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October 18, 2001

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Melvyn Leach
Chief, Fuel Cycle Licensing Branch
Division of Fuel Cycle Safety and Safeguards
Nuclear Regulatory Commission
Mail Stop T-8A33
Washington, DC 20555

Subject: Wellfield #1 Restoration Plan
License No.: SUA-1548 Docket No: 40-8964
Smith Ranch Facility

Dear Mr. Leach:

As required by License Condition 12.3 of the above referenced source material license, Rio Algom Mining Corp. is providing the restoration plan for Wellfield #1. The exact date of the initiation of restoration operations is not specified in the plan, but it is not expected to be started before February 28, 2002 as equipment and facilities are being constructed. As soon as the facilities are ready, RAMC will start restoration operations.

The plan is attached to this letter, and it follows the general restoration plan provided in the License Renewal Application dated November 15, 1999 as amended. If you have any questions, please call me at (405) 858-4807.

Sincerely,

William Paul Goranson, P.E.
Manager, Radiation Safety, Regulatory Compliance and Licensing

Enclosures

CC: John Lusher, NRC
Steve Ingle, WDEQ Land Quality Division- District I
Marvin Freeman, RAMC
Bill Ferdinand, RAMC
John Cash, RAMC
John McCarthy, RAMC

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Rio Algom Mining Corp.
Restoration Plan
Wellfield #1

1.0 Restoration Objective

The objective of the reclamation plan is to return the affected surface and groundwater to conditions such that they are suitable for all uses for which they were suitable prior to mining. To achieve this objective, the primary goal of the restoration program is to return the condition and quality of the affected groundwater in a mined area to background (baseline) or better. In the event the primary goal cannot reasonably be achieved, the condition and quality of the affected groundwater will at a minimum be returned to the pre-mining use suitability category (Reference: LQD Rules and Regulations, Chapter XXI, Section 3 (d) (I)).

For the purposes of this plan, the use categories are those established by the Wyoming Department of Environmental Quality, Water Quality Division. The final level of water quality attained during restoration is related to criteria based on the pre-mining baseline data from that wellfield, the applicable Use Suitability Category and the best practical technology (BPT) and economics. Baseline as defined for this project shall be the mean of the pre-mining baseline data, taking into account the variability between sample results (baseline mean plus or minus tolerance limits, as defined in Section 5.1.2 of the license application, after outlier removal).

2.0 Introduction

The primary restoration technique is a combination of groundwater sweep, chemical treatment, and clean water injection. Groundwater sweep involves withdrawing water from selected production and injection wells which draws uncontaminated natural groundwater through the leached area displacing the leach solutions. Chemical treatment involves addition of approved water treatment chemicals to waters injected into the wellfield to re-stabilize the host formation. Clean water injection involves the injection of a better quality of "clean" water in selected wells within the production area while pumping other production and/or injection wells which again displaces the leach solutions with the better quality water. The source of the clean water may be from an RO type unit, water produced from a wellfield that is in a more advanced state of restoration, water being exchanged with a new wellfield, or a combination of these sources. Water withdrawn from the production zone during restoration will first be processed through an ion exchange unit to recover the uranium, then will be treated and reused in the project or routed to a holding pond for disposal via Class I non-hazardous injection wells.

It is expected that an average of about six pore volumes of water will have to be displaced to achieve restoration of a wellfield. During restoration of the initial wellfields, it is expected that near the midpoint of the process a chemical reductant will be added to approximately one pore volume of clean water injection to accelerate stabilization of trace metals.

Chemical reductants are beneficial because several of the metals, which are solubilized during the leaching process, are known to form stable insoluble compounds, primarily as sulfides. Primary among such metals is uranium, which occurs at the site because of the naturally occurring reduced state of the ore body. The introduction of a chemical reductant into the mine zone at the end of mining phase is designed to expedite the return of the zone to its natural conditions and to return as many of the solubilized metals to their original insoluble state as possible. By effecting this partial restoration directly within the formation (in-situ), the external impact of groundwater restoration is minimized.

The chemical reductant would be added above ground to the clean water stream being injected into selected wells. Based on the historical success reported by other ISL uranium mining companies, the reductant would be a sulfur compound such as gaseous hydrogen sulfide or dilute solutions of sodium hydrosulfide, sodium sulfide, or sodium bisulfite. If RAMC should desire to utilize any reductant other than these three sulfur compounds, WDEQ approval will be obtained prior to use. Dissolved metal compounds that are precipitated by such reductants include those of arsenic, molybdenum, selenium, uranium, and vanadium. All of these may be present in concentrations above baseline levels at the conclusion of mining.

