QUARTERLY REPORT
FOR THE
ROCKY FLATS GROUNDWATER PLUME
TREATMENT SYSTEMS

July through September 2001

September 30, 2001

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ACRONYM LIST

DOE	Department of Energy
gpm	gallons per minute
ITS	Interceptor Trench System
HRC®	Hydrogen Release Compound®
msl	mean sea level
mg/l	milligrams per liter
OU	Operable Unit
PCE	Tetrachloroethene
pCi/l	picoCuries per liter
PU&D	Property Utilization and Disposal
RFCA	Rocky Flats Cleanup Agreement
RFETS	Rocky Flats Environmental Technology Site
SCFA	DOE Subsurface Contaminant Focus Area
TCE	Trichloroethene
ug/l	micrograms per liter
VOCs	volatile organic compounds

1.0 INTRODUCTION

This quarterly report describes the activities and available performance monitoring data for the Solar Ponds Plume Treatment groundwater collection and treatment system and the Property Utilization and Disposal Yard (PU&D Yard) Plume Treatability Study at the Rocky Flats Environmental Technology Site (RFETS). As required by the respective decision documents, the remaining groundwater collection and treatment systems are now sampled semi-annually.

The Annual Report prepared at the end of each calendar year will include available data for all five groundwater collection and treatment systems. This report will include the reactive barriers for the Mound Site Plume, the East Trenches Plume and the Solar Ponds Plume, Operable Unit (OU) 1 – 881 Hillside system, and OU7 – Present Landfill Seep collection system. The PU&D Yard Plume Treatability Study results will also be summarized in the Annual Report.

1.1 Site Events

Slightly above average precipitation amounts were received this quarter. The historic mean for the amount of precipitation typically received from June through August is 4.3 inches. For this year, precipitation amount for June was 0.7 inches, July precipitation was 2.7 inches and August precipitation was 2.3 inches for a total of 5.7 inches.

The flow meters for the Mound Plume, Solar Ponds Plume and East Trenches Plume treatment systems were replaced in September with bubbler-type flow meters that are more effective in measuring low flow rates.

2.0 SOLAR PONDS PLUME TREATMENT SYSTEM

The Solar Ponds groundwater plume contains low levels of nitrate and uranium generally attributed to storage and evaporation of radioactive and hazardous liquid wastes in the Solar Evaporation Ponds from 1953 to 1986. These ponds were drained and the sludge removed by 1995. Six interceptor trenches were installed in 1971 to de-water the hillside north and downgradient of the ponds. The original six trenches were abandoned in place, and the Interceptor Trench System (ITS) was installed in 1981. The ITS was replaced with a 1,100-foot long collection system and passive treatment cell containing iron and wood chips in September 1999. The system components are shown on Figure 1. This system intercepts the water previously collected by the now defunct ITS.

The original system design placed the treatment cell adjacent to North Walnut Creek. With this design, water intercepted by the collection trench would flow by gravity to the treatment cell without detention in the collection trench. Because Preble's Meadow Jumping Mouse (a Federally Listed Threatened Species) is present at this optimal location for a flow-through treatment cell, the location of the treatment cell was moved 400 feet upgradient to a location immediately adjacent to the collection trench. As a result, the collection trench for this system must hold approximately 11 feet of groundwater to develop sufficient hydraulic head for the groundwater to flow into the treatment cell.

Maintenance requirements consist of water level monitoring and sample collection. Based on information from other similar systems, the media does not require raking or other maintenance. It is expected that media replacement will be required 10 years after installation.

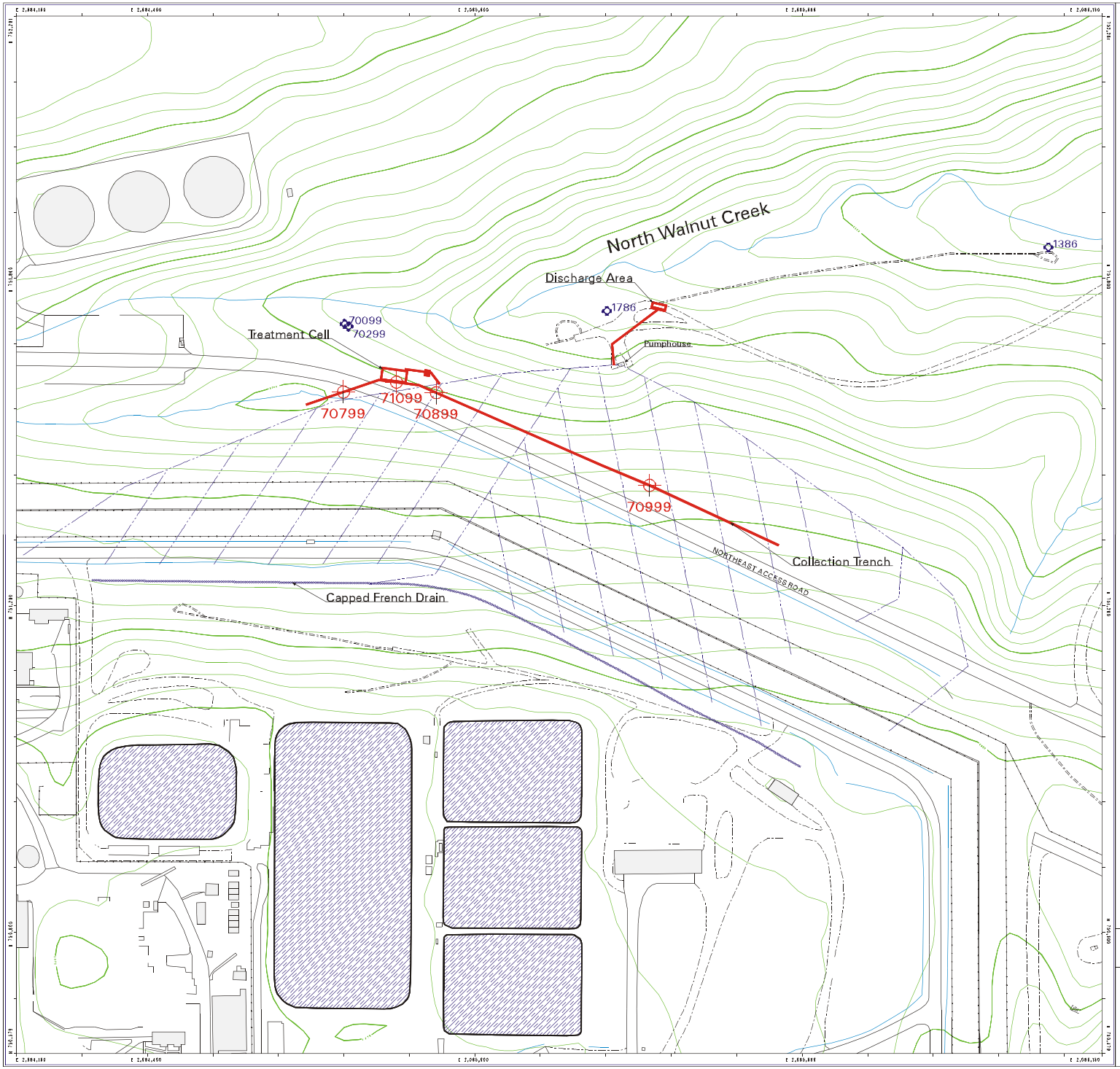

Figure 1

Solar Ponds Plume Treatment System Locations

EXPLANATION

- ITS
- In Trench Piezometer Location
- Monitoring Well

Standard Map Features

- Buildings and other structures
- Solar Evaporation Ponds (SEP)
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contour (5-Foot)
- Paved roads
- Dirt roads

DATA SOURCE BASE FEATURES:

Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas. Digitized from the orthophotographs. 1/95

Topology (contours) were derived from digital elevation model (DEM) data by Morrison Knudson (MK) using ESRI Arc TIN and LATTICE to process the DEM data to create 5-foot contours. The DEM data was captured by the Remote Sensing Lab, Las Vegas, NV. 1994 Aerial Fly-over at ~ 10 meter resolution. DEM post-processing performed by MK, Winter 1997.

