40-8968

HRI, Inc.

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October 15, 1996

Jim Van Dyke
Environmental Impact Analyst
Oak Ridge National Laboratory
Box 2008
Oak Ridge, TN 37831-6205

RE: Additional costs associated with operation of Town of Crownpoint water wells due to HRI's *in situ* mining operations.

Dear Jim:

HRI, Inc. (HRI) has reviewed the location of the Town of Crownpoint's water wells and our hydrologic modeling (and past ISL experience) demonstrates that the company can operate without deleterious effect on the quality and quantity of available water resources. However, as we discussed this past week, HRI has already committed to replacement of any existing Town of Crownpoint water wells, if needed, because of regulatory concern with the proximity of those wells to HRI's *in situ* mining (ISL) operation. Wells would be moved beyond a minimum distance from active ISL operations, as agreed upon by the regulatory authorities in discussions with the Company. This caveat is designed to ensure that HRI will have hydrologic and technical input in the selection of any proposed replacement site.

A pipeline from the replacement well(s) to the existing municipal water supply distribution system will also be provided. The replacement well(s) and pipeline would provide equivalent quantities of water at equivalent pressures to the existing system and would conform to regulatory standards for municipal water supplies.

The locations of existing Town of Crownpoint water wells in relation to the proposed HRI license boundaries are shown in Figure 1 (attached). Table 1 below shows the approximate distances from the Town water wells to the nearest license boundaries of our proposed ISL operations (except as noted). Also shown is the "Average Summer Flowrate (gpm)" for each of the Town water wells. The summer flowrate is shown because it is greater than the corresponding winter rate.

1/1

NL05

Table 1

Approximate Distances of Town of Crownpoint Water Wells from Nearest License Boundaries of HRI's Proposed ISL Mining Operations

Well	Average Summer Flowrate (gpm)	Minimum Distance to Crownpoint ISL Operation [1] (feet)	Minimum Distance to Unit 1 ISL Operation [2] (feet)
BIA #3	79.4	2,350	11,240
BIA #5	6.2	2,560	11,050
BIA #6	100	4,150	13,470
NTUA #1	27.7	1,610	10,930
NTUA Conoco	58.7	4,620	13,820
NTUA Littlewater	100.3	38,760	48,300

[1] Excludes Crownpoint, Section 29.
[2] Excludes Unit 1, NW/4, Sec 24.

Section 29, R12W, T17N shown on Figure 1 has not been included in the hydrologic modeling because the property will not be produced for a considerable time into the future. As a result, the distances for the Town wells from HRI's proposed Crownpoint ISL operations were measured only from the areas to the west, and a note was included in Table 1: "Excludes Crownpoint, Section 29". Town well BIA #6 is approximately 1,360 feet north of Section 29. When ISL production does begin on Section 29, HRI commits that, prior to any wellfield development (except exploration), well BIA #6 will be moved beyond a minimum distance from active ISL operations as agreed upon by the regulatory authorities in discussions with the Company.

Also, Sec. 24, R13W, T17N is shown as part of Unit 1 on Figure 1. This was done to show a difference in probable regulatory jurisdiction between that portion and the rest of Section 24. However, because of its location, it will be more appropriately part of the Crownpoint operations and, thus, the note in Table 1: "Excludes NW/4, Sec 24.

Concerning HRI's ISL operation, any one of three scenarios may take place initially: (1) only the Crownpoint facility is in operation, (2) only Unit 1 is in operation, or (3),

Crownpoint and Unit 1 operate concurrently. In addition, Table 1 shows the distances of the Town wells to HRI's **nearest** ISL license boundary (except as noted), and as such, these distances are **minimums**. All ISL operations must take place within these boundaries, but future exploration and delineation of the uranium roll fronts may result in actual ISL operations somewhat further from the Town water wells than shown in Table 1. Thus, the replacement (and its timing) of any particular Town water well would depend on a minimum distance to **actual** ISL operations, as agreed upon.

It is HRI's understanding that the Crownpoint municipal water system must have multiple water supply wells in the event that any one water well is unavailable for water production (due to pump failure, well testing, etc.). It is unlikely that all of the water wells shown in Table 1 would have to be replaced because of HRI's nearby ISL operations, in which case, there will always be multiple water wells available. However, if all wells are replaced by HRI, HRI will commit that at least two replacement wells will be drilled and completed, providing an equivalent quantity of water and pressure to the existing system, so that the regulatory criteria of multiple wells can be met.

In our discussions with the Crownpoint Navajo Chapter officials, the most favorable location for replacement of the Town water wells is to the northeast of the Town of Crownpoint in Sec. 8, T17N, R12W (see Figure 1, attached). Table 2 shows the pressure loss per mile of additional pipeline, as well as, the costs associated with pumping an equivalent quantity of water through that length. The pressure losses are shown for the size of pipeline which would be used for the cumulative flowrates of the wells which are replaced. The size of the PVC pipeline would be dependent on the total flowrate which is being replaced.

Table 2

Pressure Loss (psi) and Additional Operating Costs per Mile of PVC Pipeline for Cumulative Flowrates from Town of Crownpoint Water Wells Based on Distance from HRI's Proposed Crownpoint ISL Operation

Town Water Well	Minimum Distance To HRI's Crownpoint ISL Operation (feet)	Average Summer Flowrate for Individual Wells (gpm) [1]	Cumulative Flowrate If Nearest Wells are Moved (gpm)	Pressure Loss (psi) per Mile [2] for Cumulative Equivalent Flowrate			Cumulative Additional Operating Cost per Year per Mile of Pipeline for Relocated Wells ($) [4]
				PVC 4" SDR 21 [3] 3.996" ID	PVC 6" SDR 21 [3] 5.856" ID	PVC 8" SDR 21 [3] 7.663" ID	
NTUA #1	1,610	27.7	27.7	1.2	---	---	$17
BIA #3	2,350	79.4	107.1	---	2.3	---	$127
BIA #5	2,560	6.2	113.3	---	2.6	---	$149
BIA #6	4,150	100.0	213.3	---	8.4	---	$908
NTUA Conoco	4,620	58.7	272.0	---	---	3.6	$490
NTUA Littlewater	38,760	100.3	372.3	---	---	6.3	$1,200

[1] Average summer flowrates are greater than winter water usage.
[2] Using Hazen-Williams equation with coefficient of 150.
[3] SDR 21 is rated at 200 psi; ID is the average internal diameter in inches.

[4] Typically, electrical amperage required by a submersible pump is reasonably constant over a wide range of flowrates. However, conservatively assuming that amperage varies with hydraulic horsepower, the cost per year would be calculated as follows:

$$\frac{\$}{\text{year}} = \frac{(\text{gpm})\ (\text{head, psi})\ (0.746\ \text{kW/hp})\ (1440\ \text{min/day})\ (365\ \text{day/yr})\ (\$/\text{kW-hr})}{(3960)\ (60\ \text{min/hr})\ (\text{pump efficiency})\ (\text{motor efficiency})\ (0.4335\ \text{psi/ft})}$$

75% <-- Submersible pump efficiency (%).
75% <-- Motor efficiency (%).
$0.075 <-- Cost per kW-hr ($).

The length of pipeline, connecting any newly drilled Town water well to the existing water distribution system, would be 1 1/4 to 2 1/2 miles, depending on the location of the tie-in point to the existing pipeline. Using the more conservative number of 2 1/2 miles and Table 2 above, the additional annual pumping cost due to the longer pipeline would

be about $43 (= 2.5 x $17) if just well NTUA #1 is relocated, and $318 per year (= 2.5 x $127) if the nearest wells, NTUA #1 and BIA #3, are both moved, etc.

