GROUND WATER CORRECTIVE ACTION PROGRAM REVIEW

BLUEWATER URANIUM MILL
NEAR GRANTS, NEW MEXICO

Submitted by:
ATLANTIC RICHFIELD COMPANY

Prepared by
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December, 1993

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1.0 INTRODUCTION

Wick drainage of the fluids from the tailing slimes is the current ground water Corrective Action Program (CAP) required by 10 CFR Part 40, Appendix A for the main tailings impoundment at the Bluewater Uranium Mill near Grants, New Mexico. This CAP was approved by the U. S. Nuclear Regulatory Commission (NRC) and incorporated into the Material License No. SUA-1470 (License) on February 2, 1993. The License amendment requires ARCO to submit a CAP review by December 31 of each year. This report provides the CAP review required by the License amendment.

The main tailings impoundment covers an approximate area of 265 acres. The methods utilized for depositing the tailings resulted in segregation of tailings, with the coarser sands being concentrated at the south end and the fine-grained tailings (slimes) being concentrated at the north end. In 1982 ARCO installed approximately 56 wells into the tailings sands and pumped tailings liquid to reduce the seepage source term from the tailings impoundment. The dewatering activity was successful in lowering the phreatic surface in the southern portion of the tailings impoundment by approximately 30 feet. However, the slimes in the northern portion of the tailings impoundment have remained saturated. Thus, the significant source of ground water contamination remaining at the Bluewater Mill prior to final closure of the facility is the interstitial liquids contained in the slimes in the main tailings pile.

In developing closure plans, it was determined that there may be a short-term increase of the seepage rate into the ground water as the tailings are loaded for slime consolidation during reclamation. Based on the main tailings settlement analysis (Shepherd Miller, Inc), a weighted average of slime consolidation of 3.3 feet was expected to occur over the 74 acres of slime area. At 90% consolidation this could result in displacement of up to 81 million gallons of fluid. While a portion of this fluid was projected to be removed by seepage into the loading layer in the base case, the wick drainage of the 74 acre slimes area located at the north end of the tailings area was approved as the ground water corrective action program to prevent seepage to ground water of a substantial portion of this displaced tailings fluid.

2.0 CORRECTIVE ACTION ASSESSMENT

2.1 Previous Corrective Actions

Past corrective actions, including minimizing the amount of free water, use of lined evaporation ponds, removal of standing surface water, and tailings dewatering by the use of approximately 56 wells, have reduced seepage impacts significantly as demonstrated by the significant downward trends observed in constituent levels in monitor wells on site.

Use of the lined evaporation ponds reduced the source by approximately 525 million gallons of liquid containing 91,000 lbs. of uranium. The tailings dewatering program used approximately 56 wells installed in the main tailings pile to recover about 122 million gallons of liquid containing 116,000 lbs. of uranium. However, dewatering wells were effective only in the tailings sands. Well dewatering was continued to a point where yields were no longer sustainable. Surface water removal activities have also removed annually approximately 9 million gallons containing 4,000 lbs. of uranium. This removal of standing surface water following precipitation events is a practicable action which has continued during the interim stabilization period. With reclamation and placement of the cover on the main tailings pond, recharge to the main tailings will cease and any seepage of waters presently entrained in the tailings will diminish.

2.2 Corrective Action Program

License Amendment No. 6 for the Bluewater Mill, dated February 17, 1989 required ARCO to implement a CAP to meet ground water protection standards at the Point of Compliance (POC). On August 9, 1989, ARCO submitted a ground water CAP involving pumping wells in the San Andres and Alluvial aquifers.

Following approval by the NRC, the CAP was implemented and the pumped water was placed into a lined evaporation pond for evaporation treatment. Ground water quality was monitored in both aquifers at the POC and at other wells during operation of the revised CAP in order to evaluate the effectiveness of pumping. A graphical evaluation of monitoring data indicated that there was no reduction in the constituents in the ground water due to pumping. A statistical evaluation confirmed these observations. Therefore, as specified in the CAP, ARCO met with NRC on May 24, 1990 to discuss the results of the ground water pumping program. It was agreed that pumping would not reduce concentrations of the constituents in ground water at the POC and that the concentrations in ground water are As Low As Reasonably Achievable (ALARA). Since the concentrations in ground water do not pose a human health hazard at present or potential points of exposure, it was concluded that ARCO should proceed with the submittal of an Alternate Concentration Limit (ACL) Petition.

In June, 1990, ARCO compiled the results of the ground water CAP and submitted for approval a ground water ACL Petition in the form of a license amendment. On October 21, 1992, NRC notified ARCO that, due to currently unresolved issues in ACL guidance, timely approval of ARCO's ACL Petition for the Bluewater Mill is unlikely. Since ground water standards established in the license continue to be exceeded at the POC, NRC required ARCO to propose a supplemental ground water CAP in accordance with 10 CFR Part 40, Appendix A, for incorporation into the license.

2.3 Supplemental Corrective Action Program

ARCO's supplemental ground water CAP involved installation of a network of vertical band drains or wicks to reduce seepage to ground water of a substantial portion of the tailings fluid squeezed from the slimes portion of the tailings as a result of loading during reclamation. On February 16, 1993, NRC approved ARCO's proposed supplemental ground water CAP utilizing the wicks system over the 74-acre slime area of the main tailings impoundment. Installation of the wicks system as described in Section 2.2.3 of the supplemental ground-water CAP was initiated in November 1992 and completed by March, 1993.

The wicks consist of bands approximately four inches wide and 1/4 inch thick that are placed into 12 inch diameter boreholes drilled through the loading material and into the slimes within the tailings area. Penetration into the tailings was stopped approximately three to five feet above the base of the slimes, allowing the slimes below the wicks to act as a barrier to downward movement of interstitial tailings liquid from the slimes. This accomplished two objectives: (1) it minimized the potential for ground water contamination during consolidation of tailings slimes and (2) it promoted upward movement of tailings fluid allowing immobilization by evaporation and adsorption by the consolidation layer. Approximately 27,450 wicks were installed at a triangular spacing of approximate 11 feet over the slime area of about 74 acres.

3.0 SUPPLEMENTAL CORRECTIVE ACTION PROGRAM RESULTS

This review of the Supplemental Corrective Action Program was completed in accordance with the license amendment of February 16, 1993 to describe progress towards attaining ground-water protection standards. This review also provides an estimate of the quantity of tailings fluid that was removed or immobilized as a result of the supplemental CAP involving wicks.

3.1 Analysis of Effectiveness of Wicks System

This evaluation of the effectiveness of the wicks system involves estimating the quantity of tailings fluids removed by the wick system. This includes removal of tailings fluids by wick drainage to the surface and subsequent evaporation and by adsorption within loading materials.

After wicks were installed, the interstitial fluid in the slimes under pressure from loading was observed to rise via the path provided by the wicks. Excess fluids were observed reaching the top of the loaded material in most of the 27,450 wick locations although the timing for reaching the surface and quantity of excess fluid appeared to vary. Excess water was observed to pond on the surface where the water evaporated. Ponded water was observed to extend over an area ranging from one third to one half of the slimes area during the period from March 1 until early July. Although it was not possible to actually measure the quantity removed by evaporation at the surface, a reasonable estimate can be obtained from pan evaporation data collected at the site over this same time interval.

