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COMMENTS ON SEQUOYAH FUELS CORPORATION'S DRAFT RCRA FACILITY INVESTIGATIONS WORKPLAN

by

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March 10, 1994

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INTRODUCTION

The U.S. Environmental Protection Agency (EPA) has issued an Administrative Order on Consent (AOC) to Sequoyah Fuels Corporation (U.S. EPA Docket No. VI-005-(h)93-H) under the Resource Conservation and Recovery Act (RCRA) based on the release of hazardous waste or hazardous waste constituents into the environment from Sequoyah's Facility. The purpose of the Administrative Order on Consent is to ensure that corrective action activities will be designed and implemented by Sequoyah Fuels Corporation (SFC) in order to protect human health and the environment. In meeting these objectives SFC will have to: (1) perform Interim Measures (IM) at the Facility to mitigate potential threats to human health or the environment; (2) perform a RCRA Facility Investigation (RFI) to determine fully the nature and extent of any release(s) of hazardous waste or hazardous constituents (i.e. contaminant or contamination) at or from the Facility; (3) perform a Corrective Measure Study (CMS) to identify and evaluate alternatives for corrective action(s) necessary to prevent, mitigate, and/or remediate any migration or release(s) of hazardous waste or hazardous constituents at or from the Facility and any other information that would support the selection of corrective measures at the Facility; and (4) perform a Corrective Measure Implementation (CMI) implementing the corrective measure or measures selected, if any, by EPA for the Facility.

The AOC required that SFC perform Interim Measures so as to control, abate, or monitor for threats to human health and/or the environment and/or prevent or minimize the further spread of contamination while long-term remedies are pursued at the Facility. Specifically, EPA required that SFC submit a draft Groundwater Monitoring Interim Measures (GMIM) Workplan. The purpose of the GMIM Workplan is to assure that GMIM are designed to detect or monitor for groundwater contamination while long-term remedies are pursued at the Facility. A Draft Groundwater Monitoring Interim Measures Workplan was submitted by SFC (September 2, 1993) and reviewed by EPA. This review (see attached portion of U.S. EPA 1993) aptly commented that SFC could not assert that the nature and extent of hazardous constituents released from the Facility would be determined in the GMIM, or more importantly, was determined in the Facilities Environmental Investigation (FEI). EPA clearly stated to SFC that the "nature and extent of hazardous constituents released from the Facility will be determined within the RCRA Facility Investigation (RFI)."

The Institute for Energy and Environmental Research (IEER) has been retained by Native Americans for a Clean Environment (NACE) to review the RCRA Facility Investigation Draft Work Plan submitted by Sequoyah Fuels Corporation (SFC) to the U.S. Environmental Protection Agency (EPA) on January 28, 1994.[1] This review has focused on the overall adequacy of the Draft Work Plan, and on some specific aspects of SFC's effort to define contamination as specified by the Administrative Order on Consent. IEER

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[1] IEER is a nonprofit scientific and educational institution whose areas of study include radioactive contamination and waste disposal. The author of this report, Bret Leslie, is a geologist with the Institute and has experience in radiochemistry and contaminant transport processes.

also concurs in the comments submitted to EPA on behalf of NACE by L. Lehman & Associates (March 10, 1994).

As discussed below, both the proposed plan of action outlined in the RFI Draft Work Plan and the supporting data provided by SFC are utterly inadequate to satisfy the objectives of the EPA's Administrative Order on Consent, i.e. to determine fully the nature and extent of any release(s) of hazardous waste or hazardous constituents at or from the Facility. There are three main areas of concern. First, SFC proposes a "phased" approach which would intensify investigation in later phases based on information collected in the earliest site characterization phase. Yet, this first phase is so deeply flawed, with its reliance on incomplete and unproven data and its use of vague and unsupported analogies to exclude broad areas of inquiry, that it undermines the integrity of any later phases. Second, the Data Collection Quality Assurance Plan proposed by SFC neglects critical aspects required in the Corrective Action Plan (see AOC Appendix II Task II Section B.1 and B.2) regarding the completeness and validity of information acquired under the RFI. Finally, SFC has ignored basic hydrologic principles in the proposed RFI: there is no attempt to determine the importance or extent of vertical groundwater transport at the Facility. Accordingly, this documents provides no assurance that SFC can and will develop a reasonably accurate understanding of the severity and extent of contamination of the SFC Facility in preparation for ultimate cleanup.

COMMENTS

As stated in the AOC, the objectives for the RFI Work Plan are to:

1. Characterize the potential pathways of contaminant migration;
2. Characterize the source(s) of contamination;
3. Define the degree and extent of contamination;
4. Identify actual and potential receptors; and
5. Support the development of alternatives from which a corrective measure will be selected by EPA.