However, as noted in HRI's response to the NRC's Q3 / 95 (attached), there would be additional operating costs for the **existing** Town water wells due to a lowering of the piezometric surface caused by mining and restoration at HRI's Crownpoint and Unit 1 properties. If any of the Town wells are moved away from HRI's operation, then these additional operating costs would be lessened. Using Table Q3/95 -1, the weighted average (weighted by flowrate) of the lowered fluid levels for the five nearest Town wells, with both Crownpoint and Unit 1 ISL properties operating, would be 75 feet. The maximum decrease in water levels for Section 8, mentioned above as the most likely area for relocated water wells, would be about 62-63 feet, or 12 foot less, as estimated from Attachment 60-2, part of HRI's response to NRC's Q1/60. This would be about 16% decrease in additional operating costs, or about $715 as calculated from Table Q3/95-1.

The topographic elevations in Sec. 8, T17N, R12W generally range from +6,850 feet MSL to +6,900 feet. The elevations of the Town water wells range from +6,795 feet MSL at NTUA Littlewater to +7,005 feet at BIA #5 (as reported in Table 3, Pump Test Analysis - Crownpoint Project, Appendix D, Crownpoint Project - *In Situ* Mining Technical Report - July 1996). Well NTUA Conoco, at +6,860 feet MSL, represents the most likely location for connecting a pipeline from the northeast (Section 8). Since this is within the +6,850 to +6,900 feet surface elevation of Section 8, there should be no additional pumping costs associated with change in surface elevation.

If you have additional questions, please contact me.

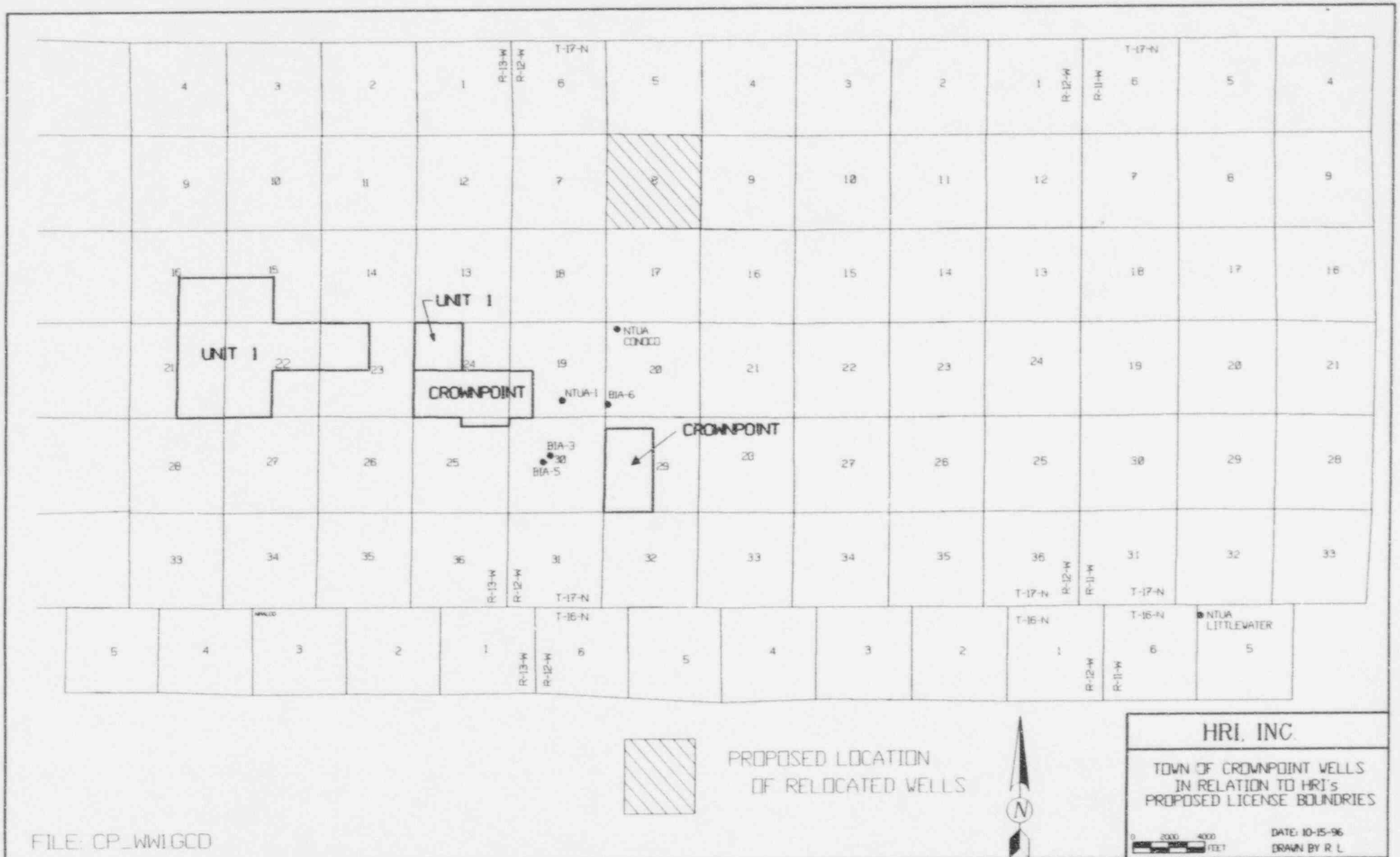
Sincerely yours,

Craig S Bartels

Craig S. Bartels
VP - Technology
HRI, Inc.

cc: Tony Thompson - HRI
Mark Pelizza - HRI
Joe Holonich - NRC
Bob Carlson - NRC

FIGURE 1


T-17-N
R-13-W
R-12-W
R-11-W
T-16-N
UNIT 1
UNIT 1
CROWNPOINT
CROWNPOINT
NTUA
CONOCO
NTUA-1
BIA-6
BIA-3
BIA-5
NTUA
LITTLEWATER
PROPOSED LOCATION
OF RELOCATED WELLS
N
HRI, INC.
TOWN OF CROWNPOINT WELLS
IN RELATION TO HRI's
PROPOSED LICENSE BOUNDRIES
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Q3 - NRC STAFF REVIEW COMMENT

Q3/95 Comment: Effect of Groundwater Drawdown on Town of Crownpoint Wells

DISCUSSION: The applicant modeled drawdown effects due to mining and restoration activities from the combined effect of the Crownpoint and Unit 1 properties in their response to NRC Comment 60 (HRI 1996). The cumulative drawdown at the end of 21 years of mining at both Unit 1 and Crownpoint is shown in Attachment 60-1 of the applicant's response. This model projects a drawdown effect of 55 feet on well NTUA-1 (49 to 55 feet for the area of the town wells). The maximum projected drawdown from mining and restoration at the two properties is anticipated to occur after 17 years, and produces a drawdown effect of 80 feet on well NTUA-1 (70 to 80 feet for the area of town wells). However, the applicant does not describe the effect of the predicted drawdown on the town well's ability to continue to supply water for the town of Crownpoint. This information is needed to evaluate impacts to the cost of pumping and potential impacts to well yields.

ACTION NEEDED: Describe the potential pumping cost and well yield impacts on the town well's ability to continue to supply water for the town of Crownpoint due to projected drawdowns as a result of (1) the combined effect of mining and restoring the Unit 1 and Crownpoint properties, (2) mining and restoring only the Unit 1 property, and (3) mining and restoring only the Crownpoint property.

REFERENCES:

HRI, 1996, transmittal to Joe Holonich (NRC) titles, "Request for Additional Information Questions 49-91, Water Resources Protection and Cost/Benefit Analysis; Safety Analysis Review and Environmental Review for Hydro Resources, Inc." dated April 1, 1996.

RESPONSE:

Generally, the amperage used by submersible pumps in water wells is nearly constant over the lifting range differences (drawdown) which have been demonstrated will result from the operation of the Crownpoint/Unit 1 ISL mines (Q1/60) for the pumping flowrates specified in Q1/50. Practically speaking there will be very little (if any) increase in actual amperage drawn by the submersible pump motor in the NTUA #1 well during operations because of mining activities. Certainly, inefficiencies in the well itself such as electrical problems and wellbore damage will have a far greater effect on pumping cost.