Net evaporation measurements for the time period March, 1993 through June, 1993 are summarized below:

Time Period	Net Evaporation (inches)
March	5.10
April	8.66
May	9.13
June	12.96
March-June	35.85

Given free water surface evaporation of 35.85 inches over an average area of about one third of the 74 acre slimes area, results in over 24,000,000 gallons of water removed by evaporation at the surface. This estimate is reasonable but conservative because it is based on ponding over only an average of one third of the area and does not include the evaporation from wet soils which would have occurred over much of the remaining portion of the slimes area during this same time interval. This estimate is also consistent with the salt deposits observed on the surface of the consolidation layer as well as with the visual observation of surface ponding, wet soils and site evaporation data.

Also, a significant portion of fluid from the slimes moved up into the unsaturated consolidation loading layer where these fluids have been adsorbed and neutralized by the loading materials. The quantity of tailings fluid contained by the consolidation loading layer was determined from two components:

(1) the quantity of tailings fluid which has moved into the consolidation layer and is currently found under saturated conditions in the consolidation materials, and

(2) the quantity of tailings fluid which has seeped laterally from the wicks borehole into the unsaturated portion of the consolidation layer.

The volume of tailings fluid which has been contained in the saturated portion of the consolidation layer was determined by first estimating the volume of saturated material in the consolidation layer from the ground water isopach for this layer prepared by Shepherd Miller and Associates from piezometer information obtained during July, 1993. The average thickness of the saturated portion of the consolidation layer was estimated to be 8.42 feet over an area of 74 acres. The volume of tailings fluid in this layer was determined by multiplying the volume of saturated material by the available porosity at the time the consolidation layer was placed on the tailings slimes. An available porosity of 6% by volume was determined from the average difference between total porosity and placed moisture content (by volume) of samples taken by ARCO of materials placed over the slimes during construction of the consolidation layer.

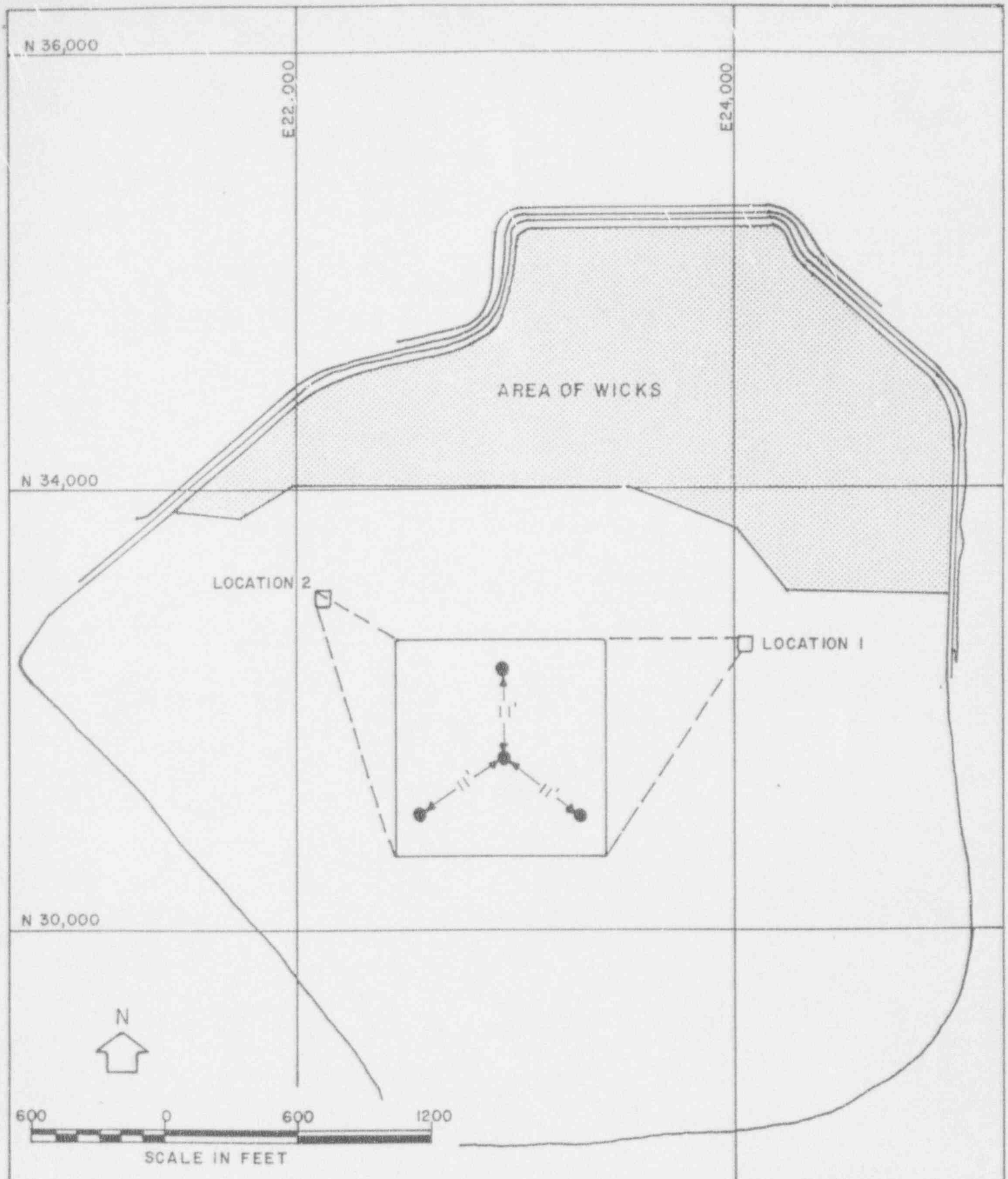
Following this approach, a volume of 12,200,000 gallons of tailings fluid has been estimated to have moved into the saturated portion of the consolidation layer from the slimes. This tailings fluid either seeped laterally from the boreholes containing the wicks or moved vertically up into the consolidation layer under pressure gradients created by loading of the slimes.

A large quantity of tailings fluid has also seeped laterally from the borehole into unsaturated portion of the consolidation layer. An estimate of this quantity can be obtained by determining the quantity which would have infiltrated from an average vertical wick drain (borehole) and multiplying this estimate by the 27,450 boreholes located within the slimes area. This quantity would be made up of the quantity of water that infiltrated the cover while the borehole was full or flowing plus the quantity of water stored in the borehole which infiltrated while water in the borehole receded.

An estimate of the volume of fluid stored within each borehole above the saturated layer of 38.66 gallons was determined for an average unsaturated zone thickness of 6.58 feet and a 12 inch diameter borehole. This results in a total volume estimate of 1,061,000 gallons for the 27,450 boreholes installed in the slimes area.

Since fluid remained in the boreholes for some period of time as water flowed to the surface in most of the boreholes, a quantity of fluid would have infiltrated in addition to that which could be stored in each borehole. Borehole infiltration tests were performed to provide an estimate of the quantity of fluid which would have seeped from the wick boreholes into the currently unsaturated portion of the consolidation layer during implementation of the CAP. These tests were conducted at two locations within the area of the tailings impoundment where wicks were not installed through the loading material and into the slime. Four boreholes were installed per location in the pattern shown on Figure 1. The boreholes were drilled to a depth of approximately 6 feet using an 11 inch diameter auger, similar to the wicks borehole. Each borehole was backfilled with pea gravel to a depth of 2 feet below surface to prevent hole collapse during the test.