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Scale = 1 : 3080
1 Inch represents approximately 257 feet

50 0 100 200 ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

GIS Dept. 303-966-7707

Prepared by: DynCorp THE ART OF TECHNOLOGY

Prepared for: KAISER-HILL

MAP ID: 01-0345/solar_pond_ver1.aml

June 27, 2001

NT_Svr w:/projects/fy2001/01-0345/solar_pond_ver1.aml

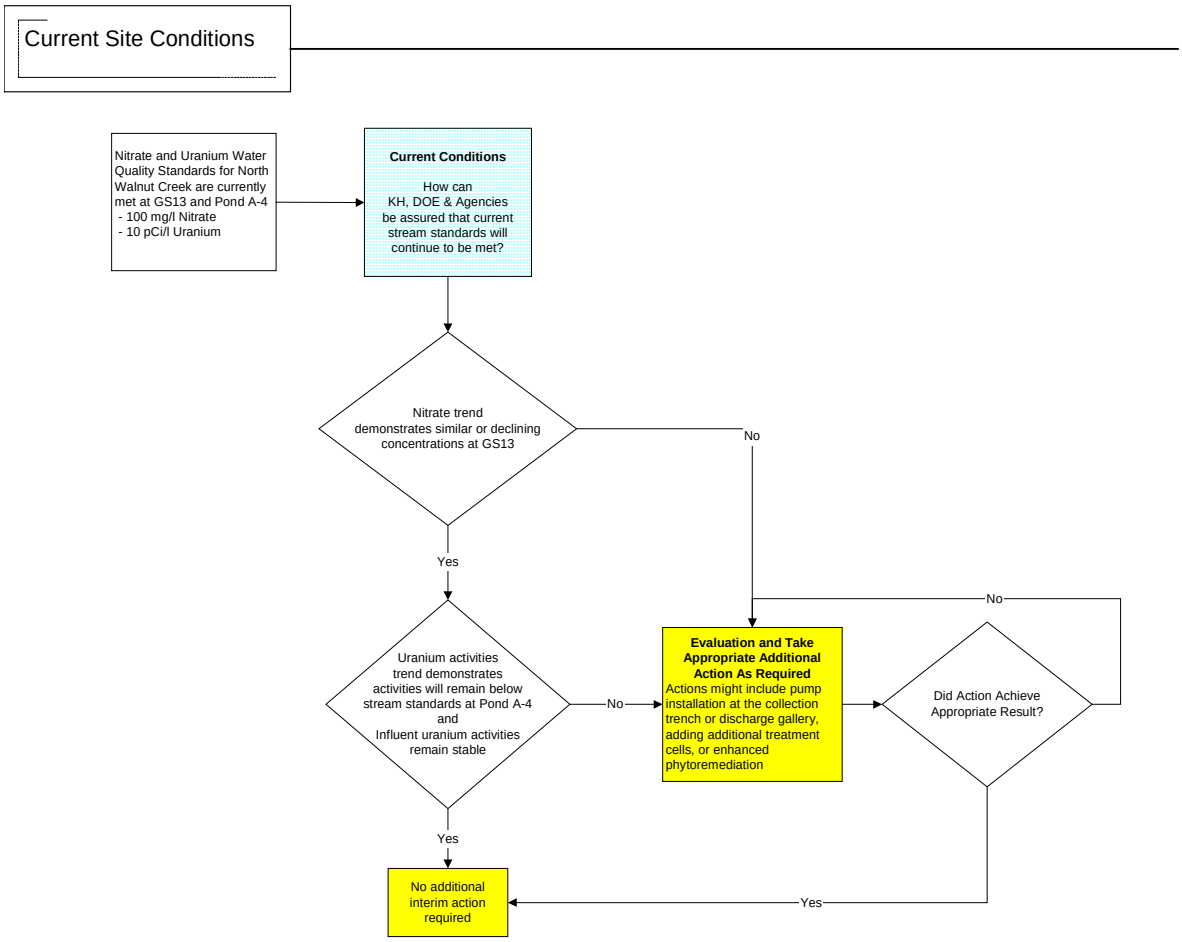
2.1 Project Status

The Solar Ponds Plume system is currently collecting groundwater containing nitrate and uranium from the Solar Ponds Plume. However, some untreated groundwater is also reaching surface water at the discharge gallery. This results in higher nitrate and uranium levels in North Walnut Creek than were observed prior to system installation.

Surface water quality continues to be well below applicable standards of 10 picoCuries per liter (pCi/l) uranium and 100 milligrams per liter (mg/l) nitrate specified in the Solar Ponds Plume Decision Document (DOE 1999). The 100 mg/l nitrate standard is a temporary modification of the underlying stream standard of 10 mg/l nitrate in North Walnut Creek (DOE 1999).

2.1.1 Solar Ponds Plume System Decision Trees

The performance of the Solar Ponds Plume System and the impact on water quality in nearby North Walnut Creek will continue to be evaluated. The long-term impacts on water quality in North Walnut Creek after the temporary modification to the underlying stream standards expire in 2009 will be evaluated. The following decision tree was developed by the CDPHE, EPA and DOE to determine whether additional actions are required for current conditions.