However to be conservative, HRI presents the following worst case analysis of the most affected well during operations. The following equation is used to calculate ADDITIONAL $ / year required to operate the submersible pump in Well NTUA #1:

$$\frac{\$}{\text{year}} = \frac{(\text{gpm})\ (\text{head, feet})\ (0.746\ \text{kw/hp})\ (1440\ \text{min/day})\ (365\ \text{day/yr})\ (\$/\text{kw-hr})}{(3960)\ (60\ \text{min/hr})\ (\text{pump efficiency})\ (\text{motor efficiency})}$$

This equation assumes that the increase in hydraulic horsepower, required to pump the average 27.7 gpm flowrate of NTUA #1 (cost for other wells can be calculated with the same equation) an additional vertical height because of the lowered water level at that well, is reflected completely as an increase in yearly pumping costs (shown in Table Q3/95-1).

It is unlikely that the submersible pump will actually need to be lowered into the well as a result in the drop of the pumping fluid level. However, if additional pipe will be needed to lower the submersible pump, HRI will estimate a one time cost of $5000.00 for this work. Again, this cost is conservative because the additional pipe would normally be added during routine well servicing at the nominal cost of the pipe.

Adequate water column exists in the Crownpoint area to assure that well yield will not be affected with even the worst case drawdown. (i.e. if current water column is 1500 ft. then 1420 ft. will still be available). The Crownpoint water wells run intermittently. Therefore, even if there was a minor decrease in yield rate as a result in water level change, it could be compensated for simply by pumping the well a little longer. These additional pumping costs are reflected in the annual cost stated in Q3/95-1.

TABLE Q3/95-1

Table Q3/95 - 1

Conservative Case Showing Additional Pumping Cost per Year Due to Lowered Water Levels at Crownpoint Town Water Wells Caused by ISL Mining & Restoration at Crownpoint / Unit 1

Crownpoint Town Well	Average Summer Flowrate (gpm)	Additional Cost Due to Crownpoint ISL Operation		Additional Cost Due to Unit 1 ISL Operation		Additional Cost Due to Crownpoint & Unit 1 ISL Operation	
		Drawdown (feet) [1]	Annual Cost ($)	Drawdown (feet) [3]	Annual Cost ($)	Drawdown (feet) [2]	Annual Cost ($)
BIA #3	79.4	53	$926	25	$437	78	$1,363
BIA #5	6.2	53	$72	25	$34	78	$106
BIA #6	100	51	$1,122	22	$484	73	$1,606
NTUA #1	27.7	55	$335	25	$152	80	$488
NTUA Conoco	58.7	44	$568	26	$336	70	$904

[1] Drawdown (feet) due to operation of HRI's Crownpoint ISL; estimated from figure shown as Attachment 60-1, HRI's response to NRC Q1 / 60.

[2] Drawdown (feet) due to operation of HRI's Crownpoint & Unit 1 ISL; estimated from figure shown as Attachment 60-2, HRI's response to NRC Q1 / 60.

[3] Drawdown (feet) due to operation of HRI's Unit 1 ISL; estimated by subtracting [1] from [2].

Typically, electrical amperage required by a submersible pump is reasonably constant over a wide range of flowrates. However, conservatively assuming that amperage varies with hydraulic horsepower, the cost per year would be calculated as follows:

$$\frac{\$}{\text{year}} = \frac{(\text{gpm})\ (\text{head, feet})\ (0.746\ \text{kw/hp})\ (1440\ \text{min/day})\ (365\ \text{day/yr})\ (\$/\text{kw-hr})}{(3960)\ (60\ \text{min/hr})\ (\text{pump efficiency})\ (\text{motor efficiency})}$$

75% <-- Submersible pump efficiency (%).
75% <-- Motor efficiency (%).
$0.075 <-- Cost per Kw-hr ($).

ADDITIONAL INFORMATION REQUEST
HYDRO RESOURCES, INC. IN-SITU LEACH URANIUM MINE
CROWNPOINT, NEW MEXICO

ISSUE: Water Resource Protection

Comments Applicable to
Crownpoint, UNIT 1, and Churchrock

50. Degradation of Crownpoint Water Supply Wells By Restored Solution Mine Ground Water

Discussion - Given the location of the license boundaries, ground water degraded by solution mining activities, even after restoration, might degrade the town of Crownpoint water supply. Mining in the Crownpoint mine units would occur on minerals operating leases in Section 24, extending eastward into Sections 19 and 29, T17N R12W (Reference 1, page 1-3). Pumping from the town of Crownpoint water supply wells causes ground water under the Crownpoint mine units to flow towards the water supply wells in Crownpoint (Reference 1, page 3-12). The town of Crownpoint is supplied by 5 wells BIA-5, BIA-3, BIA-6, NTUA-1, and NTUA-2. All of these wells pump water from the West Water Canyon Member. Two of the wells, NTUA-2 and BIA-5, are located no more than 2,640 ft. (1/2 mile) outside the licensed boundary. Well BIA-3 is located approximately 1,760 ft. outside the licensed boundary. Well BIA-6 is located just outside the boundary, and well NTUA-1 is located inside the boundary (Reference 2, Figure 2.3-1, page 27). The Crownpoint site is located so close to the town of Crownpoint, that pumping from the town wells causes the water levels under the Crownpoint site to move up and down (Reference 2, pages 47-54). The Crownpoint site is located on three sides of the town of Crownpoint (north, east, and west) (Reference 1, page #1-5). This means that water moving into the wells from the north, east, and west will be processed by solution mining activities and then could move a relatively short distance to the town of Crownpoint water supply wells.

Solution mining activities may be conducted anywhere within the site boundary. Crownpoint Well NTUA-1 is located inside the site boundary and BIA-6 is located at the edge of the site boundary. This means that there would be little or no delay in water processed by solution mining activities to reach these wells.

It is stated in the Draft Environmental Impact Statement (reference 1, page 3-5) that in the first 5 years of operation, well fields would be found 300 m (1000 ft) from the nearest residences and monitor wells would be found as close as 200 m (650 ft). It is further stated that municipal drinking water supply well NTUA-1, is found in the Crownpoint leases and is located approximately 650 m (2100 ft) east of the initial well fields. It is also stated (Reference 1, page 3-18) that in the initial 5 year mine plan monitoring wells would coincide with the location of well NTUA-1.

Few *in-situ* mines restore the ground water to baseline conditions. Most successful restorations are to the water use or average water quality standards. Furthermore, the approach used to determine a successful restoration has varied from mine site to mine site. At commercial *in-situ* mining sites, small volumes of water are sampled (either from wells or plant pipes and tanks) to determine when restoration parameters have been achieved. At best these are statistically based conclusions, which cannot guarantee that some contaminated ground water has not been left in the ground. However, most in-situ mines are in remote locations. This means that if some water has not been restored, there is significant time and distance for the water to reequilibrate to its natural water quality before it reaches a public water supply. However, at the Crownpoint site, this buffer of time and distance may not exist and therefore, it is possible that after restoration, contaminated ground water might reach the town water wells.

Action Needed: Demonstrate that ground water degraded by solution mining activities, even after restoration for both of the UNIT 1 and the Crownpoint properties will not degrade the town of Crownpoint water supply (mining over the whole of both properties should be considered, not just the first 5 years at the Crownpoint property).

Response

Effect of License Area Boundary Modification Eliminates Affected Water Wells

The basic concept and regulation of in-situ mining industry have been designed to protect the fresh groundwater supplies that may be located near an in-situ mine. The controls in place both during mining and restoration have been shown to protect groundwater away from the mine. To arbitrarily state that mines in remote areas away from water supply wells are inherently safer, implies that residual contamination is acceptable in such areas but not in others. This implication would appear to be contrary to the goal of the regulations.

The discussion portion of this issue statement makes numerous references to wells within or just outside the license area boundary. As stated in Response #49, the license area boundary has been redrawn, which effectively increases the distance from proposed in-situ mining activities and the five town water wells. The resulting distances are illustrated in Table 50-1. As shown, the closest water supply well to the in-situ mining license boundary is 1500 feet for the Crownpoint project and 11,000 feet for UNIT 1. This distance should be used for the potential impact analysis.