The test was performed simultaneously on all four boreholes at a given location. The test consists of filling the 4 boreholes at a given location with water and maintaining the water level at a prescribed depth near the surface. The volume of water added to each borehole and the corresponding time were recorded in the field throughout the test. The tests were run for a period ranging from 7 to 10 hours and are reported in Attachment 1.



Applied Hydrology Associates, Inc.

FIGURE 1
LOCATION AND SPACING OF BOREHOLES FOR PERCOLATION TESTS

Date: 11/22/93
Project: Bluewater Mill
File: TAILINGS SETTLEMENT

The total quantities of water added during the test to maintain water level within 0.5 ft. of the surface in each borehole are summarized below:

LOCATION 1				LOCATION 2			
borehole	test duration (hrs.)	volume water (gal.)	rate (gph)	borehole	test duration (hrs.)	volume water (gal.)	rate (gph)
BH 1-1	10	3.4	0.34	BH 2-1	8	50	6.25
BH 1-2	10	7	0.70	BH 2-2	7	34	4.86
BH 1-3	10	7.4	0.74	BH 2-3	7	15.4	2.20
BH 1-4	10	7.1	0.71	BH 2-4	7	23.75	3.39
Average			0.62	Average			4.18

The results were relatively consistent among boreholes at a given location but varied considerably from Location 1 to Location 2. Nevertheless, these results suggest that significant quantities of water infiltrated the unsaturated zone while the wicks were dewatering the slimes. These results were used to establish a range for borehole infiltration. Borehole infiltration rates would be expected to decline with time even though a well defined declining trend could not be identified during the test. Assuming that borehole infiltration during the entire wick drainage period was only twice the quantity observed during these short term infiltration tests, it is projected from these tests that a conservative range for infiltration to the unsaturated zone from each borehole would be 7 to 100 gallons of water. This equates to a volume of 192,000 to 2,745,000 gallons for 27,450 boreholes located over the entire slimes area.

The total quantity of fluid which would have infiltrated the unsaturated consolidation layer from the vertical wick drains (boreholes) is estimated to be in the range from 1,250,000 to 3,800,000 gallons. In addition, it is estimated that an additional 12,200,000 gallons have been contained under saturated conditions in the consolidation layer. Nevertheless, the most significant quantity of tailings fluid which has been contained or removed by the CAP is the estimated 24,000,000 gallons that was wicked to the surface and subsequently removed by evaporation. Thus, the total quantity of tailings fluid contained or immobilized by the CAP is estimated to range from 37,450,000 to 40,000,000 gallons. This reduction in seepage to ground water of up to 40,000,000 gallons of tailings fluids is determined to be effective in removing or in preventing at least 38,000 lbs. of uranium, 275 lbs. of molybdenum, and 88 lbs. of selenium from reaching ground water in the Alluvial and San Andres aquifers.

3.2 Compliance Monitoring Results

The License amendment of February 16, 1993 requires ARCO to describe progress towards attaining ground-water protection standards. Progress toward attaining ground water protection standards is based on compliance monitoring results at the designated Point(s) of Compliance (POC). The compliance monitoring program incorporated in the License requires ARCO to:

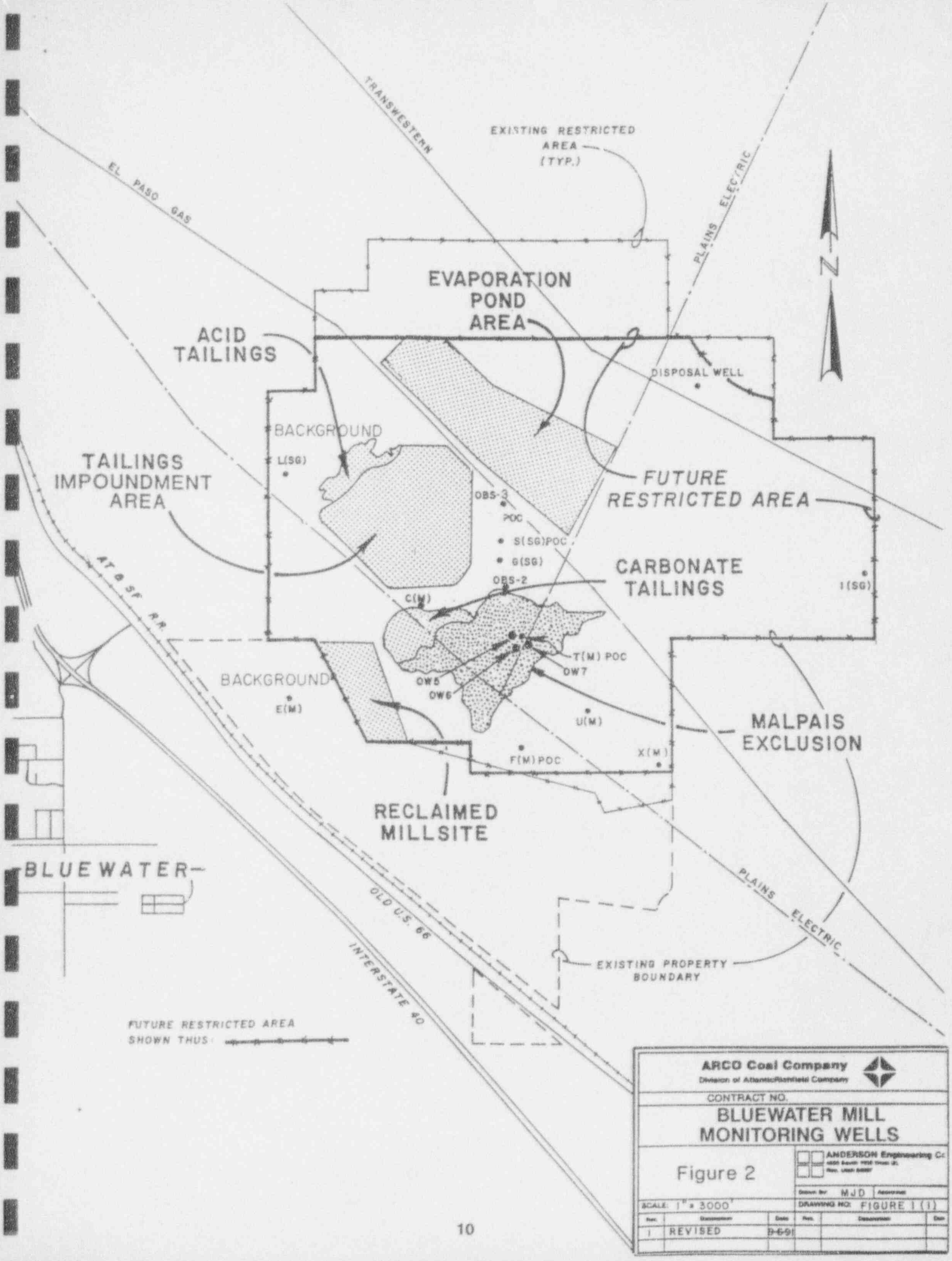
- Perform semiannual compliance monitoring of Alluvial wells E(M), T(M) and F(M) and meet compliance limits for molybdenum, natural uranium, and selenium at POC wells T(M) and F(M);

- Perform semiannual compliance monitoring of San Andres wells S(SG), L(SG) and OBS#3; and meet compliance limits for natural uranium and selenium at POC wells S(SG) and OBS#3.