The reductant would be introduced during the midst of the restoration process because the introduction of sulfur and sodium increases the total dissolved solids (TDS) level of the injected fluid. Once the reducing conditions are re-established, an oxygen free clean water can be injected to effect the final reduction in TDS.

If gaseous hydrogen sulfide is chosen for use, a program for its safe handling would be prepared and submitted to the appropriate agency prior to its use.

3.0 Restoration Flow Circuits

In Regulatory Information Summary 2000-23, the NRC has classified restoration effluents as 11e.(2) byproduct material, and no longer eligible for discharge according to the limits under 40 CFR Part 440. As a result, RAMC will combine a limited groundwater sweep process with clean water injection. As stated in Chapter 6 of the License Application, RAMC expects to meet the primary or secondary restoration goals within 6 pore volumes or less of groundwater circulation. It is expected that a combination of limited groundwater sweep and clean water injection will continue throughout the restoration process. A generalized flow circuit is presented as Figure 1.

The restoration circuit will be separate from the production circuit. Approximately 1400 GPM of wellfield solutions will be pumped from selected patterns in the wellfield undergoing restoration to the restoration water treatment facility. The produced water is treated through an ion exchange column (IX treatment) to remove any residual uranium. After IX treatment 600 GPM of the flow is returned to the wellfield for restoration. The remaining 800 GPM of the flow is sent to the reverse osmosis unit for further treatment. Using a 2 pass reverse osmosis unit, approximately 600 GPM of clean permeate is returned to the wellfield to be commingled with the 600 GPM of IX treated water and 200 GPM of brine (reject) flow is sent to disposal into Class I non-hazardous injection well. In addition, two existing, evaporation ponds may be used to handle any necessary surge capacity.

The 200 GPM flow difference between the production and injection sides of the flow circuit constitutes the groundwater sweep component. The commingled treated IX and permeate solutions constitute the clean water injection component. In order to meet the injection limits of the two Class I non-hazardous injection wells, simultaneous application of these two components creates an efficient means for meeting restoration goals and timing as well as minimizing the water to be disposed to deep well injection.

Chemical additions can occur at anytime during the restoration phase. It is anticipated that deployment of chemical reductants will occur after significant progress has been observed with respect to Total Dissolved Solids. Chemical reductants, when deployed, will be applied to the injection side of the flow circuit, immediately before injection into the production zone.

4.0 Treatment Methods

Restoration activities will include three steps designed to optimize restoration equipment used in treating groundwater and to minimize the time necessary to treat groundwater to meet the primary and secondary restoration goals. Restoration progress will be monitored using selected wells during restoration.

4.1 Groundwater Sweep

During groundwater sweep, water is pumped without injection from the wellfield causing an influx of baseline quality water from the perimeter of the wellfield that sweeps the affected portion of the aquifer. As water impacted by the production lixiviants is recovered through pumping, it is displaced, (swept), by groundwater containing lower ion concentrations originating from outside of the wellfield. Additionally, the over withdrawal of water creates a pressure sink inside of the wellfield that aids in reduction of the plume, or flare, of lixiviants immediately perimeter of the wellfield patterns.

The rate of groundwater sweep will be dependent upon the capacity of the wastewater disposal system and the ability of the wellfield to sustain the rate of withdrawal.

4.2 Groundwater Treatment

Simultaneous with groundwater sweep, clean water injection will be used to as a means for removing and treating groundwater impacted by uranium recovery operations. Ion exchange and reverse osmosis equipment is used. The ion exchange process will use fixed bed downflow columns located in the Central Processing Plant. The IX columns will remove the majority of the residual uranium from the recovered waters, and they will be operated in the same manner as the IX columns from the producing wellfields.

Approximately half of the water recovered from the portion of the wellfield undergoing restoration will be treated through the reverse osmosis unit located at the central processing plant. The feed into the reverse osmosis will consist of a portion of the flow discharged from the IX columns.

The purpose of the reverse osmosis unit is to perform the following actions:

- Reduce the total dissolved solids in the impacted groundwater;
- Reduce the quantity of water that must be removed from the aquifer to meet restoration limits;
- Concentrates the dissolved contaminants in a smaller volume of brine to optimize wastewater disposal capacity.