TABLE 50-1
Distance and Water Flow Time
Crownpoint and UNIT 1

Well	Closest to Crownpoint	Closest to UNIT 1*	Crownpoint Flow Time	UNIT 1 Flow Time
BIA 1	1800	11,000	NA **	NA **
BIA 3	3100	12,000	NA **	NA **
BIA 6	1500	13,800	35.6 years	1,657.5 years
NTUA 1	1700	11,100	90.4 years	2,616.43 years
NTUA 2	5000	13,200		NA **

* Excluding NW/4 24
** Will not pull water due to well configuration (not applicable)

In-situ mining activities have commonly occurred in aquifers where water supply wells are of similar distances as stated above. These other in-situ activities have been conducted without any reported deterioration of water quality.

Federal and state Underground Injection Control (UIC) programs have defined the appropriate Area of Review for Class III wells, as proposed herein, as 1/4 mile. (See 40 CFR 146.6 and NMWQCCR 2.202.) The distances shown in Table 50-1 all exceed the 1/4 mile area of review distance.

Water Level Fluctuations Do Not Imply Increase Contamination Potential

In the discussion portion of this issue statement, NRC noted a correlation between water levels in observation wells at the project, and closeness to the town water wells. While the correlation between water levels and town water wells is evident, there is not evidence of potential contamination - only that good horizontal transmissivity exists - as also demonstrated in the hydrologic testing. In confined aquifers, rapid water level response is evident over a much greater distance and more quickly than is possible for physical movement of water molecules. Water levels may fluctuate distinctly over many miles, where the potential for physical water migration is extremely remote. For this reason, HRI, Inc. utilized water level measurements (increases) in monitor wells as a precursor to leach solution migration.

Rate of Water Movement Is Very Slow

As stated under the previous heading, the degree of water level change is not reflective of the rate of water level movement. Table 50-1 illustrates the travel time for water to move from the closest license area boundary from Crownpoint and UNIT 1, and individual water wells, under worst-case conditions. Worst-case conditions assume all mine bleed stops, pumping of existing water supply wells continues at present rates, and water is allowed to migrate in the subsurface without any corrective action taken. Given these circumstances, water will require 35.6 years to migrate from the closest Crownpoint license boundary to the closest well (BIA 6) and 1,657.5 years to migrate from the closest UNIT 1 boundary to NTUA 1. For the purpose of this illustration, the NW/4 of Section 24 is presumed to be part of the Crownpoint Property. Models illustrating these migration rates are within Attachments 50-1 and 50-2.

This analysis is unrealistically conservative, because if NRC or NMED were unsatisfied with the companies operational performance , be operational monitoring or restoration, corrective action would be taken long before the times stated above were exceeded and the water supply wells would not be affected.

Restoration To Pre-Mining Standards Is Assured

NRC has acknowledged that successful restoration to pre-use standards is assured. This correct statement is based on fact; including applicant and industry restoration experience, experience by Mobil Oil, who operated an in-situ Pilot in the Crownpoint area, and by core studies conducted by HRI, Inc.

Therefore, the question becomes: will the level of restoration proposed for the project, i.e., the restored water quality, be protective of the public water supply? In considering previous use standards in the Crownpoint/UNIT 1 area, one must consider the quality of the water in the mine area which will be affected. The area where mining will occur will be classified as an exempted aquifer by the EPA (per 40 CFR) 146.4 before mining can begin. To qualify for exempted aquifer status, certain criteria shall be met, including:

(a) It (the portion of the aquifer where mining will be conducted) does not currently serve as a source of drinking water, and

(b) It cannot now and will not in the future serve as a source of drinking water because:

(1) It is mineral, hydrocarbon or geothermal energy producing, or can be demonstrated by a permit applicant as part of a permit application for a Class II or III operation to contain minerals or hydrocarbons that considering their quantity and location are expected to be commercially producable.

(2) It is situated at a depth or location which makes recovery of water for drinking water purposes economically or technologically impractical;

(3) It is so contaminated that it would be economically to technologically impractical to render that water fit for human consumption; or

(4) It is located over a Class III well mining area subject to subsidence or catastrophic collapse.

When considering potential limitations that migration of the water from the mine zone may have on outside water supply wells after restoration, it is important to note that similar, if not identical, water quality limitations exist prior to mining as will exist after restoration due to the natural occurrence of the uranium orebody. The conditions of 40 CFR 146.4 cannot be met if the portion of the aquifer is not mineralized. HRI, Inc.'s experience that the radionuclide concentrations limit the use of water (RA-226, RN-222 and U_3O_8) before mining in uranium-bearing aquifers. These are also the primary parameters of concern to NRC (See Question #52) after restoration. Currently, the presence of high radionuclide concentrations do not affect surrounding water supply wells because these parameters are not mobile and remain in the orebody, not in the water supply wells. This fact will remain the same, with or without mining.

Restoration Operations Are Engineered Soundly
The Sampling And Verification Is Performed Statistically

The restoration of ground water in an in-situ wellfield has the benefit of a previously engineered array of injection and production wells that were initially installed in a configuration to maximize sweep efficiently throughout the uranium orebody, and maximize uranium recovery. The same engineering principals hold for maximum sweep efficiently during the restoration phase.

The efficiency of ground water sweep between injection and production wells can be and is modeled before a wellfield is installed. This is performed by streamline modeling. An example of streamline modeling of an individual ore zone for the Crownpoint project is shown in Attachment 50-4. Here we see that while individual wells cover a statistically small area, the radial flow of the injection and extraction fluid swept the entire orebody. It matters not whether the operations are conducted during the restoration or production phases, the reservoir engineering principle associated with wellfield design are the same.

In summary, ground water restoration is performed uniformly throughout the mine zone and verified statistically at individual sampling points. The confidence of the statistics can be increased by increasing sampling points (more wells) or increasing samples (stability period). However, the scientific principle which assures restoration is sound.

Ground water Chemistry Will Be Changed Slightly,
But Changes Will Not Affect Its Use

Leach solution is not significantly different than native ground water within the orebody.

The leaching solution utilized by HRI, Inc., is simply ground water fortified with oxygen. The leaching solution is benign compared to acidic leading solution or ammonia bicarbonate leaching solution that were used in earlier in-situ operations. Early leach solutions had the common trait of introducing foreign substances to the ground water during mining, which ultimately caused restoration difficulties. The proposed leaching solution for this project simply changes the oxidation state of the ground water and utilized natural ionic materials within the water as a complexing agent. pH remains neutral and restoration is centered around reducing naturally occurring constituents in ground water which become elevated as a result of the leaching process.

This section will focus on the anticipated parameter which will be elevated, their successful track record in restoration, the effect on ground water and recommendations for evaluation.

Secondary Parameters

The success of restoration of secondary (aesthetic) parameter is well documented in HRI, Inc's Crownpoint core study, the Mobil Pilot test and with industry experience in general. Using information from the Mobil Section 9 Pilot as a conservative case the Table 50-2 shows the values of secondary parameters after approximately 4 and 10 volumes of restoration.

TABLE 50-2				
Parameter	At 3.92 Value PV	At 9.7 PV	Baseline	NM 3-103 STANDARD
CA	55	38	14.2	NONE
Mg			1.1	NONE
Na	379	156	.8	NONE
K			41.2	NONE
CL	174	150	35.6	250
SO_4	348	43		600
CO_4				NONE
HCO_4	415	122	200	NONE
TDS	1050	587	394	1000

Following restoration, none of these secondary parameter values exceeds NMWQCC 3-103 drinking water standards, and would not effect the use quality. As a matter of evaluation, these values may be noteworthy in terms of environment change, but they do not affect public health.

Trace Metals

HRI does not anticipate that most trace metals will be present in the in-situ leach solution. Mobil's Section 9 Pilot showed three traces metals which were elevated during in-situ leaching as shown in Table 50-3:

TABLE 50-3			
Parameter	Before Restoration	After Restoration	NMWQCC 3-103
As	.054	.032	.1
Se	4.6	.032	.05
Mo	62	1.18	1

Values for parameters a As and Se were restored to NMWQCC 3-103 standards. Moly remained above the NMWQCC 3-103 standard.