Figure 2 shows the locations of the background monitoring wells [L(SG) and E(M)], POC Wells [OBS-3, S(SG), T(M), and F(M)] involved in the compliance monitoring program along with other monitoring wells in the vicinity.

Protection standards for uranium and molybdenum were set at "background" concentrations from upgradient well data (as determined by a single sampling event during June 1988). The selenium standard was set at the Table 5(C) concentration in 10 CFR Part 40, Appendix A. ARCO has maintained a semi-annual schedule of compliance monitoring for uranium, molybdenum, and selenium as required under the License Amendment.

Implementation of the wicks system alternative was determined to be the most reasonable and practicable alternative to supplement previous corrective actions which would enable the quickest attainment of the compliance limits at the point of compliance at the Bluewater Mill. Nevertheless, cessation of mill operations and prior corrective action activities, involving minimizing the amount of free water, use of lined evaporation ponds, removal of standing surface water, and tailings dewatering have made the most significant progress towards attaining ground-water protection standards.


TRANSWESTERN
EXISTING RESTRICTED AREA (TYP.)
EL PASO GAS
PLAINS ELECTRIC
EVAPORATION POND AREA
ACID TAILINGS
DISPOSAL WELL
BACKGROUND
L(SG)
TAILINGS IMPOUNDMENT AREA
FUTURE RESTRICTED AREA
OBS-3
POC
S(SG)POC
G(SG)
CARBONATE TAILINGS
OBS-2
I(SG)
C(M)
AT & SF R.R.
T(M) POC
OW7
OW5
OW6
BACKGROUND
E(M)
U(M)
MALPAIS EXCLUSION
F(M) POC
X(M)
RECLAIMED MILLSITE
BLUEWATER
OLD U.S. 66
PLAINS ELECTRIC
EXISTING PROPERTY BOUNDARY
INTERSTATE 40
FUTURE RESTRICTED AREA SHOWN THUS
ARCO Coal Company
Division of AtlanticRichfield Company
CONTRACT NO.
BLUEWATER MILL MONITORING WELLS
ANDERSON Engineering Co.
Figure 2
MJD
SCALE: 1" = 3000'
DRAWING NO. FIGURE 1 (1)
1 REVISED 9-6-91

Compliance monitoring of uranium, molybdenum and selenium conducted at the background well and at point of compliance (POC) wells for the Alluvial aquifer is provided in Figures 3 through 5. Uranium concentrations at the POC well T(M) have declined since 1988. Modeling projections reported by ARCO (1986) had predicted a temporary increase in uranium concentrations in both aquifers after slimes consolidation. It was determined that the wicks system would only reduce the magnitude of increase.

There has been no apparent increase in the concentrations of uranium in the Alluvial aquifer since the consolidation layer was placed starting in 1991. On the other hand, it appears that concentrations may have leveled out or have not continued to decline along the same trend that was observed from 1988 through 1991. Due to random variation in the analytical results, it is difficult to ascertain the trend through 1992 and 1993. Continued semiannual compliance monitoring over the next few years is needed to better define the trend in uranium concentrations at POC well T(M) following consolidation of tailings slimes.

Selenium concentrations in the Alluvial aquifer at POC well T(M) declined to background levels in 1991 and have remained close to background since 1991. Molybdenum concentrations at POC well T(M) have exhibited no trend throughout the monitoring period but have fluctuated between .02 and .04 mg/l. Uranium, selenium and molybdenum concentrations at POC well F(M) have remained at or below background.

Since previous monitoring and modeling of the Alluvial aquifer has demonstrated that this finite channel system is quite responsive to seepage influences, it is expected that any impact due to an increase in seepage in response to loading should have appeared at well T(M) relatively quickly (within the first few years following consolidation). Since the consolidation layer was placed starting in the early part of 1991, the recent trend in uranium and selenium concentrations at POC well T(M) indicate that slime consolidation will have negligible impact on concentrations in ground water in the Alluvial aquifer.