Before entering the reverse osmosis unit, the water is filtered to remove any fine solids and particulates to prevent plugging of the membranes. The water is pressurized and enters the reverse osmosis vessel and passes through the membranes. The membranes allow the water to permeate through them while the ions are concentrated in the center of the tube. The permeate, (clean water), is collected in the annulus of the vessel, and it is re-injected into the wellfield. The water containing the concentrated ions, (brine), is discharged for disposal. In a dual-pass configuration, approximately 60 - 75 percent of the feed water is recovered as permeate for re-use in the wellfield, and approximately 60 - 90 percent of the dissolved salts in the feed are collected in the brine to be handled by the wastewater disposal system.

Ion exchange and reverse osmosis are effective at removing non-redox sensitive ions from the water during restoration. However, given the nature of the depositional environment that developed the uranium ore body as described in Chapter 2 of the license application, it is necessary to return the aquifer to redox conditions similar those conditions that existed before injection operations were initiated. It is necessary to remove the oxidizing environment created during production operations. The most used method of treatment is the use of chemical reductants.

At a point in the future of the restoration operations, a chemical reductant may be added to the injection stream. The purpose of the chemical reductant is to reduce the oxidation-reduction (redox) potential of the aquifer. The addition of the reductant will lower the redox potential of the aquifer, and thereby reducing the solubility of the redox sensitive metals, of which uranium, selenium, molybdenum, and iron are significant restoration concerns.

There are various chemical reductants that can be used. In the in-situ leach uranium recovery industry, four common reductants are used: hydrogen sulfide, sodium sulfide, sodium hydrosulfide, and sodium bisulfite. The first three reductants represent occupational safety risks with respect to chemical toxicity, but they are also the most effective chemical reductants. Before RAMC intends to deploy chemical reductants, whichever is to be used, a chemical safety program will be developed and submitted to NRC for review and approval. Upon receiving that approval, RAMC expects that only one pore volume of treatment is required to achieve the anticipated results of in-situ precipitation of the redox-sensitive metals.

4.3 Groundwater Transfer

As a result of the limited feed into the reverse osmosis unit as well as the operating costs, a method of optimizing the operation of the reverse osmosis unit is to ensure that the feed contains a relatively high concentration of ions. Additionally, this concept allows for the efficient concentration of contaminants in the brine in order to optimize the disposal well limits. To effectively manage the optimization of the treatment and disposal facilities, RAMC will be using a groundwater transfer process.

This process will be used in conjunction with the groundwater sweep and treatment processes. The concept is as follows. When a series of patterns in the wellfield undergoing restoration reach a point where the selected contaminate concentrations have been restored to a level approximately 50% of the difference between wellfield average post leach and baseline concentrations, the recovered water will be redirected to new restoration patterns and used for clean water injection. The recovered water, with higher concentrations of contaminants, from the new patterns will sent to the IX/reverse osmosis treatment facility.

5.0 Effluent Disposal

With respect to the restoration activities related to Wellfield #1, RAMC has two approved methods of wastewater disposal. The primary means of disposal are the two, approved, Class I non-hazardous injection wells that are permitted and constructed at the facility. Combined these wells have a permitted disposal rate of 300 GPM, and that limitation is factored into the flow circuit design for the restoration plan.

The second approved disposal method is the two small, evaporation ponds located near the Central Processing Plant at the facility. These ponds are double-lined ponds with a leak detection system, and they are described in Chapter 4 of the approved license application. These ponds are limited in storage and evaporative capacity, and are not considered as the primary method of wastewater disposal.

6.0 Restoration and Stability Sampling

When sampling results indicate that restoration has been achieved, the designated production area wells will be sampled and analyzed for the full suite of parameters listed in Table 5-1, of the license application (attached), as Suite A. Unless otherwise requested and approved by the applicable regulatory agencies, the production area wells in a wellfield to be sampled for determining restoration and stability shall be wells used for collecting pre-mining baseline data for that unit. If the data confirm restoration is complete this will initiate the stability demonstration period.

Prior to starting restoration operations, the designated production area wells,(see table 2) to be used for determining restoration success will be sampled and analyzed for Suite A, as listed on Table 5-1. After restoration is completed, a second series of samples from the designated production wells will be collected and analyzed using Suite A, as listed on Table 5-1. During restoration, sampling of recovery wells will be conducted as needed to measure the progress of restoration activities, but these samples will be used internally only.