HRI's Crownpoint core study has show that Se and Mo will not be elevated during mining to the extent it was at the Mobil test. This assumption is supported by the geochemistry of Tertiary age Crownpoint/Unit 1 orebodies in our applications, and in the DEIS. HRI's core study showed restoration of all trace metals to below NMWQCC 3-103 standards, Therefore, if restoration is conducted to the demonstrated levels, residual trace metal concentrations will not effect public water supply quality above drinking standards.

Radionuclides

Radionuclides especially uranium will be elevated during the mining process. They are also the most significant parameter limiting premining use of the water. Restoration of these parameters in HRI, Inc.'s core study, Mobil's Pilot and in general industry experience results in premining use levels after restoration. As a conservative case, example of uranium and radium values in Mobil's Pilot are as follows:

TABLE 50-4			
Parameter	Value After 4 PV.	NMWQCC 3-103	[1]Mobil Restoration Standard
U	4	5	5
Ra-226	51.8	30	97.2

1. Crownpoint Restoration Declaration and Water Quality Document, Mobil, November, 1986

Mobil restored uranium to the 4 ppm range in 4pv and 1 ppm shortly thereafter, starting at a very high value of 145 ppm, because ore reserves were not depleted. Restored values achieved, are consistent with typical pre-mining uranium concentrations at other in-situ facilities and below New Mexico WQCC 3-102 standards.

RA-226 was restored to the 50 ppm range. This value is above NMWQCC 3-103 standards. However, radium is a parameter that nearly always exceeds these standards before operations.

Examples of pre-mining average RA-226 levels at URI in-situ mines read as follows:

Texas	Benavides	105
	Longoria	67
	Kingsville Dome	56.5
	Rosita	156.5
Wyoming	North Platte	135.8 pCi/l
Average	URI Projects	104.2 pCi/l

Mobil's restoration of radium and HRI's core restoration were both below the average concentration for radium stated above, which is expected based on other HRI operations. Therefore, we anticipate post-restoration results for Ra-226 will not have an effect on water quality.

Trace Metal Radionuclide Parameters Will Equilibrate Before Water Can Reach Public Wells

Se and As are immobile in the reduced state. As they move from the oxidation source they become insoluble and their concentration will decrease. At the Crownpoint site, in the production zone proper, the concentrations of these parameters will be below drinking after restoration. These parameters will further decrease in concentration as they migrate through reduced sediments.

Radionuclide attenuation is rapid and well documented. Uranium is not soluble in the reduced state. The formation of these uranium orebodies is a result of this fact. NRC made this observation in Question #55 where it was noted that uranium was not mobile outside the oxidized ore zone and should be replaced. Uranium in the orebody proper will be restored to NMWQCC 3-103 standards and therafter will be further reduced in concentration as it moves from the orebody and will not affect water supply wells.

RA-226 attenuation is rapid, and well documented. RA-226 which is found in orebodies, stays there and does not even effect monitor wells hundreds of feet away.

Examples of Average Radium values at URI, Inc.(HRI, Inc.'s Texas affiliate) project monitor wells which are completed in the operating horizon which have been demonstrated to be in hydrologic communication through regulator testing, are shown below:

		pCi/l Orebody	**pCi/l Surrounding Mine**
Texas	Benavides	105	9.8
	Longoria	67	24.5
	Kingsville Dome	56.5	8.2
	Rosita	156.5	16.5

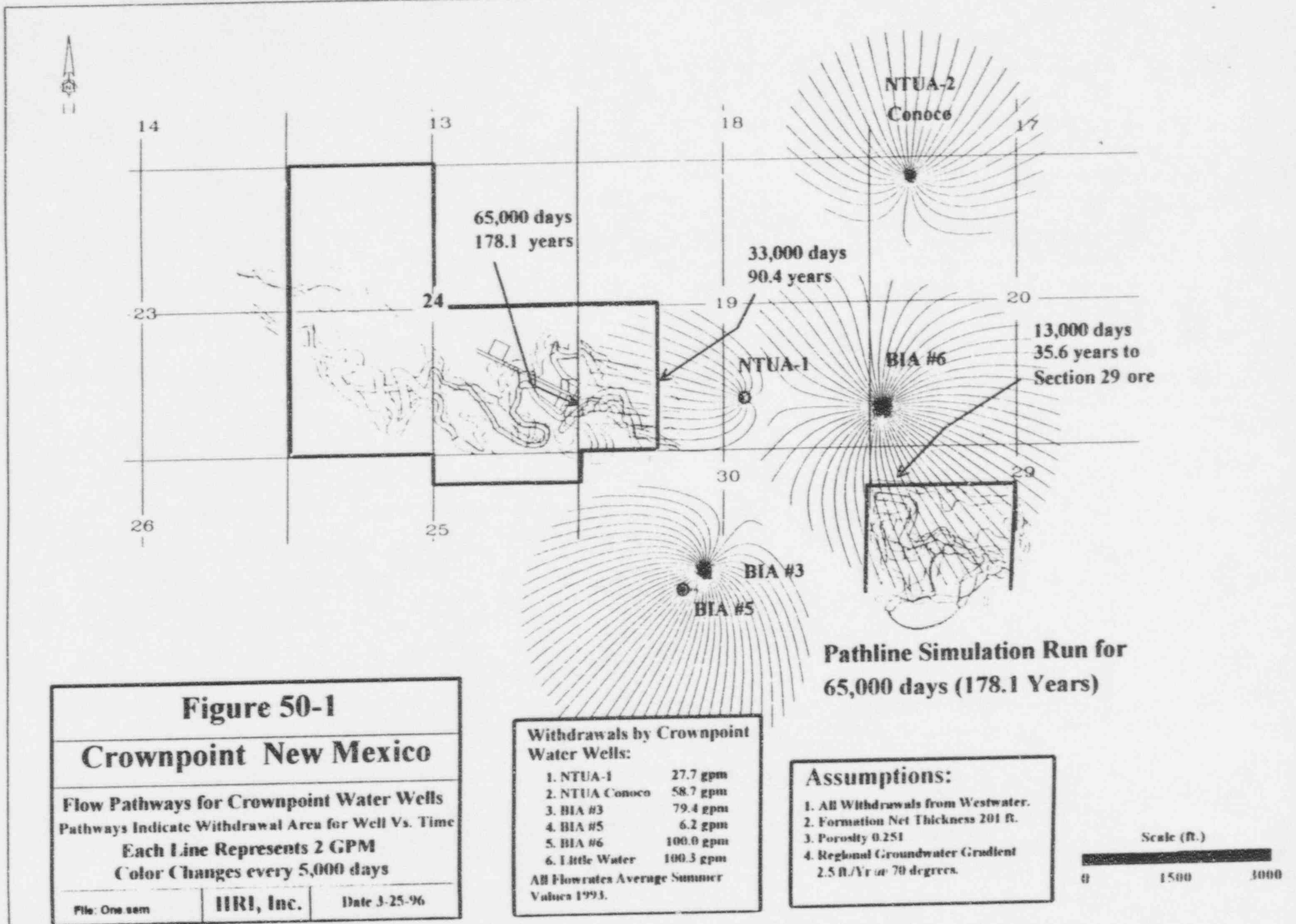
As shown most RA-226 stays proximal to the ore. At the Crownpoint project RA-226 is currently coexistent with the ore (see values in CP-2). The radium has not affected any water supply well, in the town of Crownpoint even with years of production from these wells. A recent radium analysis from NTUA #1, the closest well to the uranium orebody, is within Attachment 50-4.