Figure 3

Bluewater Mill

U-nat vs TIME

Groundwater, Alluvial Aquifer

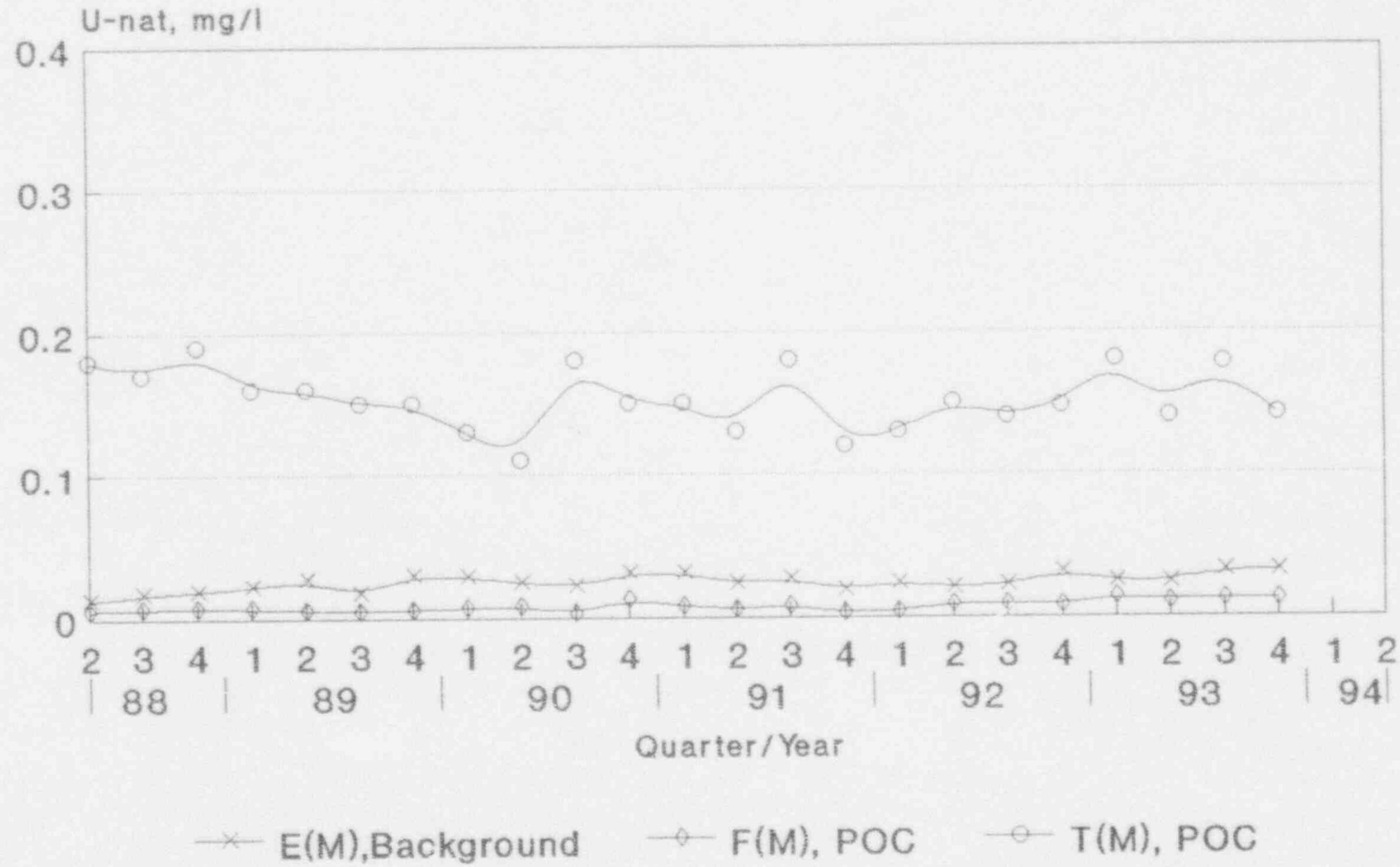


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Figure 4

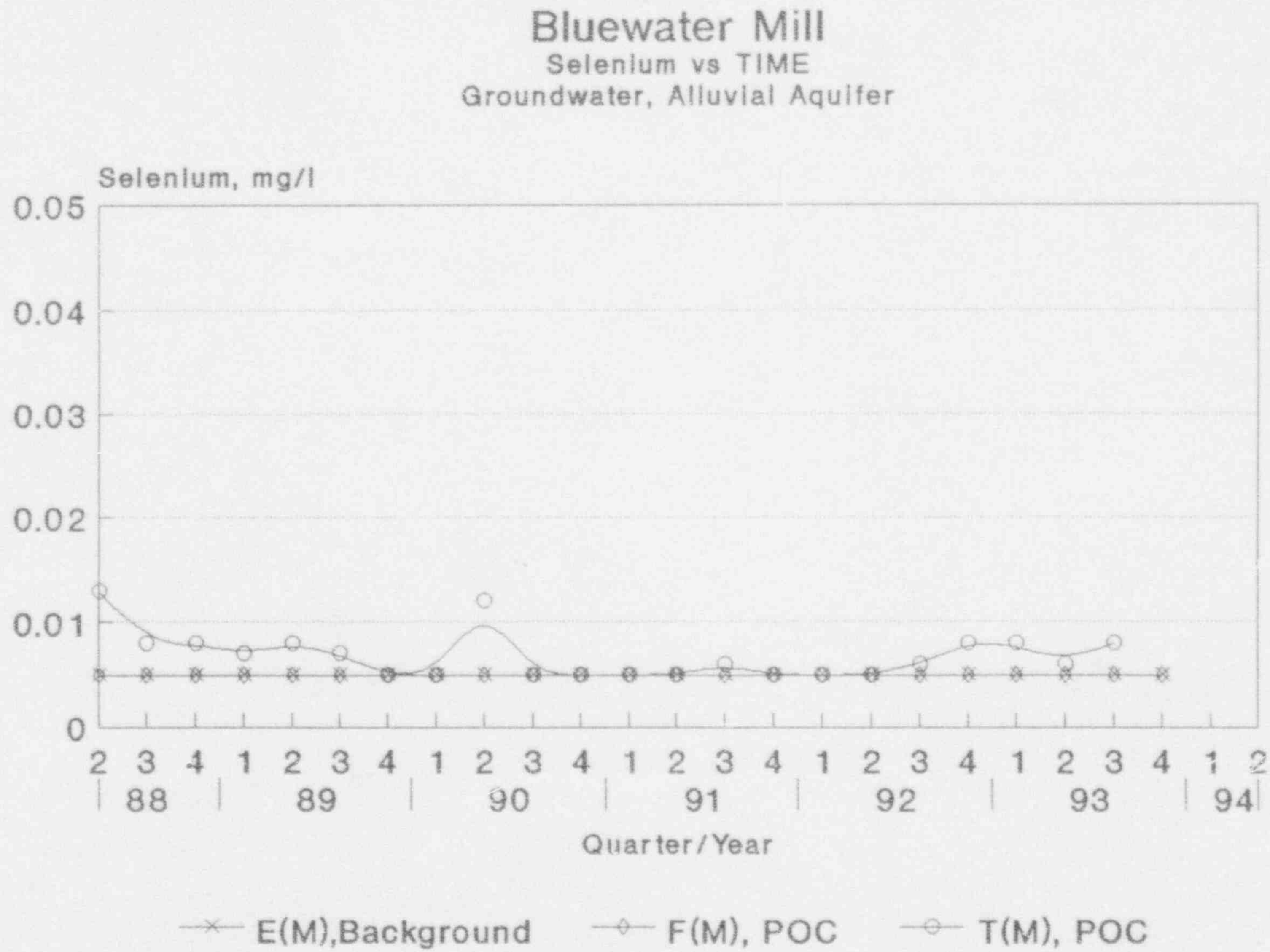

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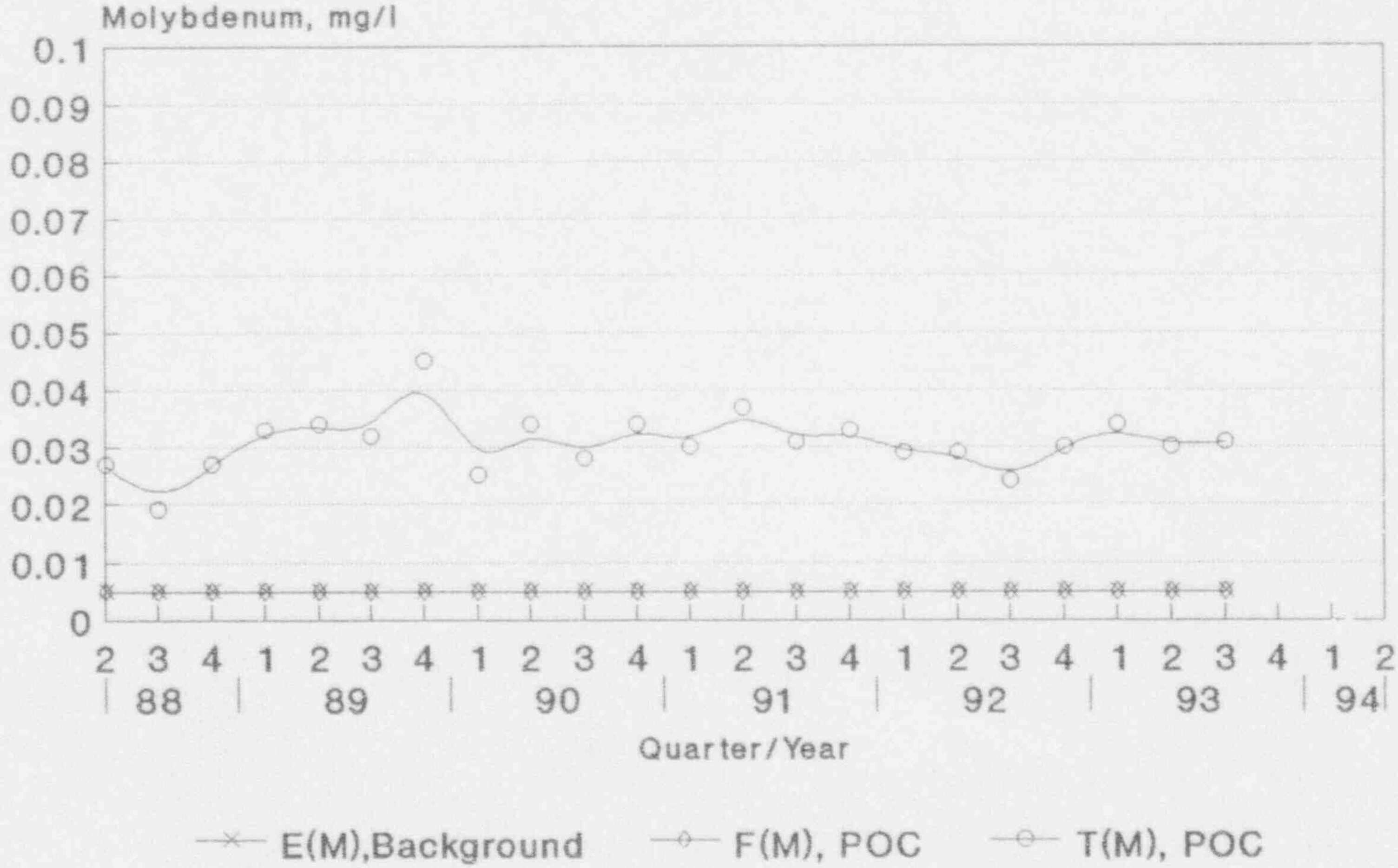
Figure 5
Bluewater Mill
Molybdenum vs TIME
Groundwater, Alluvial Aquifer