In the stability demonstration period the full suite assays will be repeated for those same wells at approximately the six month and one year periods. Between these periods the wells will be sampled at six week intervals with the samples analyzed for a short list of key parameters developed for that specific wellfield. RAMC proposes to use Suite B from Table 5.1 as the short list of key parameters. This sampling plan will provide for a minimum of nine samples within a one year period to demonstrate restoration success.

When the sampling data indicate that the wellfield aquifer has been restored and stabilized, a report documenting this will be filed with the appropriate regulatory agencies along with a request for certification of restoration. Plugging of wells and surface reclamation of the wellfield will commence after receipt of restoration certification.

During restoration, sampling of monitor wells for that wellfield will continue at the same frequency and for the same parameters as during mining. However, during stability monitoring the monitor well sampling frequency will be reduced to only once every two months and the sampling will be terminated at the end of the stability demonstration period.

7.0 Restoration Criteria

The restoration criteria for the groundwater in a wellfield is based on the wellfield production-injection wellfield as a whole, on a parameter by parameter basis. All parameters are to be returned to as close to baseline as is reasonably achievable. Restoration target values shall be established for all parameters affected by the mining process. The restoration target values for the wellfields shall be the mean of the pre-mining values. If during restoration, the average concentration of a parameter in the designated production area wells of a wellfield is not reduced to the target value within a reasonable time, a report describing the restoration method used, predicted results of additional restoration activities, and an evaluation of the impact, if any, that the higher concentration has on the groundwater quality and future use of the water will be prepared and submitted to the applicable regulatory agencies.

Restoration success will be determined after the completion of the stability monitoring period. At the end of stability, all constituent concentrations will meet approved standards and will not show strong trends in groundwater deterioration as a result of ISL facilities. Upon regulatory approval of the stability monitoring results, the decommissioning of the wellfield will be started.

The restoration water quality targets for Wellfield #1 are found on Table 1, and it is based on Table F1.2 from Appendix D6 of the Wellfield #1 Baseline Data submittal.

Table 1
Smith Ranch Facility
Wellfield #1
Restoration Targets

Major Ions (mg/l)	Q-Sand Wellfield #1 Concentration
Calcium	72.213
Magnesium	17.225
Sodium	22.525
Potassium	7.269
Carb	0.1
Bicarb	228.194
Sulfate	113.187
Chloride	4.17
Ammonium	0.049
Nitrite+ Nitrate	0.122
Fluoride	0.32
Silica	17.011
TDS	334.96
Alkalinity	186.083
TRACE METALS mg/L	
Arsenic	0.001
Boron	0.1
Cadnium	0.01
Chromium	0.05
Iron	0.065
Manganese	0.022
Molybdenum	0.1
Selenium	0.001
Vanadium	0.1
Zinc	0.01
RADIOMETRIC	
Uranium--mg/L	0.065
Radium 226--pCi/L	734.074

Table 2
Smith Ranch Facility
Wellfield #1
Proposed Designated Production Area Wells

Production Zone Baseline Wells

B1
B2
B3
B4
B5
B6
B7
B8
B9
B10
B11
B12
B13
B14
B15
B16
B17
B18
B19

TABLE 5-1
GROUNDWATER SAMPLING PROGRAM RECOMMENDATIONS

MONITORED CONSTITUENT	SAMPLE TYPE	SAMPLE FREQUENCY	DENSITY	ANALYSIS
Monitor Wells: (Perimeter Ore Zone Upper and Lower Aquifers)	Baseline	4 Samples no less than 12 days apart	All Monitor Wells	One Sample- Assay Suite A[1] Two Samples -Assay Suite B[2] One Sample - Assay Suite B plus any detects from suite A
Monitor Wells: (Perimeter Ore Zone Upper and Lower Aquifers)	Operational Monitoring	Twice Per Month (10 Days or More Between Samples)	All Monitor Wells	Assay Suite C[3]
Wellfield Wells: (Ore Zone)	Baseline	4 samples no less than 12 days apart	Ten Wells for the first 10 acres plus 1 well for each 2 acres thereafter.	Two Samples - Assay Suite A[1] Two Samples- Assay Suite B[2]

[1] Assay Suite A = Wyoming Department of Environmental Quality, Land Quality Division Guideline No. 8 - Table 1. (Dec., 1990) suite of parameters plus uranium, vanadium, radium 226, and radium 228.

[2] Assay Suite B = TDS, SO4, Cl, pH, As, Se, U, Ra-226, Ra-228, conductivity and Total Alkalinity.