Conclusion To Issue
Contamination Of Water Supply Wells Is
Physically Impossible

1. Restoration will be completed to pre-use quality, even with minor changes in chemical quality.

2. Attenuation will occur for oxidation products and/or radionuclides.

Attachment 50-1


NTUA-2
Conoco
14
13
18
17
65,000 days
178.1 years
33,000 days
90.4 years
24
23
19
20
13,000 days
35.6 years to
Section 29 ore
NTUA-1
BIA #6
30
29
26
25
BIA #3
BIA #5
Pathline Simulation Run for
65,000 days (178.1 Years)
Figure 50-1
Crownpoint New Mexico
Flow Pathways for Crownpoint Water Wells
Pathways Indicate Withdrawal Area for Well Vs. Time
Each Line Represents 2 GPM
Color Changes every 5,000 days
File: One.sem
HRI, Inc.
Date 3-25-96
Withdrawals by Crownpoint Water Wells:
1. NTUA-1 27.7 gpm
2. NTUA Conoco 58.7 gpm
3. BIA #3 79.4 gpm
4. BIA #5 6.2 gpm
5. BIA #6 100.0 gpm
6. Little Water 100.3 gpm
All Flowrates Average Summer Values 1993.
Assumptions:
1. All Withdrawals from Westwater.
2. Formation Net Thickness 201 ft.
3. Porosity 0.251
4. Regional Groundwater Gradient 2.5 ft./Yr @ 70 degrees.
Scale (ft.)
0
1500
3000