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Results of monitoring of uranium and selenium conducted at the background well and the point of compliance (POC) wells in the San Andres aquifer provided in Figures 6 and 7 show a gradual reduction in concentrations at the POC wells S(SG) and OBS(3). Based on previous monitoring and modeling work (ARCO, 1986), any seepage impacts in the San Andres aquifer are expected to be delayed and damped considerably relative to these observed in the Alluvial aquifer. Since no significant response to slimes consolidation has yet been observed in the Alluvial aquifer, no response is anticipated in the San Andres aquifer and the CAP appears to have been effective in preventing measurable contamination of ground water by tailings fluids due to consolidation of slimes.

Concentrations of uranium, molybdenum, and selenium in both aquifers have met and should continue to meet New Mexico Environmental Department (NMED) standards in all monitor wells on the site. The NMED health based ground water standard for uranium is 5 mg/l; for selenium it is 0.05 mg/l. The NMED irrigation water standard for molybdenum is 1.0 mg/l.

Water quality monitoring results and previous modeling efforts indicate that conditions will continue to improve and, based on ground water modeling results, may reach background conditions in 25 years (ARCO, 1986).

Figure 6

Bluewater Mill

U-nat vs TIME

Groundwater, San Andres Aquifer

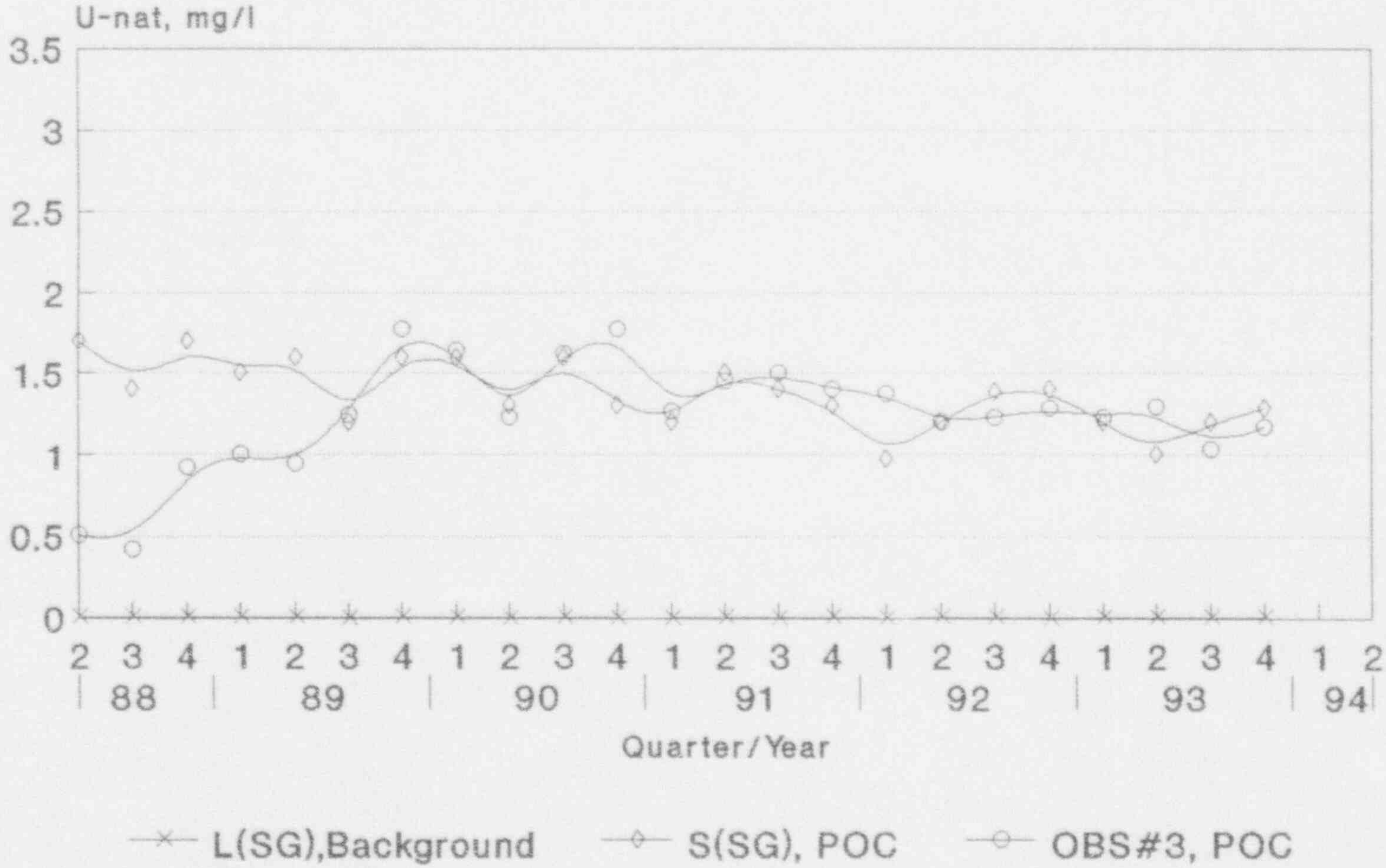

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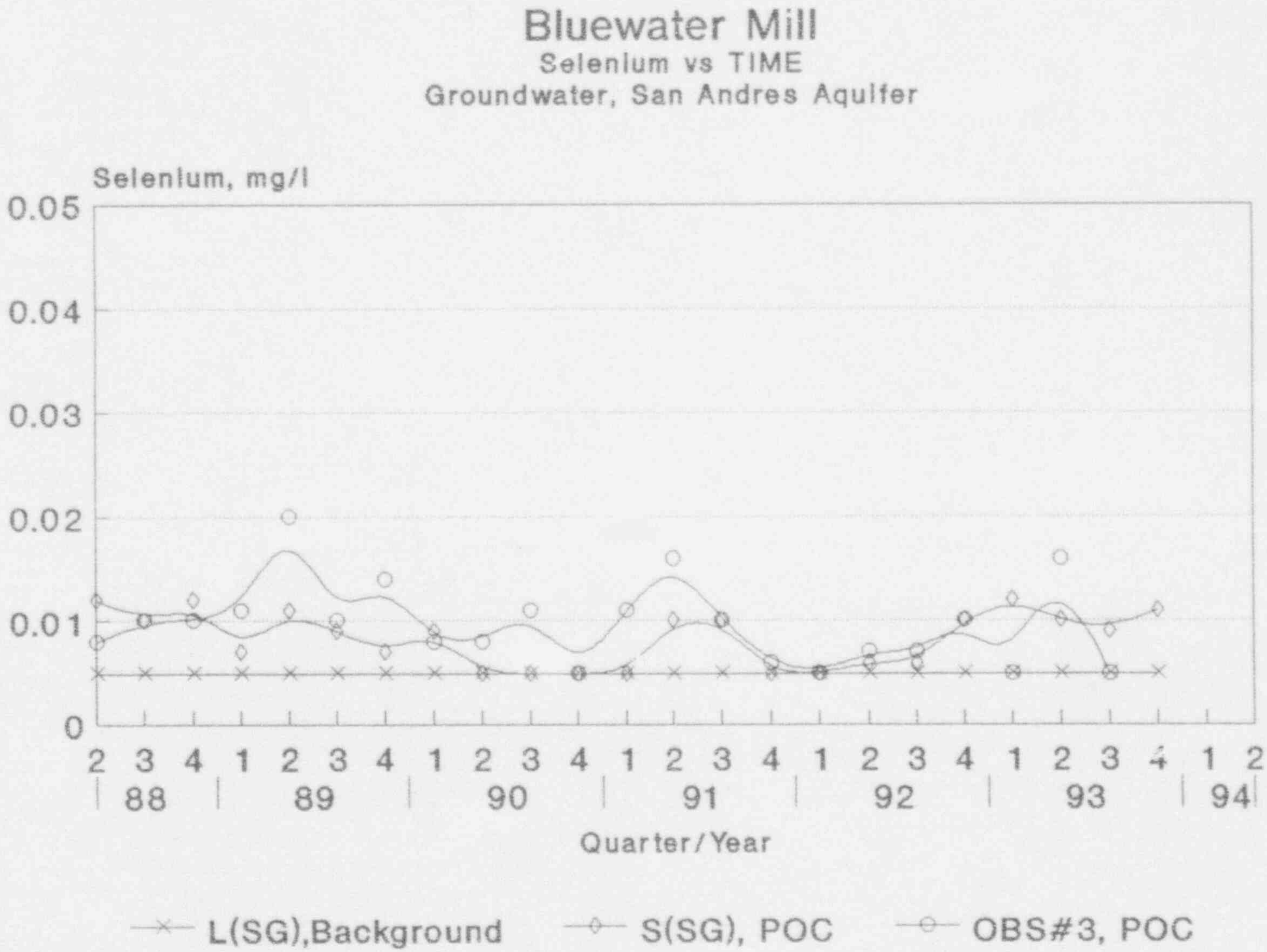
Figure 7



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4.0 CONCLUSIONS AND RECOMMENDATIONS

An evaluation of the effectiveness of the CAP for removal of the constituents from ground water estimated that a volume of about 40,0000,000 gallons of tailings fluid containing 38,000 pounds of uranium, 275 lbs. of molybdenum, and 88 lbs. of selenium was removed or prevented from reaching ground water. Prior to implementation of the CAP it was anticipated that approximately 40,000,000 gallons of tailings fluid would be removed or prevented from reaching ground water. Thus, the tailings fluid quantity contained or removed by the CAP is approximately the same volume that was expected to be removed by the CAP. Based on these results, it is concluded that the CAP has been effective in containing and immobilizing the majority of tailings fluid that has been displaced by consolidation of the tailings slimes.

Additional consolidation and associated tailings fluid displacement is likely to have occurred during placement of the consolidation layer and prior to installation of the wicks. It is expected that about one half of this fluid may have seeped up into the consolidation layer and half may have migrated laterally out or vertically down. Thus, if it assumed that infiltration of the entire 12,200,000 gallons contained under saturated conditions in the consolidation layer occurred prior to installation of the wicks, then no more than 12,200,000 gallons is likely to have seeped into ground water during consolidation of the tailings slimes. This is much less than the seepage estimate of 50% of total consolidation displacement (40,000,000 gallons) that was predicted prior to implementation of the CAP.