[3] Assay Suite C = Cl, Conductivity, Total Alkalinity

Figure 1

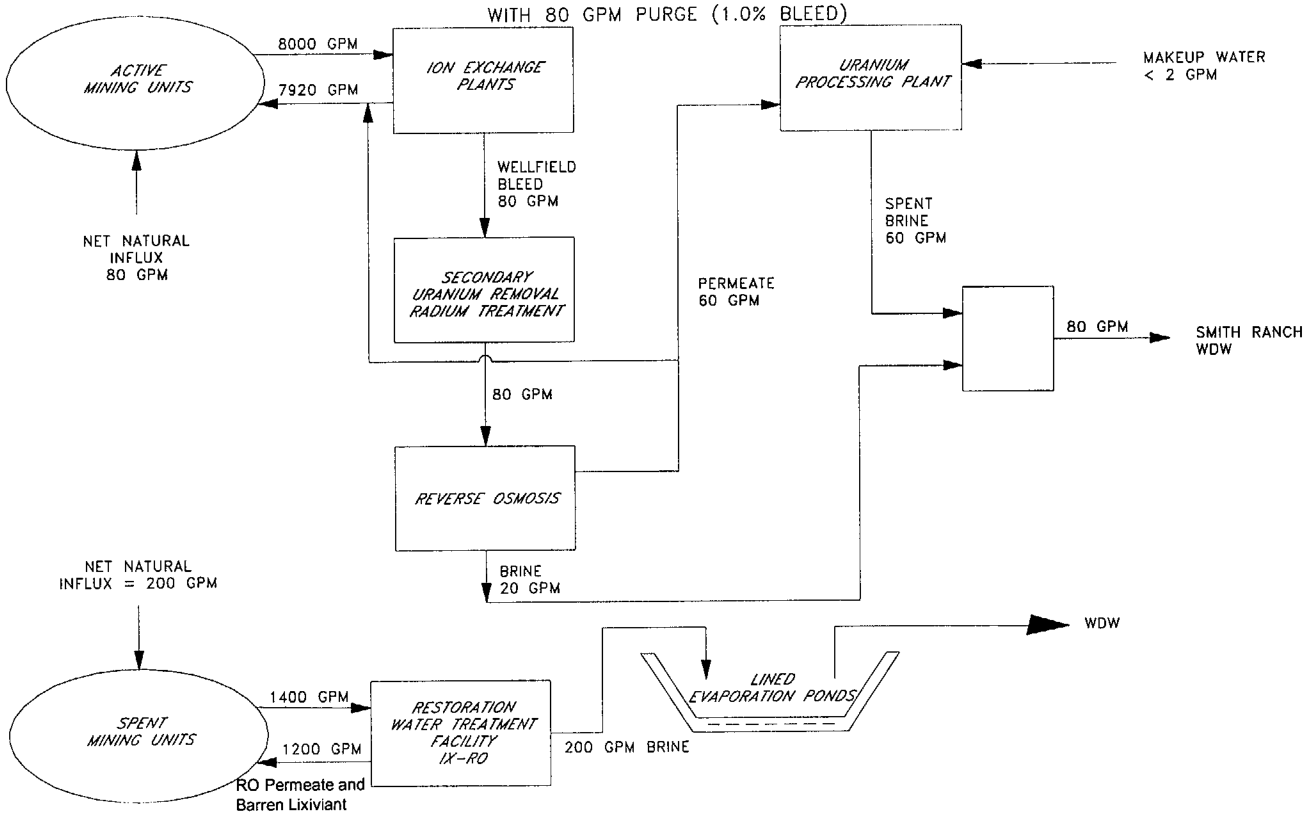
WATER BALANCE FOR SMITH RANCH PROJECT

Wellfield #1 Restoration

(2 Satellite IX Plants in Operation)

WELLFIELD OPERATIONS AT 8000 GPM

WITH 80 GPM PURGE (1.0% BLEED)



Note: The flow shown above represents an example capacity for the facility, and does not represent any design or regulatory limit imposed on the facility.