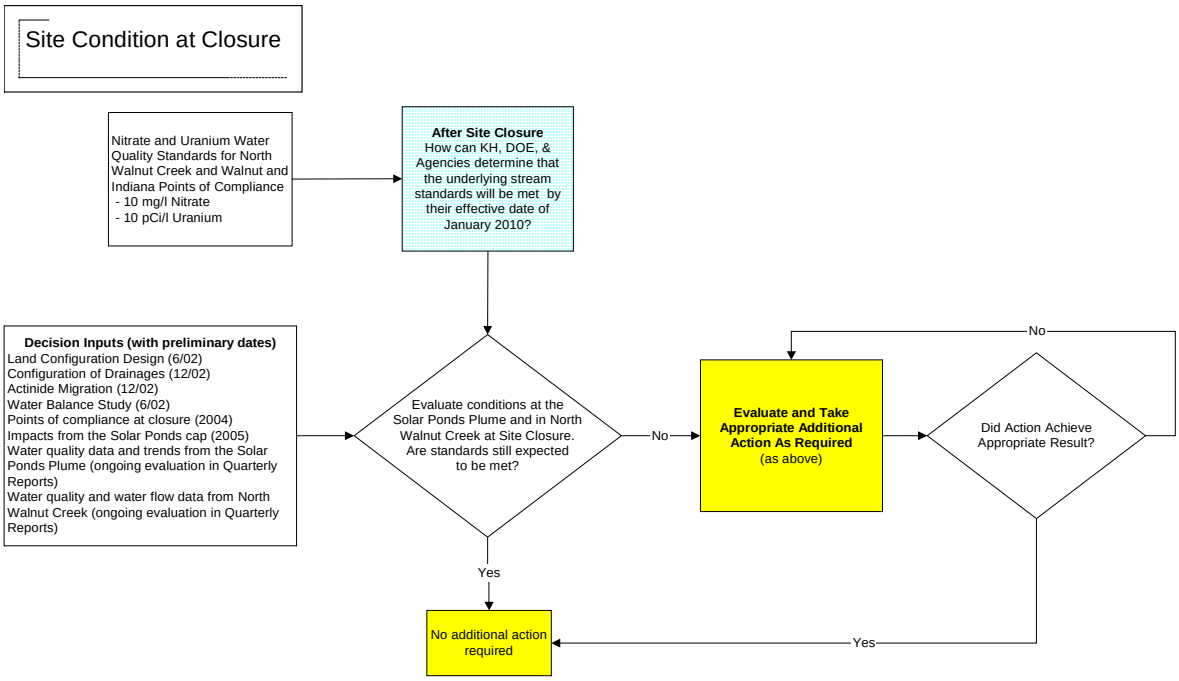


The impact to surface water quality as a result of the untreated water reaching North Walnut Creek will in part depend on the changes that will take place at the Site during closure. While the present conditions will aid in forecasting these impacts, several studies are in progress that will help determine the probable long-term impacts to North Walnut Creek.

The studies that are currently in progress, along with the anticipated date for providing relevant data, include:

- Land Configuration Design Basis (estimated completion date - June 2002) The Site design basis and the initial conceptual design are currently being developed and will assist with understanding the basis for the configuration of the Site after closure and will help determine which drainages will continue to receive storm water runoff from the plant area.
- Configuration of Drainages (estimated completion date - December 2002) Developed in conjunction with the Water Management Plan, this project will assist in determining the configuration of the drainages to determine the post-closure status of the existing ponds and dams.
- Actinide Migration (estimated completion date - December 2002) This study will predict the behavior of uranium in the environment at the Site and assist with determining the impacts to surface water from the uranium-contaminated groundwater plume in the Solar Ponds area.
- Water Balance Study (estimated completion date - June 2002) The volume and movement of groundwater and surface water flow at the Site after closure are being estimated and will include the amount of water potentially present in North Walnut Creek and the amount of groundwater available to supply the Solar Ponds Plume. This information will assist with developing estimates of the future concentrations in the groundwater plume and in North Walnut Creek.
- Points of compliance at closure (estimated completion date - 2004) The places where surface water must meet the established water quality standards will be determined.
- Impacts from the Solar Ponds cover (estimated completion date - 2005) The current plan is to install an evapotranspiration cover in the Solar Ponds area. This action may reduce the transport of contaminants, primarily by reducing the amount of groundwater available to supply the plume.
- Continuously evaluate water quality data and trends from the Solar Ponds Plume (reported in Quarterly and Annual Reports). While the evaluations detailed above will assist in predicting changes, continued monitoring will assist in estimating the anticipated decreases in concentration.
- Continuously evaluate water quality and water flow data from North Walnut Creek (reported in Quarterly and Annual Reports). In addition to the changes and studies described above, the ongoing monitoring of current conditions in the Creek will assist with the understanding of impacts after Site closure.

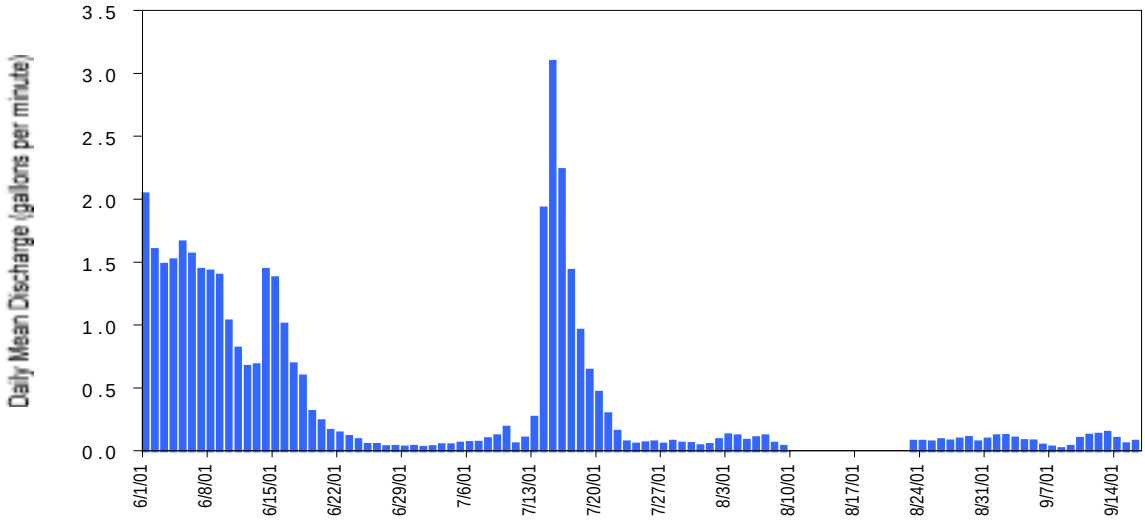
The following decision tree will be used to determine the need for additional action based on the expected conditions at Site Closure.



2.2 Treatment Effectiveness

Treatment system flow and volume of water are measured and recorded automatically. The average daily flow rates for the period June through September 16, 2001 are shown in Graph 1. The flow rate this quarter ranged from 0.1 gallons per minute to 3.1 gallons per minute. The flow meter was not functioning August 10th to 22nd and is scheduled to be replaced by October 2001.

Graph 1. Solar Ponds Plume Treatment System Flow Volume, June through September 2001



As of September 16, 2001, approximately 451,450 gallons of water have been treated since system installation. Of this volume, 22,650 gallons were treated from July 1 to September 16, 2001.

Water levels within the collection trench are monitored monthly at locations shown on Figure 1. Water levels for the last two quarters are provided in Table 1 and indicate a decline in water levels within the collection trench over the last quarter.

Table 1. Solar Ponds Plume Collection Trench Piezometer Water Levels (in feet below top of casing)

Piezometer	4/5/01	5/1/01	6/1/01	7/10-13/01	8/2/01	9/4/01
70799	14.87	13.7	13.88	16.87	16.51	17.45
70899	16.75	15.41	15.54	18.51	ND	19.17
70999	20.8	20.15	20.25	20.94	20.84	20.98
71099	17.13	15.92	16.07	17.69	18.57	19.55

ND – no data

Downgradient wells are also monitored monthly and the last two quarters of data are provided in Table 2. The groundwater elevations are relatively stable in these wells. Water levels in colluvial well (70099) fluctuated from 5875 to 5878 feet above mean sea level (msl). Water levels in the bedrock well (70299) fluctuated one foot from 5876 to 5877 feet above msl. Slightly lower water elevations in May and September appear to be related to the sample collection activities about one week before the water levels were measured. The groundwater removed for analytical samples is the most likely cause of the slightly lower water levels measured at these times.