Seepage of tailings fluid to ground water during consolidation of tailings slimes was predicted to result in a temporary increase in concentrations of constituents at the POC (ARCO, 1986). This prediction was based on an assumption of seepage to ground water of 40,000,000 gallons of tailings fluid. It was determined that seepage effects would appear relatively quickly in the Alluvial aquifer. No apparent increase in concentrations of constituents has been observed in either the Alluvial or San Andres aquifers, which is consistent with the significantly smaller quantity of tailings fluid that is estimated to have seeped into ground water during slimes consolidation.

It appears that concentrations of uranium in POC well T(M) in the alluvial aquifer may have leveled out or have not continued to decline along the same trend that was observed from 1988 through 1991. This apparent change in the trend may be due to the seepage influence from slime consolidation, although the trend for 1992 and 1993 is difficult to ascertain due to random variation in the analytical results. Selenium concentrations in the Alluvial aquifer at POC well T(M) declined to background levels in 1991 and have remained close to background since 1991.

Uranium and selenium concentrations at the POC wells in the San Andres aquifer have continued to decline. Slime consolidation seepage effects would appear much later in the San Andres and would be damped considerably by the large volume and attenuation in the San Andres. Based on the observations in the Alluvial aquifer, it is unlikely that any consolidation related seepage affects would appear at the POC wells in the San Andres aquifer.

These observations and apparent trends compare with a much smaller quantity of tailings fluid that is estimated to have seeped into ground water during slimes consolidation. Continued monitoring is needed to better define the trend in uranium concentrations at POC well T(M) following consolidation of tailings slimes.

Since concentrations have not increased and are not expected to increase in either the Alluvial or San Andres aquifers as predicted, the intent of the wicks system has been achieved. Constituents in the tailings fluid have been immobilized by wicking fluids to the surface and subsequent evaporation and by adsorption within the loading materials. It is expected that uranium and selenium concentrations at POC wells in the San Andres and Alluvial aquifers will continue to decline toward background concentrations. Based on previous modeling predictions, the concentrations at the POC in the Alluvial aquifer should decline to background well within twenty five years. The concentrations in the San Andres aquifer will continue to remain above compliance standards at the POC wells for a considerable period of time. Based on previous modeling predictions, the concentrations at the POC in the San Andres aquifer should continue to decline but could remain above compliance standards at the POC for twenty five years or perhaps even longer. Furthermore, the monitoring and modeling results presented in the ACL Petition submitted to NRC (ARCO, 1990) show that concentration of constituents at the closest potential Point Of Exposure (POE) meet health based criteria and will also continue to decline.