Attachment 50-2

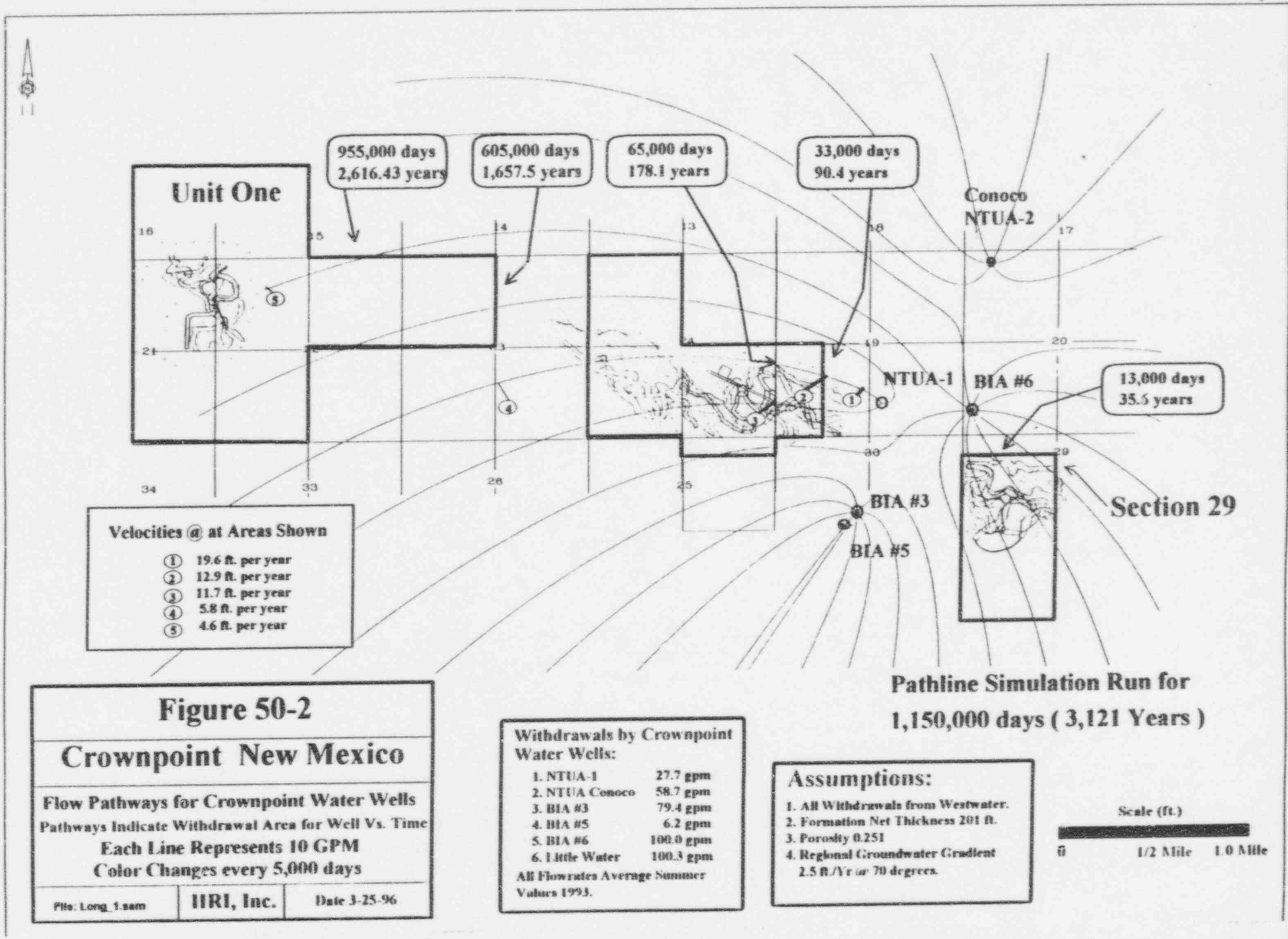


Figure 50-2

Crownpoint New Mexico

Flow Pathways for Crownpoint Water Wells

Pathways Indicate Withdrawal Area for Well Vs. Time

Each Line Represents 10 GPM

Color Changes every 5,000 days

File: Long_1.sam | HRI, Inc. | Date 3-25-96

Attachment 50-3

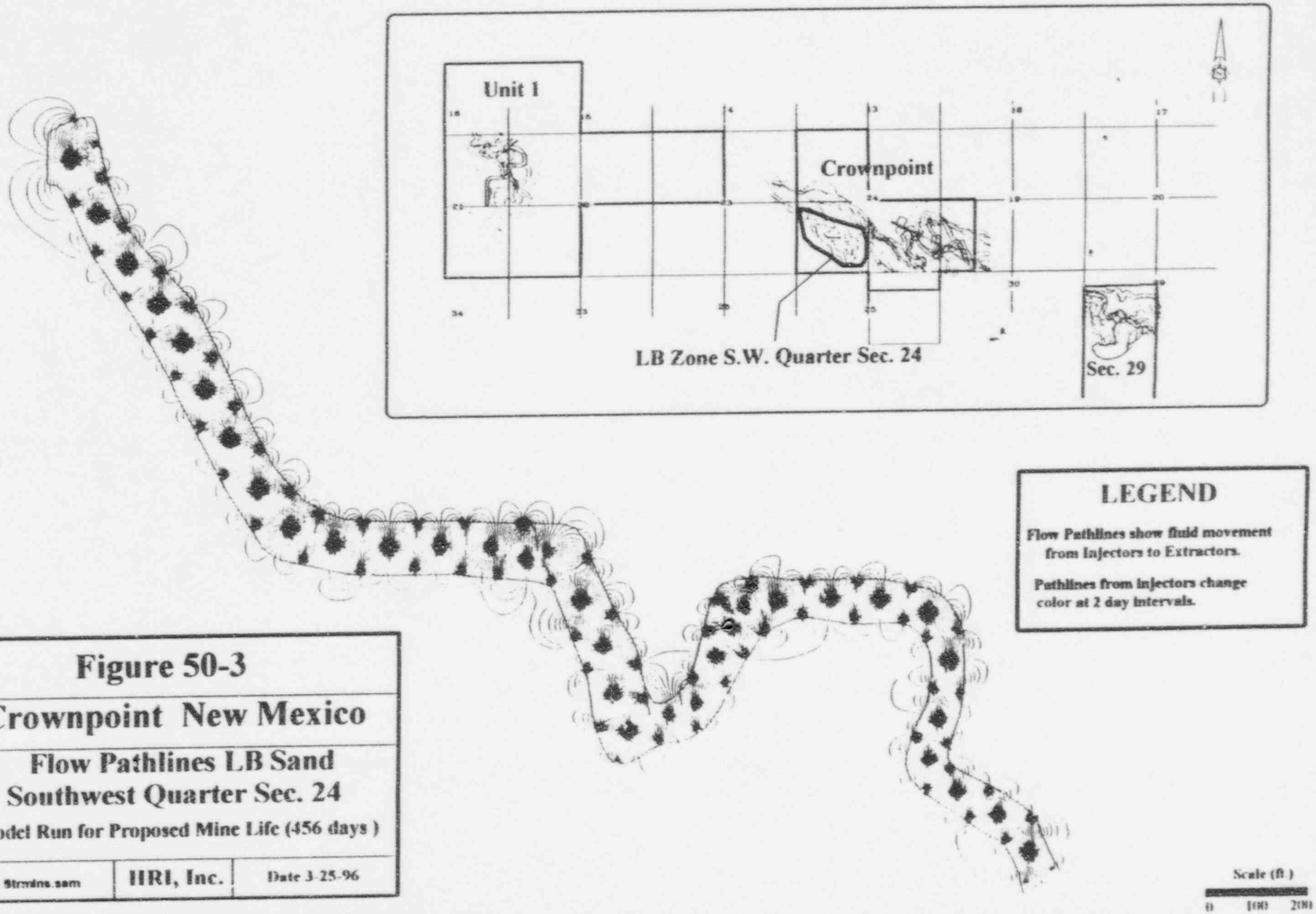


Figure 50-3

Crownpoint New Mexico

Flow Pathlines LB Sand Southwest Quarter Sec. 24

Model Run for Proposed Mine Life (456 days)

File: Strmlns.sam	HRI, Inc.	Date 3-25-96

Attachment 50-4

JORDAN LABORATORIES, INCORPORATED
ANALYTICAL & ENVIRONMENTAL CHEMISTS
CORPUS CHRISTI, TEXAS
MAY 28, 1993

URI, INC.
12377 MERIT DRIVE, SUITE 1210, LB12
DALLAS, TEXAS 75251

REPORT OF ANALYSIS

IDENTIFICATION: CROWNPOINT
NTUA #1 WATER
5-10-93

METHOD NUMBER			ANALYST	ANALYSIS DATE
EPA 600 160.1	TOTAL DISSOLVED SOLIDS (DRIED @ 180 DEG.C), MG/L -	327	T.STRAUSS	05-13-93
SM 7500-RA C	RADIUM 226, PCI/L ------------	0.3	D.STRAUSS	05-24-93
	COUNTING ERROR, PCI/L - +/-	0.1		

LAB. NO. M31-4044

RESPECTFULLY SUBMITTED,

CARL F. CROWNOVER

ADDITIONAL INFORMATION REQUEST
HYDRO RESOURCES, INC. IN-SITU LEACH URANIUM MINE
CROWNPOINT, NEW MEXICO

ISSUE: Water Resource Protection

Comments Applicable to
Crownpoint, UNIT 1, and Churchrock

60. Ground Water Drawdown Over Life of Project

Discussion - The application (Reference 3) contains a calculation of drawdown effects for the Churchrock property over its predicted 8 years of operation. However, the application does not contain a calculation of drawdown effects for the Crownpoint property for its full 20 years of operation and does not contain one for the UNIT 1 property at all.

Action Needed: The maximum drawdown effects over the life of the operation need to be calculated for each of the three sites. In addition the maximum drawdown effects on the Crownpoint public water supply wells due to the combined groundwater withdrawals of the UNIT 1 and Crownpoint properties should be calculated for the life of the project.

Response

The drawdown effects of the mining at Crownpoint and Churchrock were determined at the end of several years of mining with an analytical flow model based on the Theis equations and assumptions. The calculated drawdowns are based on non-steady state flow equations with no recharge boundaries. Due to the extended time of the runs, this model becomes conservative at the point where the ideal Theis curves are asymptotic but incremental drawdown in continuing. At this time the ideal cone of influence is so that that in reality very minor vertical leakage and/or recharge boundaries would have caused an equilibrium condition in the Westwater aquifer.

Based on these factors, it is believed that the model runs for the Crownpoint and Churchrock mining areas represent the practical maximum drawdown effect that will occur at the Crownpoint municipal wells and at the Churchrock mine area. The mining at Unit 1 near Crownpoint is a great enough distance away from the Crownpoint municipal water wells that the drawdown effects will not measurably alter the current projection.

As mining proceeds and site, local, and regional groundwater trends are monitored, the changes in the groundwater regime can be more accurately predicted and the projected drawdown impacts on the Crownpoint municipal wells determined. URI is committed to mitigate any problems with the Crownpoint water supply by mining in the Crownpoint area. When projections based on actual operational data indicate future problems in this regard, URI will initiate corrective measures as necessary.

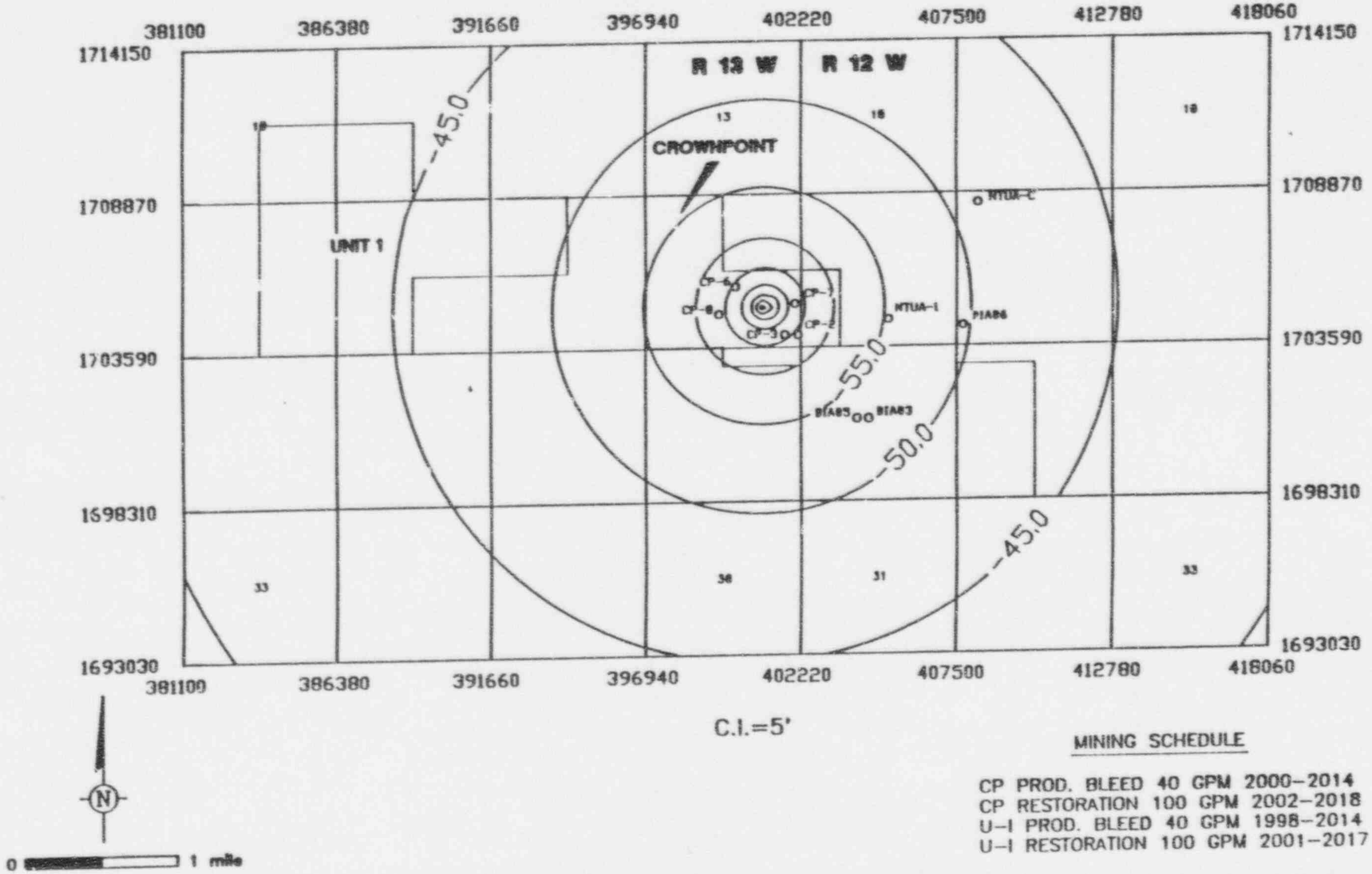
The simulations for the Crownpoint mine in Section 24 indicate a potential additive drawdown effect of approximately 17 feet at the nearest Crownpoint well (NTUA-1) at the end of restoration of wellfield 4 (see Figure 17, Reference 3). Because this mining is the closest to the Crowpoint water wells, and the projected mine plan is well defined, the need to make long-term assumptions regarding mining for 20 years was not considered to be necessary at the time that report was generated. Mining at Unit 1 is a much greater distance from the Crownpoint water wells, and any drawdown effects at the Crownpoint water wells caused by mining Unit 1 will be minor. If Unit 1 is not undergoing final restoration at the same time as the Crownpoint mine, the recovery of ground water levels at the Crownpoint mine will further reduce the drawdown impact from Unit 1. In addition, future mining at Section 29 is currently planned to occur after completion of mining at Crownpoint. The drawdown effects on the Crownpoint water wells from mining in this area will be similar to the effects from the Crownpoint simulations, however, a detailed mine plan is not available at this time. Because of the likelihood that mining in Section 29

