 (suspended)[d]			
Pb-210 (dissolved)			
Pb-210 (suspended)[d]			
Po-210 (dissolved)			
Po-210 (suspended)[d]			

4. VEGETATION, FOOD, AND FISH SAMPLES

For each sample analyzed, report the following information:

a. Date sample was collected
b. Location of sample collection
c. Type of sample and portion analyzed

Radionuclide	Concentration (μCi/kg wet)	Error Estimate (μCi/kg)	LLD (μCi/kg)
U-nat			
Th-230			
Ra-226			
Pb-210			
Po-210			

[d] Not all samples must be analyzed for suspended radionuclides. See Sections 1.2 and 2.2 of this guide.

SAMPLE FORMAT FOR REPORTING MONITORING DATA

5. SOIL AND SEDIMENT SAMPLES

For each sample analyzed, report the following information:

a. Date sample was collected
b. Location of sample collection
c. Type of sample and portion analyzed

Radionuclide	Concentration ($\mu Ci/g$)	Error Estimate ($\mu Ci/g$)	LLD ($\mu Ci/g$)
U-nat			
Th-230			
Ra-226			
Pb-210			
Po-210			

6. DIRECT RADIATION MEASUREMENTS

For each measurement, report the dates covered by the measurement and the following information:

Location	Exposure Rate (mR/qr)	Error Estimate (mR/qr)

7. RADON FLUX MEASUREMENTS

For each measurement, report the dates covered by the measurement and the following information:

Location	Flux (pCi/m^2-sec)	Error Estimate (pCi/m^2-sec)