Continued semi-annual compliance monitoring for uranium and selenium at POC wells in the San Andres and Alluvial aquifers is recommended for further annual review of the CAP and to verify whether the observed trends for uranium and selenium continue as predicted in this review.

5.0 REFERENCES

ARCO, 1990. Corrective Action Program and Alternative Concentration Limit Petition For Uranium, Selenium and Molybdenum. Submitted to The Nuclear Regulation Commission as a license amendment. June, 1990

ARCO, 1989. Revised Ground Water Corrective Action Program. Submitted to The Nuclear Regulation Commission, August, 1989.

ARCO, 1986. Volume III, Bluewater Mill Reclamation Plan, November 1986, Anaconda Minerals Company, New Mexico Operations, (Atlantic Richfield Company), P. O. Box 638, Grants, NM 87020.

Shepherd Miller, Inc. 1993 Draft Mill Tailings Settlement Report, Bluewater Mill, Grants, New Mexico. September 22, 1993.

Attachment 1

Borehole Infiltration Test Results

ARCO
BLUEWATER MILL
MAIN TAILINGS PERCOLATION TEST

TEST DATE: 8-10-93
11" DIA HOLES 6' DEEP

HOLE TIME H20 LEVEL (IN.) H20 ADDED (GAL) RESULTING H20 LEVEL REMARKS

ARCO
BLUEWATER MILL
MAIN TAILINGS PERCOLATION TEST

TEST DATE: 8-10-93
11" DIA HOLES 6' DEEP

HOLE	TIME	H20 LEVEL (IN.) (0=6" below surface)	H20 ADDED (GAL)	RESULTING H20 LEVEL (0=6" below surface)	REMARKS
1-1	7:27	EMPTY	25	0	
	7:43	-1.5	0	-1.5	COLLAR CAVING
	7:49	-0.5	0	-0.5	
	8:06	-1.25	0	-1.25	
	8:28	-1.25	0	-1.25	
	8:50	-0.75	0		
	9:49	0	0	0	
	10:59	-0.75	0	-0.75	
	11:42	-1.25	2	0.5	
	13:10	0	0	0	
	14:25	-0.5	0.2	-0.5	
	15:14	-0.25	0	-0.25	
	15:42	-0.5	0	-0.5	
	16:01	-0.5	0.5	0	
	17:14	-0.5	0.5	0	
	17:30	-0.25	0.2	0	
TOTAL TIME 10HRS		TOTAL H20 USED	28.4		
'1-2	7:37	EMPTY	20	0.5	
	7:43	1.5	0	1.5	COLLAR CAVING
	7:51	1.75	0	1.75	COLLAR COLLAPSE
	8:08	1	0	1	H20 STARTS TO RECEI
	8:29	0.5	0	0.5	
	8:53	0	0	0	SOIL WITHIN 12" OF CC
	9:50	-0.75	0	-0.75	
	11:00	-2.25	3	0.75	
	11:46	-0.25	0	-0.25	
	13:11	-1.5	1.2	0	
	14:29	-1.25	0.9	0	
	15:43	-1	0	-1	
	16:13	-1.25	1	0	
	17:16	-1	0.8	0	
	17:33	-0.12	0.1	0	
TOTAL TIME 10 HRS		TOTAL H20 USED	27		
1-3	7:33	EMPTY	25	0.25	
	7:44	-1.25	0	-1.25	COLLAR GOOD
	7:54	-3	0	-3	HOLE GOOD
	8:09	-3.25	0	-3.25	
	8:31	-3	2	0	
	8:54	-0.25	0	-0.25	
	9:51	-0.75	0	-0.75	SLOUGHING
	11:01	-1.5	0	-1.5	
	11:46	-3.5	3	1.5	
	13:16	0	0	0	
	14:31	-2	1	0.5	
	15:44	-0.75	0	-0.75	
	16:17	-1.5	0.8	0	
	17:21	-0.5	0.6	0.5	
	17:35	0.12	0	0.12	
TOTAL TIME 10 HRS		TOTAL H20 USED	32.4		
1-4	7:40	EMPTY	27	0.5	
	7:44	-1.25	0	-1.25	HOLE BUBBLING
	7:55	-5.5	3	0.25	HOLE GOOD
	8:11	0	0	0	
	8:58	0.5	0	0.5	
	9:52	0.5	0	0.5	
	11:04	-0.5	0	-0.5	
	11:49	-1.5	2	0.5	
	13:17	0	0	0	
	14:34	-2	0.8	0.25	
	15:45	-1.25	0	-1.25	MINOR RAIN 15:44 TO 1
	16:19	-2.25	1	0	
	17:22	-0.5	0.3	0	
	17:36	0	0	0	
TOTAL TIME 10HRS		TOTAL H20 USED	34.1		

ARCO
BLUEWATER MILL
MAIN TAILINGS PERCOLATION TEST

TEST DATE: 8-10-93
11" DIA HOLES 6' DEEP

HOLE	TIME	H20 LEVEL (IN.)	H20 ADDED (GAL)	RESULTING H20 LEVEL	REMARKS
2-1	8:35	EMPTY	34	0	
	8:38	-7.5	0	-7.5	
	9:20	-18	0	-18	
	9:25	-18	9	0	
	9:28	-4	0	-4	
	9:39	-7	0	-7	
	10:21	-12	9	1	
	11:04	-8	5	0	
	11:17	-3	2.5	0	
	11:26	-2	2	0	
	11:34	-1.5	2.5	0	
	12:08	-4	3	0	
	13:27	-7.75	5	-0.25	
	15:00	-8.75	6	0.5	
	15:37		3	1	
	16:24	-3.5	3	0	
TOTAL TIME 8 HRS		TOTAL H20 ADDED	84		
'2-2	9:38	EMPTY	33	0	
	9:41	-5	7.5	0	
	10:16	-5	8.5	1	
	11:06	-3.5	5	0	
	11:26	-2	2.5	0.5	
	12:09	-1.25	1.5	0	
	13:31	-3	4	0.5	
	15:05	-2	3.5	0.25	
	15:40	-0.5	1	0	
	16:26	-1	1	0	
TOTAL TIME 7 HRS		TOTAL H20 ADDED	67.5		
'2-3	9:33	EMPTY	28		
	9:40	-2	0	-2	
	10:19	-6	5	0	
	11:09	-1	4	1	
	11:31	0	0	0	
	12:10	-0.5	1.7	0.5	
	13:35	-5	1.7	0.5	
	15:07	-0.25	1.5	0.5	
	15:42	0	0	0	
	16:29	-0.5	1.5	0.75	
TOTAL TIME 7 HRS		TOTAL H20 ADDED	43.4		
'2-4	8:28	EMPTY	28	0	
	9:27	0	5	0	
	9:40	-2	0	-2	
	10:24	-4	6	0	
	11:14	-2	5	0.5	
	11:32	0	0	0	
	12:12	-2	1.5	0	
	13:38	-2.25	3.25	0	
	15:09	-2	2	0	
	15:42	-0.75	1	0.25	
TOTAL TIME 7 HRS		TOTAL H20 ADDED	51.75		