will occur much later than the Crownpoint area, any residual drawdown effects from the Crownpoint mining area will be minimal when mining in Section 29 occurs.

In order to provide additional backup regarding the final drawdown effects caused by mining, a longer-term mine plan that includes both Crownpoint and Unit 1 was developed. This plan was conservatively developed to use the maximum amount of ground water removal for the 21 year period. Attachment 60-3 is a bar chart showing the mining plan. This plan was modeled with Aquasim to determine the maximum drawdown effect at the end of the plan. The transmissivity and storativity used in the model were 2,550 and 0.000086, respectively as used in the previous modeling. The cumulative drawdown after 21 years is shown on Attachment 60-1. Drawdown at the Crownpoint water wells ranges from 45 to 55 feet, with the maximum drawdown at a water well of approximately 55 feet at well NTUA-1. During the mining, the maximum ground water withdrawal and drawdown would occur after 17 years. Attachment 60-2 is a map showing the total drawdown at that time.

ATTACHMENT 60-1

DWG DATE: 27MAR96	PRJCT NO.: CC0340.001	FILE NO.:	DRAWING: TC	CHECKED: T. CAROTHERS	APPROVED: T. CAROTHERS	DRAFTER: LGF



C.I.=5'

MINING SCHEDULE

CP PROD. BLEED 40 GPM 2000–2014
CP RESTORATION 100 GPM 2002–2018
U–I PROD. BLEED 40 GPM 1998–2014
U–I RESTORATION 100 GPM 2001–2017

GERAGHTY & MILLER, INC.
Environmental Services

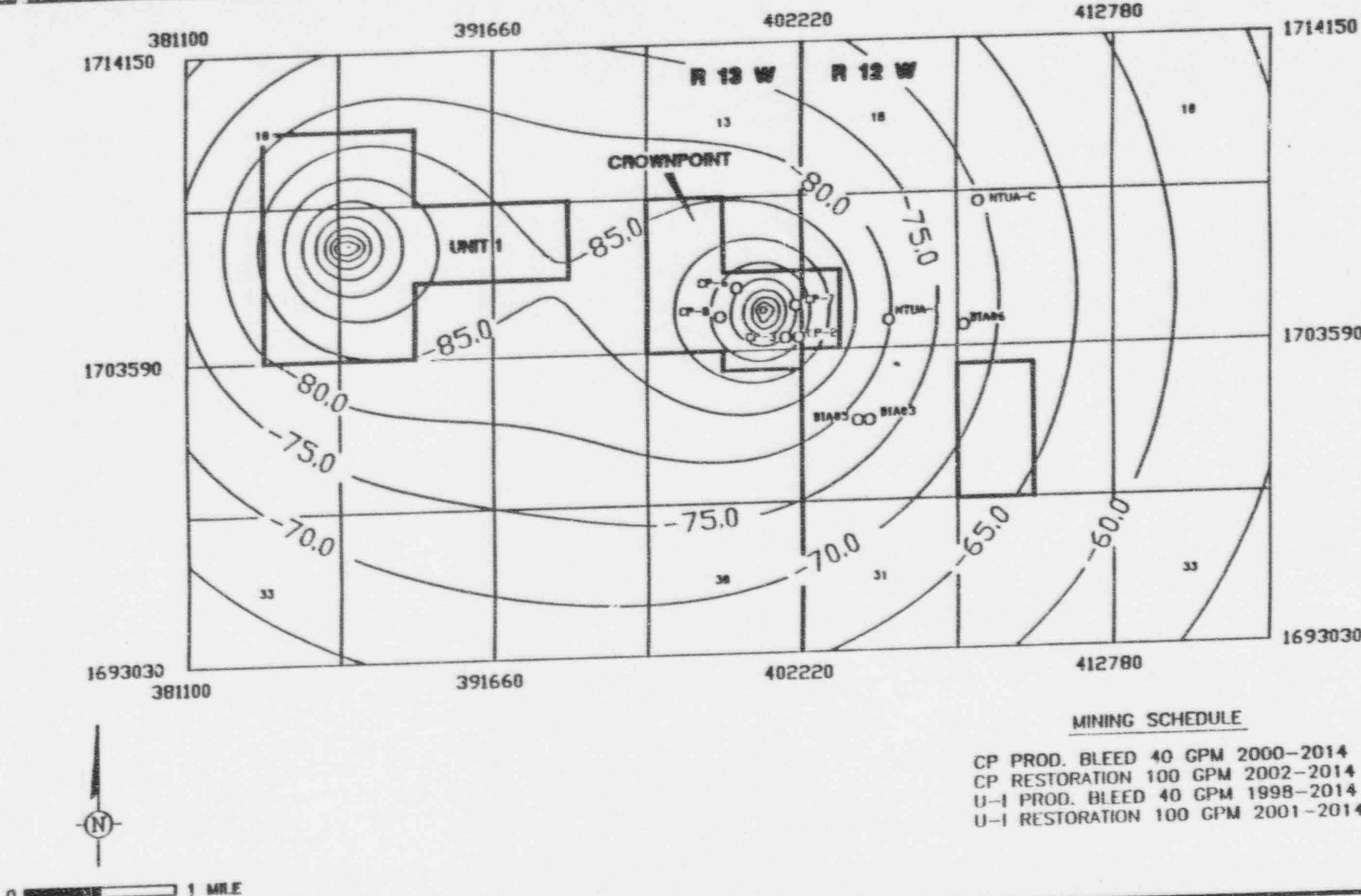
WORST CASE SIMULATED DRAWDOWN AFTER 21 YEARS MINING (2018)

HRI, INC.
CROWNPOINT, NEW MEXICO

FIGURE

ATTACHMENT 60-2

DWG DATE: 29MAR96	PRJCT NO.: CC0340.001	FILE NO.:	DRAWING: 17YRS	CHECKED: T. CAROTHERS	APPROVED: T. CAROTHERS	DRAFTER: LGF



MINING SCHEDULE

CP PROD. BLEED 40 GPM 2000-2014
CP RESTORATION 100 GPM 2002-2014
U-I PROD. BLEED 40 GPM 1998-2014
U-I RESTORATION 100 GPM 2001-2014

GERAGHTY & MILLER, INC.
Environmental Services

WORST CASE SIMULATED DRAWDOWN AFTER 17 YEARS MINING (2014)

HRI, INC.
CROWNPOINT, NEW MEXICO

FIGURE

ATTACHMENT 60-3

CP/U1 Schedule