For this quarter, water levels in well 1786, located adjacent to the discharge gallery, increased from 5864 to 5865 feet above msl. During this period, water levels in well 1386 declined from 5837 feet to 5831 feet above msl.

Table 2. Depth to Groundwater in Solar Ponds System Wells (in elevation above msl)

Well	4/5/01	5/1-5/01	6/1/01	7/10-12/01	8/2/01	9/4/01
70099	5876	5875	5876	5877	5878	5875
70299	5877	5876	5877	5877	5877	5876
1386	5837	5837	5837	5836	5835	5831
1786	5864	5865	5865	5864	5864	5864

2.2.1 Treatment System Monitoring

Monthly samples are collected from the treatment system influent, effluent and discharge gallery (Figure 1) and available data are provided in Table 3. Influent concentrations are consistently 110 to 150 mg/l nitrate and 20 to 28 pCi/l total uranium. Effluent concentrations continue to be much lower than predicted, generally less than 1 mg/l nitrate and 0.3 pCi/l total uranium.

Table 3. Solar Ponds Plume Treatment System Analytical Results

	SPP Influent		SPP Effluent		SPP Discharge Gallery	
Collection date	Nitrate in mg/l	Total Uranium in pCi/l	Nitrate in mg/l	Total Uranium in pCi/l	Nitrate in mg/l	Total Uranium in pCi/l
28-Oct-99	130	20.93	-	-	-	-
30-Nov-99	140	20.59	-	-	-	-
28/30-Dec-99	170	23.53	-	-	280	37.44
27-Jan-00	160	27.63	-	-	-	-
29-Feb-00	140	24.66	-	-	-	-
24/27-Mar-00	48	28.3	<0.05	-	240	45.2
25-Apr-00	140	24.99	<0.05*	0.96	283*	34.96*
22-May-00	115	23.05	<0.05 to 0.1*	0.24*	188*	-
29-Jun-00	130	21.72	-	-	294*	28.84
18-Jul-00	140	19.67	<0.05 to 1.1*	0.233	217*	26.17
17-Aug-00	130	26.03	.16	0.061	246*	36.91
25-Sep-00	140	24.51	<0.05*	0.03	203*	19.62
Oct-00	110	25.46	<0.05	0.02	200	23.95
30-Nov-00	130	23.27	-	-	200	35.47
27-Dec-00	150	24.68	-	-	220	33.38
30-Jan-01	140	25.06	-	-	130	25.66
26-Feb-01	150	26.44	-	-	140	24.51
19-Mar-01	120	25.58	0.07	0.15	110	28.84
13-Apr-01	140	24.43	<0.05	0.003	120	20.2
25-Apr-01	130	24.58	<0.05	0.05	130	28.55
3-May-01	110	24.82	0.13	0.091	150	24.79
8-May-01	150	23.66	5.3	0.11	140	26.6
23-May-01	130	27.97	<0.05	0.002	180	31.16
21-Jun-01	120	25.49	<0.05	0.168	220	50.38
16-Jul-01	150	21.3	0.11	0	130	55.4
10-Aug-01	140	24.51	<0.05	0.1	150	28

* average concentration for month
\- not sampled

As shown in Table 3, concentrations at the discharge gallery are similar to the influent concentrations. It appears that the discharge gallery is discharging groundwater that is either bypassing the treatment cell, or that is derived from the pre-existing downgradient part of the plume that has nitrate concentrations consistently above 500 mg/l. This downgradient part of the plume may also contribute to the higher nitrate and uranium concentrations at the discharge gallery than are observed at the treatment system effluent.

Elevated uranium activities were observed at the discharge gallery during June and July. While the July sampling event took place within a week of a hard rain (0.8 inches in 15 minutes), the June sampling event does not correlate with a similar storm event. The uranium activity at the discharge gallery returned to normal levels by the August sampling event and overall the uranium activities at the discharge gallery continue to show a declining trend. As discussed in Section 2.2.2.1, increased activities at the discharge gallery do not appear to impact surface water quality.

2.2.2 Downgradient Water Quality

Surface water and groundwater are monitored at several locations downgradient of the collection and treatment system.

2.2.2.1 Surface Water Quality

GS13 and Pond A-3 are monitored monthly to verify that nitrate concentrations at both locations are below the temporary stream standard of 100 mg/l. The nitrate and uranium concentrations are provided in Table 4 and verify that the existing stream standards continue to be met. Even with the elevated uranium activities at the discharge gallery during June and July, surface water quality was not impacted. As shown in Table 4 below, uranium activities at GS 13 remained well below the surface water standard of 10 pCi/l.

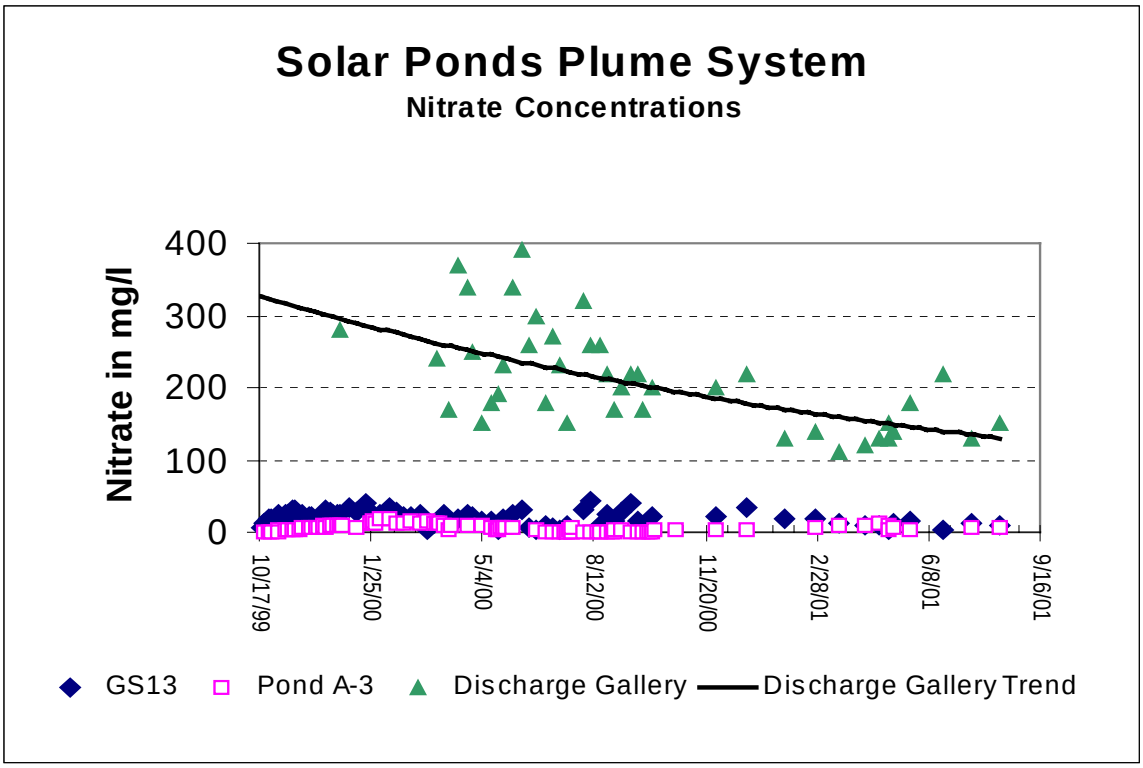
Table 4. Downgradient Surface Water Quality