Figure 2
Wellfield #1 Layout

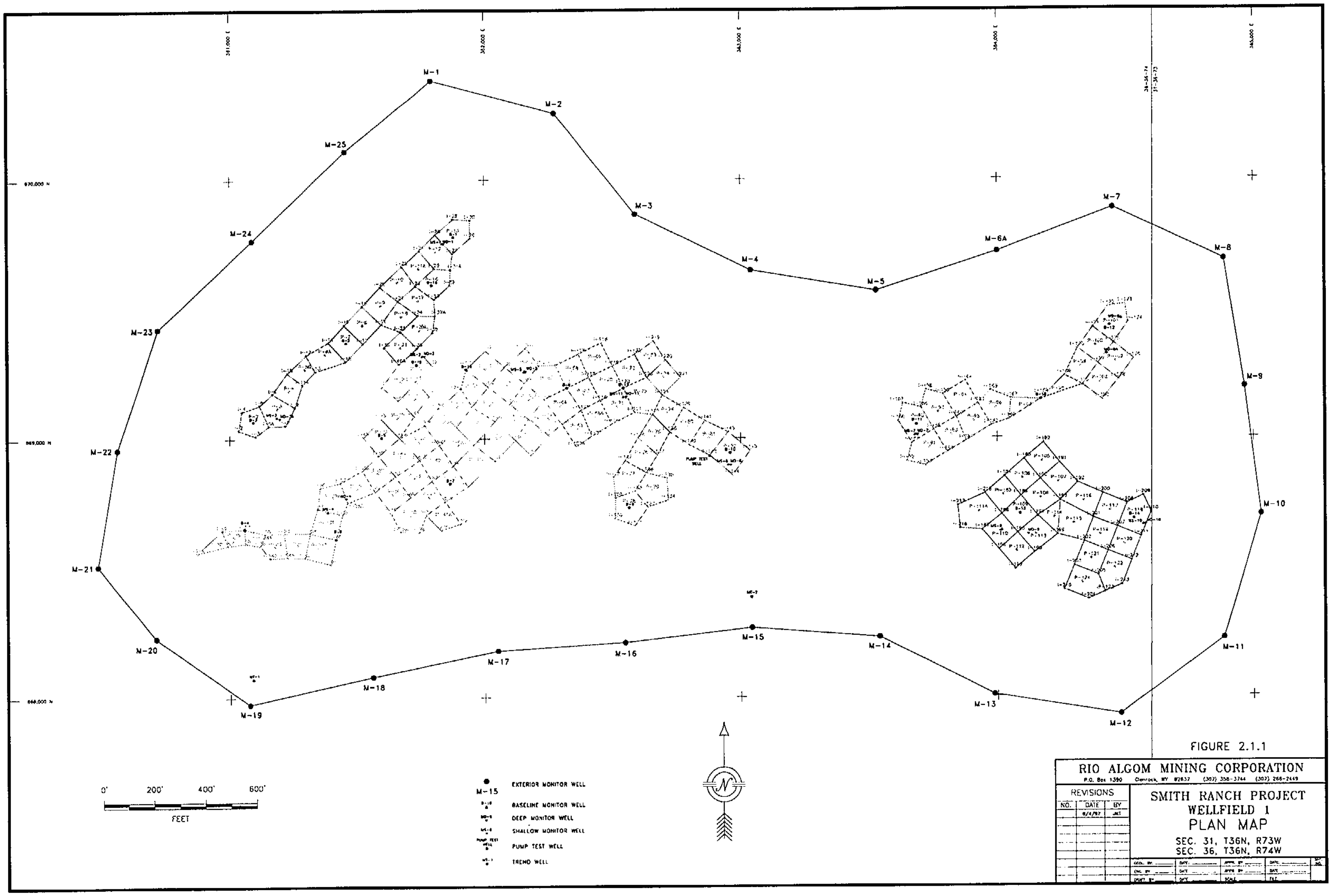


Figure 3
Restoration Timeline
Smith Ranch Facility
Wellfield #1

		Month of Operation										
Phase of Restoration	Flowrate (GPM)	1	2	3	4	5	6	7	8	9	10	11
Phase A (58 Patterns)												
Groundwater Sweep	200					50%	25%					
Cleanwater Injection	1400					50%	25%					
Chemical Reductant Addition												
Groundwater Transfer	200											
Phase B (58 Patterns)												
Groundwater Sweep	200					50%	75%					
Cleanwater Injection	1400					50%	75%					
Chemical Reductant Addition												
Groundwater Transfer	-200											
Total Flow (gal.)		4.39E+07	4.39E+07	4.39E+07	4.39E+07	4.39E+07	4.39E+07	4.39E+07	4.39E+07	4.39E+07	1.82E+07	
Cummulative Pore Volumes		0.64	1.27	1.91	2.55	3.19	3.82	4.46	5.10	5.74	6.00	