	GS 13		**Pond A-3**
Collection date	Nitrate in mg/l	Total Uranium in pCi/l	Nitrate in mg/l
October 99*	17.9	5.59	1.14
November 99*	24.11	6.41	5.04
December 99*	23.67	7.99	8.37
January 00*	32	6.75	14.13
February 00*	26.6	7.57	13.2
March 00*	16.65	5.15	9.26
April 00*	18.65	5.59	8.33
May 00*	13.18	7.1	4.88
June 00*	15.12	3.27	1.11
July 00*	6.5	3.23	1.51
August 00*	24.26	4.13	1.12
September 00*	22.8	3.77	1.23
October 00*	21	5.49	2.48
30-Nov-00	22	9.18	7.1
27-Dec-00	33	9.81	8.8
30-Jan-01	20	9.15	7.9
26-Feb-01	18	8.85	11
19-Mar-01	13	5.89	8.2
13-Apr-01	7.8	2.999	4.1
25-Apr-01	10	2.936	5.4
3-May-01	2.9	1.328	4.5
8-May-01	12	4.08	5.3
23-May-01	15	5.53	5.6
21-Jun-01	4.3	2.33	2.9
16-Jul-01	11	3.71	2.2
10-Aug-01	8.9	4.4	1.5
Standards	**100**	**10**	**100**

* Average monthly concentrations

Graph 2 below displays the surface water nitrate data since installation of the Solar Ponds Plume system along with concentrations observed at the discharge gallery. The graph also shows the decreasing trend in discharge gallery nitrate concentrations.

Graph 2. Nitrate Concentrations at the Solar Ponds Plume Treatment System



GS13 is the performance monitoring location for the Solar Ponds Plume System (DOE 1999) and is located in North Walnut Creek immediately downgradient of the Solar Ponds Plume. Since January 2001, the nitrate concentrations have been at or below 20 mg/l but fluctuate depending upon precipitation and other factors. For this quarter, the nitrate concentration ranged from 4.3 to 11 mg/l with an average concentration of 8.1 mg/l nitrate. So far in calendar year 2001, the 85th percentile concentration of nitrate is 16.5 mg/l. This is a 40% reduction over the calendar year 2000 85th percentile nitrate concentration of 29.3 mg/l. The annual 85th percentile values will be compared again when data for the complete calendar year 2001 are received.

At Pond A-3, located downstream of GS13, nitrate concentrations are now generally below 10 mg/l. Nitrate concentrations this reporting period ranged from 1.5 to 2.9 mg/l nitrate with an average concentration of 2.2 mg/l. The much lower concentrations observed this quarter correspond to the lower concentrations noted during this same time period in 2000 and most likely represent seasonal influences.

The Pond A-4 Outfall (GS-11) is a Rocky Flats Cleanup Agreement (RFCA) Point of Compliance for uranium. Samples are collected during the Pond A-4 discharge events and usually contain 3 to 4 pCi/l total uranium, well below the stream standard of 10 pCi/l. The most recent Pond A-4 discharge was August 16 to 20, 2001; uranium data from the pre-discharge sample are shown in Table 5 and are well below the 10 pCi/l stream standard. Results from the discharge samples are expected early next quarter.

Table 5. Recent Uranium Activities at the Pond A-4 Point-of-Compliance (pCi/l)

Date	U-233, 234	U-235	U-238	Total Uranium
7/30/01	1.07	0.03	0.66	1.76

2.2.2.2 Groundwater Quality

Analytical samples are collected quarterly from the two downgradient wells and these data are provided in Table 6. Analytical samples are also collected from wells 1786 and 1386 near Walnut Creek.

Table 6. Solar Ponds Plume Downgradient Well Analytical Results

Well	Date	Nitrate/Nitrite (mg/l)	Uranium-233,-234 (pCi/l)	Uranium-235 (pCi/l)	Uranium-238 (pCi/l)	Total Uranium (pCi/l)
70099 Alluvial	6/6/00	0.87	117	5.04	84.6	206.64
	10/26/00	2.2	79	2	58	139
	1/23/01	2.4	115	3.69	81.9	200.59
	4/20/01	1.9	96	3.5	68	167.5
	8/01	NR	NR	NR	NR	NR
70299 Bedrock	8/24/99	2.1	5.17	0.18	2.98	8.33
	10/26/99	0.1	11.17	0.55	10.70	22.42
	6/2/00	0.05	5.46	0.32	3.85	9.63
	10/26/00	0.05	7.8	0.16	5.3	13.26
	1/22/01	0.25	9.01	0.22	5.98	15.21
	4/20/01	0.66	6.6	0.22	4	10.82
	8/01	NR	NR	NR	NR	NR
1786	5/11/99	410	33.79	1.13	27.40	62.32
	5/4/00	560	41.7	1.56	29	72.26
	11/8/00	630	36	1.1	26	63.1
	1/23/01	570	36.7	1.3	26.9	64.9
	4/17/01	620	38.2	1.79	28.4	68.39
	7/11/01	363	43	1.4	33	77.4
1386	5/18/99	0.06	6.68	0.31	5.79	12.78
	5/4/00	0.05	8.65	0.33	7.47	16.45
	10/26/00	0.23	8.7	0.33	7.3	16.33
	1/23/01	0.1	9.91	0.58	7.96	18.45
	4/16/01	0.05	12.3	0.41	9.92	22.63
	8/01	NR	NR	NR	NR	NR

NR – Not Received

The observed nitrate concentrations are lower than anticipated in 70099 and 70299. The uranium activity in the colluvial well (70099) is higher than the upgradient part of the Solar Ponds Plume (DOE 1999) and elsewhere in the collection and treatment system (Table 3). The uranium activity at 70099 is also much higher than in the adjacent bedrock well. This order of magnitude difference probably indicates that this well intersects naturally occurring uranium-rich cobbles or other native material.

Well 1786 is located adjacent to the discharge gallery within the zone-of sacrifice for the Solar Ponds Plume, the downgradient part that was not intended to be treated. The high concentrations present at this location confirm that the Solar Ponds Plume extended to North Walnut Creek prior to installation of the Solar Ponds Plume System. Well 1386 is near GS13 and is located outside of the plume extent.

2.3 Conclusions and Planned Changes

The treatment cell is performing as designed, however, water levels in the collection trench fluctuate rather than holding constant at 11 feet suggesting that water is bypassing the treatment system. Water quality in North Walnut Creek continues to be well below applicable standards for nitrate and uranium even with bypass of the treatment system.

Water levels within the collection trench and nearby wells will continue to be monitored on a monthly basis. Monitoring will continue at GS13, Pond A-3, and the treatment system influent, effluent and discharge gallery to measure system performance and the impact to surface water. Results for this reporting period reinforce the seasonal effects experienced in system performance, with normal treatment during fall and winter and treatment augmented by phytoremediation during the spring and summer.

At this time, the Site plans to continue to monitor the system monthly through fiscal year 2001 to document seasonal impacts. Based on the results from the 2 years of monitoring, sampling is expected to be conducted quarterly beginning in Fiscal Year 2002. The decision trees discussed in section 2.2.1 will be used to determine if other actions are required should there be additional adverse impacts to surface water quality.

3.0 PU&D YARD PLUME TREATABILITY STUDY

A plume of volatile organic compound (VOC) contaminated groundwater is derived from a contaminant source located in the PU&D Yard at RFETS. Investigation results indicate that subsurface VOC contamination is present in only a few locations and that the primary contaminant is tetrachloroethene (Kaiser-Hill 2001).

A treatability study is in progress to evaluate the effectiveness of Hydrogen Release Compound® (HRC®) for enhancing natural attenuation of the VOCs in the groundwater and soil at the PU&D Yard Plume. HRC® is a proprietary, environmentally safe, food quality, polylactate ester formulated for slow release of lactic acid upon hydration. The HRC® is expected to stimulate rapid degradation of chlorinated VOCs found in groundwater and soil at this location by making low concentrations of hydrogen available to the resident microbes to use for dechlorination. The HRC® is expected to be a one-time application. According to the manufacturer (Regenesis), the material is expected to stimulate contaminant degradation for approximately one year.

The product has been used at other sites to stimulate rapid degradation of chlorinated VOC contaminants in groundwater and soil. This study will evaluate the effectiveness of HRC® in the low-flow groundwater regimes common at RFETS (Kaiser-Hill 2001). This project is a cooperative effort between RFETS and the Department of Energy (DOE) Subsurface Contaminant Focus Area (SCFA) and funding is provided by DOE SCFA.

3.1 Project Events

The treatability study is located within the source area and that portion of the PU&D Yard Plume exhibiting the highest contaminant concentrations (Figure 2). A monitoring well (30900) was previously installed in this area immediately adjacent to borehole 17497 where the highest concentrations of VOCs in soils were detected. An additional monitoring well (31001) was installed slightly downgradient of the source area in January 2001. Baseline samples were collected from these two monitoring wells prior to insertion of the HRC®.

Beginning in February 2001, 16 material insertion points were used to place over 800 pounds of HRC® into the subsurface. A 10 feet by 6 feet grid was used for material insertion and was located within the source area of the plume immediately surrounding borehole 17497 (Figure 3). The initial grid consisted of nine points; additional geoprobe boreholes used as material insertion points were spaced between these initial locations biased to the upgradient part of the source area. HRC® insertion was completed on March 1, 2001. Subsurface conditions were allowed to stabilize for two months, then monthly sampling was initiated April 30, 2001.

Groundwater samples were to be collected from the northwest and southwest corners of the insertion grid as possible (Kaiser-Hill 2001). Sufficient groundwater was present at southwest corner of the insertion grid (MIP3) to collect a groundwater sample prior to insertion of the HRC®. Insufficient water was present to collect a sample at the northwest corner (MIP1).

3.2 Preliminary Results

Results from the initial baseline samples and the monthly sampling events through July 2001 are reported below. Additional samples were collected in late August but results have not been received. For completeness, the previous sample from the pre-existing monitoring well (30900) in the source area is also included. In addition, results from the one time only groundwater sample from MIP3 are also shown below.

Table 7. Preliminary Treatability Study Results (in micrograms per liter (ug/l))

Location	Sample Date	Tetrachloro-ethene	Trichloro-ethene	Cis 1,2 Dichloro-ethene	Trans 1,2, Dichloro-ethene	1,1-Dichloro-ethene	Vinyl Chloride
MIP3	2/20/01	4.9	ND	ND	ND	ND	ND
30900	10/21/00	96	7.4	53.1	ND	ND	ND
	2/7/01	120	7	78	0.5	0.5	ND
	4/30/01	180	11	110	0.1	0.4	ND
	5/30/01	350	23	210	ND	ND	ND
	6/27/01	240	15	140	0.2	0.5	ND
	7/31/01	93.6	10.6	91.4	0.19	0.31	0.21
	8/01	NR	NR	NR	NR	NR	NR
31001	2/7/01	18	5.5	1.2	ND	2.6	ND
	4/30/01	130	20	52	0.1	4	ND
	5/30/01	41	18	4	ND	ND	ND
	6/27/01	120	25	38	ND	1	ND
	7/31/01	105	16.3	189	0.13	1.49	0.12
	8/01	NR	NR	NR	NR	NR	NR
Groundwater Tier I Action Levels		500	500	700	700	700	200
Groundwater Tier II Action Levels		5	5	7	7	7	2

ND - not detected
NR - not received

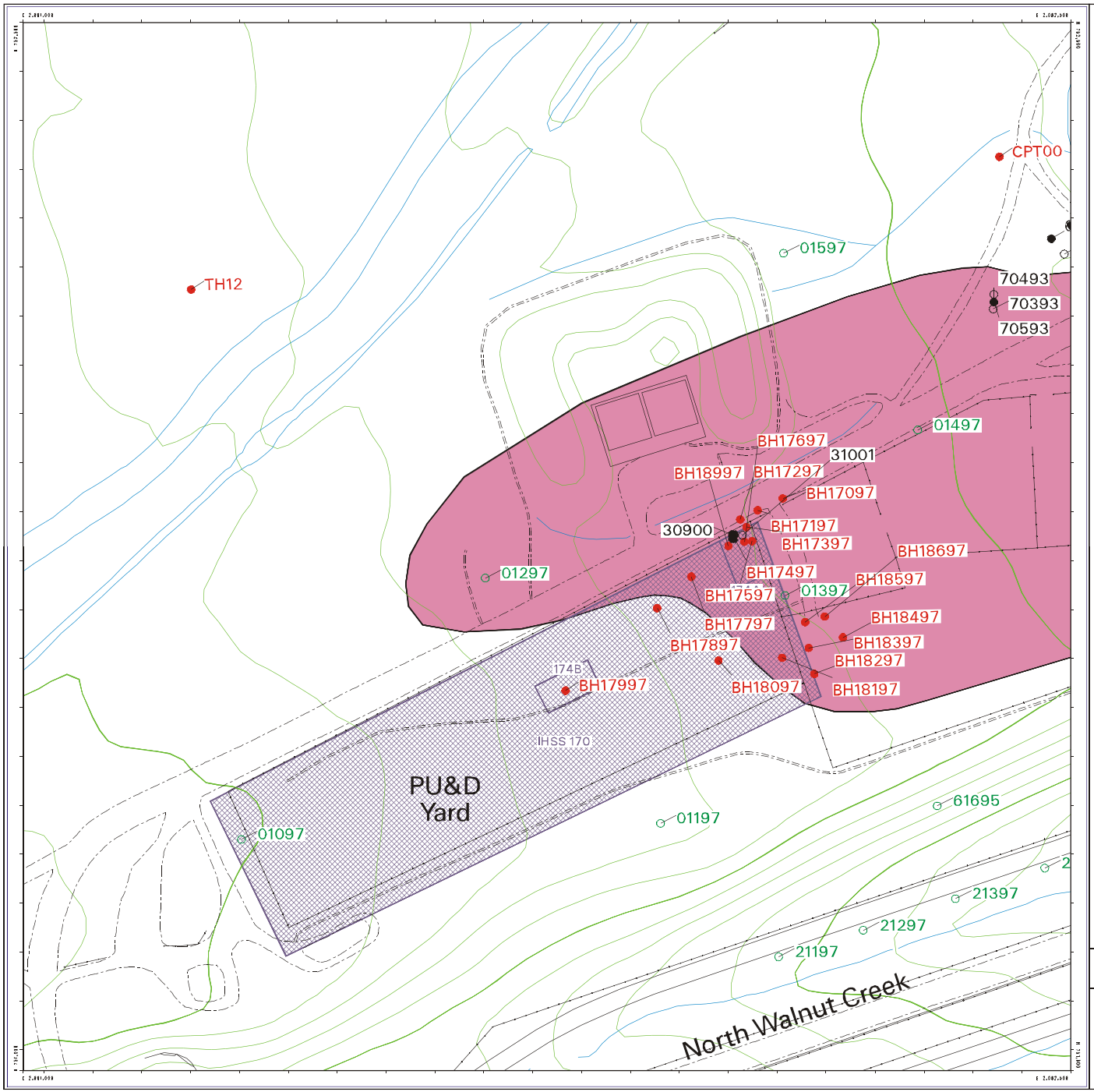


Figure 2

PU&D Yard Groundwater VOC Plume Project Area

EXPLANATION

- PU&D Yard Monitoring Well
- Groundwater Monitor Well UHSU Surficial Material
- Groundwater Monitor Well UHSU Bedrock
- Groundwater Monitor Well LHSU Bedrock
- Borehole Locations
- Abandoned Monitor Well
- Material Insertion Point
- Composite VOC Groundwater Plume (concentration equal to MCL)
- PU&D Yard IHSS

Standard Map Features

- Buildings and other structures
- Landfill Pond
- Streams, ditches, or other drainage features
- Fences and other barriers
- Topographic Contour (5-Foot)
- Paved roads
- Dirt roads

NOTES:
Source of GIS data available upon request.

Scale = 1 : 2570
1 inch represents approximately 214 feet

50 0 100 200ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

GIS Dept. 303-966-7707

Prepared by:
DynCorp
THE ART OF TECHNOLOGY

Prepared for:
KAISER-HILL

MAP ID: 01-0904

September 24, 2001

NT_Svr w:/projects/fy2001/01-0904/pud-yard_fig2_a.aml

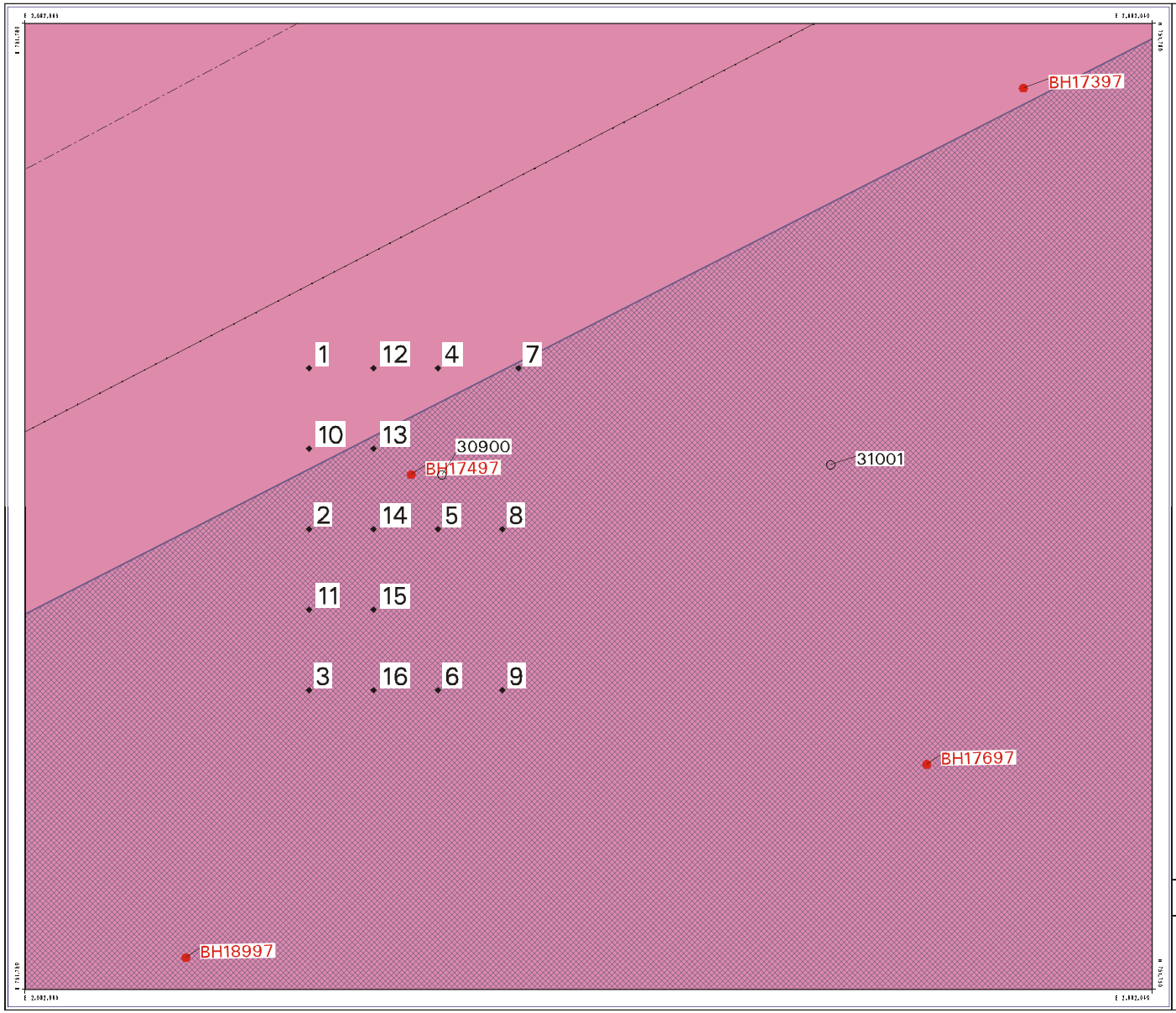


Figure 3

PU&D Yard
Groundwater VOC Plume
Material Insertion Point Configuration

EXPLANATION

- PU&D Yard Monitoring Well
- Groundwater Monitor Well UHSU Surficial Material
- Groundwater Monitor Well UHSU Bedrock
- Groundwater Monitor Well LHSU Bedrock
- Borehole Locations
- Abandoned Monitor Well
- Material Insertion Point
- Composite VOC Groundwater Plume (concentration equal to MCL)
- PU&D Yard IHSS

Standard Map Features

- Buildings and other structures
- Landfill Pond
- Streams, ditches, or other drainage features
- Fences and other barriers
- Topographic Contour (5-Foot)
- Paved roads
- Dirt roads

NOTES:
Source of GIS data available upon request

Scale = 1 : 60
1 inch represents 5 feet

1 0 2 4 ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

GIS Dept. 303-966-7707

Prepared by:
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THE ART OF TECHNOLOGY

Prepared for:

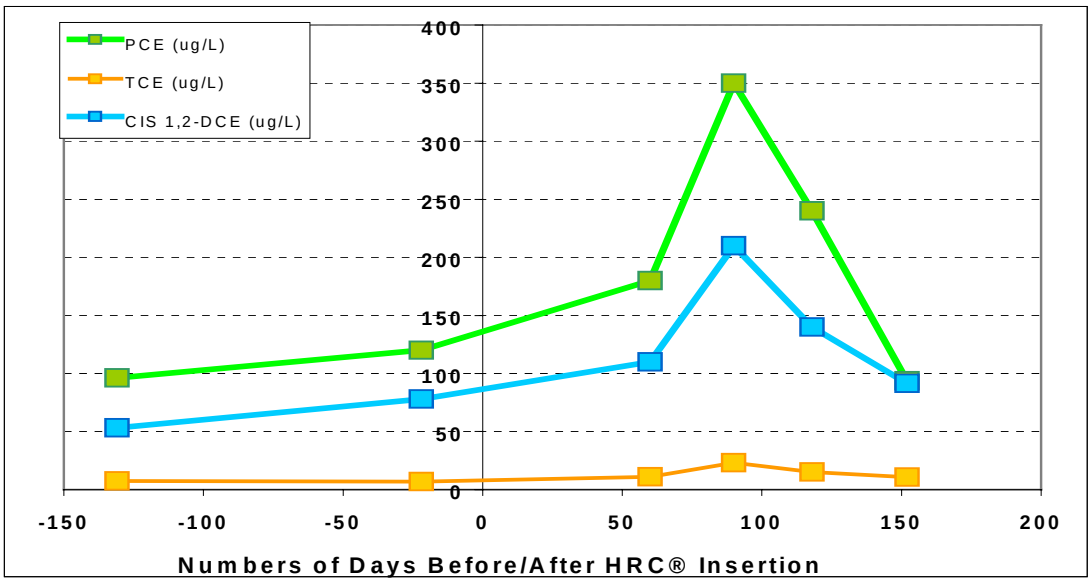
MAP ID: 01-0904

September 24, 2001

NT_Svr w:/projects/fy2001/01-0904/pud-yard-mip_fig3_a.aml

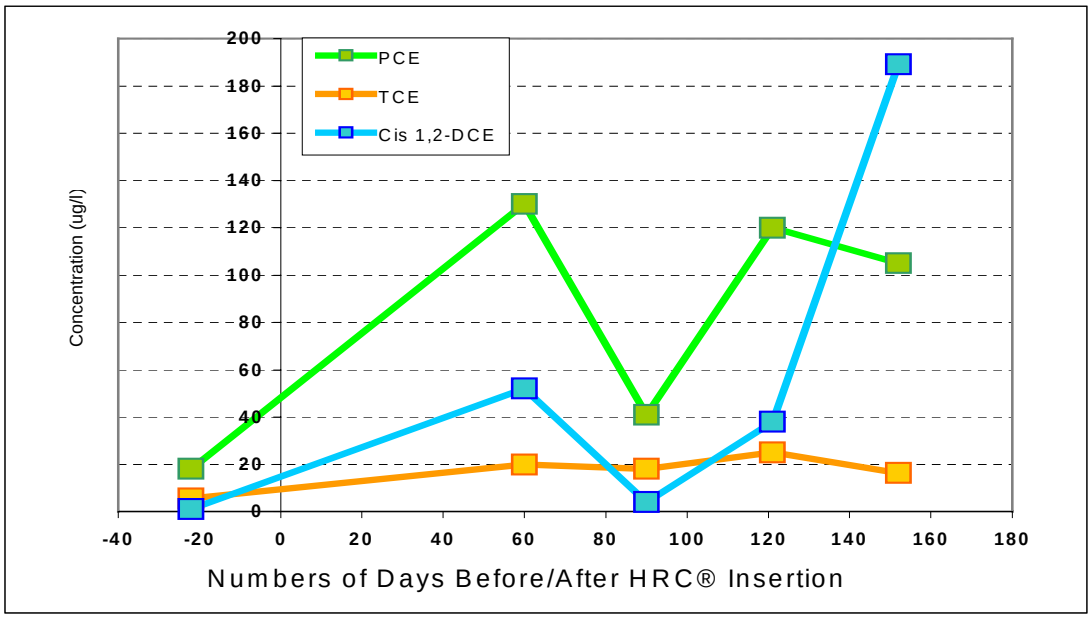
As shown in Table 7 and on Graph 3, concentrations of tetrachloroethene, trichloroethene and cis-1,2 dichloroethene in the source area well (30090) increased after insertion of the HRC®, then decreased. Trichloroethene and cis-1,2 dichloroethene are common degradation products of tetrachloroethene. According to Regenesis (the HRC® manufacturer), approximately 70% to 80% of project sites see an initial increase in VOC concentrations before a downward trend is observed. This downward trend is expected to continue.

Graph 3. Tetrachloroethene and Degradation Products Concentration versus Time in 30900



The data from Well 31001 shows a similar pattern with the exception of the sample taken on May 30, 2001 that had lower than anticipated volatile organic values. It is possible that there are problems with this sample although no errors could be found in the sample documentation.

Graph 4. Tetrachloroethene and Degradation Products Concentration versus Time in 31001



The cause of the increase in tetrachloroethene groundwater concentrations is most likely due to one of or a combination of the following conditions:

- A change in the surface tension of free phase solvents in the pores that would cause more solvent to be released from the pores. This could be from the lactic acid dissolving into the residual contaminants trapped in the pore space within the source area.
- A change in the relative solubility of the individual VOCs due to the presence of the lactic acid in the aqueous phase that would allow more VOCs to go into solution.
- Other changes in liquid and organic phases caused by changes in pH, temperature, oxidation-reduction potential, etc. caused by the addition of lactic acid or by increases in biological activity associated with the lactic acid that result in an increase in relative solubility of the VOCs.

The initial increases in concentrations indicate that VOCs are being transferred from the soil to an aqueous phase, potentially accelerating both soil and water remediation. Typically, the VOCs trapped in soil below the saturated zone have been most difficult phase to remediate and continue to act as a reservoir for contaminants. If these are being mobilized and then biologically degraded along with the dissolved phase this will be a much more robust treatment methodology than simply biologically degrading the dissolved fraction.

The increase in concentration appears to initially outpace the biological effects that reduce the contaminants, causing a temporary increase in concentration both at the source and at downgradient locations. Ideally, the biological effects should degrade the additional tetrachloroethene before it moves very far downgradient. Because the groundwater moves slowly, at around 100 feet per year in this area, this is not a concern.

As shown in Table 7, the presence of other degradation products such as trans 1,2-dichloroethene, 1,1-dichloroethene and vinyl chloride demonstrates that degradation is occurring since these contaminants were not associated with releases at the PU&D yard. Vinyl chloride is the last degradation product generated prior to the degradation to ethene. The small quantities of ethene produced by the process are expected to offgas and are not expected to be detected.

3.3 Conclusions and Work Planned

The decrease in tetrachloroethene and appearance of its byproducts provide direct evidence that the contaminant plume is being degraded. However, monthly monitoring will continue through the end of the calendar year or until the sufficient data are collected to conclusively prove or disprove the effectiveness of the HRC®.

A treatability study report is in progress to document the project results. This report should be completed in October 2001. Additional sample results will be presented in the next Quarterly Plume Report.

4.0 REFERENCES

DOE, 1999, *Final Solar Ponds Plume Decision Document*, RF/RMRS-98-286.UN, June.

Kaiser-Hill, 2001, PU&D Yard Plume Enhanced Natural Attenuation Treatability Study Work Plan, PRO-1256-PU&DPLUME-WP, January.