SFC has proposed to achieve these goals through a phased investigation of each study area. The RFI Draft Work Plan states:

> "For the SFC RFI there will be three (3) possible phases for the study area investigations. In some study areas, Phase I may not be necessary and the investigation can proceed immediately to Phase II.
>
> Phase I will involve source characterization and include sampling of the contents of those units identified within each study area for the Target Parameters associated with that unit. The objective of this sampling effort is to determine the concentration of Target Parameters in the material contained within a unit or study area. Target Parameters found to be present at levels greater than Target Values will be considered for further investigation from that unit or study area.
>
> Phase II is a media investigation of the soils and groundwater and possibly the surface water and sediment. Target Parameters identified at levels exceeding Target Values during Phase I will be

the Target Parameters for the Phase II media investigation. Like Phase I, if a Phase II Target Parameter concentration exceeds its Target Value, further investigation is warranted and a Phase III investigation will be considered.

Phase III involves the quantification of the lateral and vertical extent of Target Parameters contained in the impacted media which exceeded the Target Values during Phase II as determined necessary. This sampling effort will be determined on a case-by-case basis after consideration of the Phase I and II results." (p.1-7).

As discussed below, none of the objectives of the AOC are approached, let alone achieved, by the RFI Draft Work Plan.

Goal #1 - Characterize the potential pathways of contaminant migration.

An accurate and complete characterization of potential contaminant migration pathways is critical to the identification of who might be impacted by the hazardous material contamination at the Facility. In addition, if SFC does not accurately characterize the potential pathways of contaminant migration (e.g. groundwater pathways), then remedial actions which neglect to consider the pathways of contaminant migration (e.g. groundwater transport) cannot ensure the cleanup of the Facility. To characterize the potential pathways of contaminant migration at the Facility SFC must define the physical and geological limits for each potential pathway. However, the RFI Draft Work Plan falls far short of this goal. For instance, SFC's own studies have demonstrated that groundwater transport is a critical path of contaminant migration at this Facility. See attached Facility Environmental Investigation (FEI) Figures 73, 97, and 98, which show lateral and vertical transport of the hazardous contaminant arsenic away from the ponds. Yet, the measures proposed in the RFI Draft Work Plan are insufficient to address the extent of lateral hydrologic transport of contaminants; and the Draft Work Plan makes no attempt to address the importance and the extent of vertical hydrologic transport of contaminants. (See also comments of L. Lehman & Associates). Given the existence of numerous ponds containing hazardous materials on the Facility, and the clear evidence of vertical and lateral hydrologic transport of contaminants away from the ponds, SFC has no basis for not characterizing this major potential pathway of contaminant migration.

Goal #2 - Characterize the source(s) of contamination.

Adequate identification of the nature and sources of contaminants is a fundamental prerequisite to the ultimate cleanup of the SFC Facility. However, SFC's proposed plan for achieving this goal, to be accomplished during their Phase I investigations, is entirely inadequate. Moreover, these inadequacies affect the entire investigation, because SFC proposes to base the in-depth investigations of its Phase II and Phase III inquiries on the information initially obtained in Phase I, its source characterization phase. The specific deficiencies in SFC's proposed source characterization are as follow.

First, SFC ignores EPA's previous comments to SFC that "the nature and extent of hazardous constituents released from the Facility will be determined within the RCRA

Facility Investigation" (see attached U.S. EPA, 1993). Instead, SFC relies almost exclusively on its previously conducted analyses of raffinate, raffinate sludge, and CaF_2 sludge to identify contaminants at the Facility, and provides for almost no further investigation during the RFI. While the Administrative Order on Consent (AOC) may allow use of previous Respondent generated data, it requires that SFC describe measures to be taken to assure that data collected previously can be compared to data collected in the RFI (see AOC Appendix II Task II Section B.1.d). SFC has not proposed a method to assure that data collected previously can be compared to data collected in the RFI.

In addition, the Data Collection Quality Assurance Plan portion of the AOC requires an assessment of the completeness and statistical validity of the data to be collected during the Facility Investigation. Yet, the RFI Draft Work Plan contains no proposal to assess the completeness or validity of data collected during the RFI. Since SFC cannot demonstrate the validity of data collected during the RFI and assure that data collected previously can be compared to data collected in the RFI, SFC's insistence on primarily relying on previously collected data is completely unacceptable. SFC must propose a plan and methodology for characterizing sources of contaminants that meet EPA criteria for completeness and statistical validity. While we believe that previous data may be instructive in identifying areas that require further investigation, under no circumstances should it be relied on to characterize the sources of contamination or to exclude consideration of particular contaminants and particular locations for monitoring.

The complete inadequacy of the RFI to reliably characterize sources of contamination is demonstrated by SFC's flawed approach to characterization of untreated raffinate, treated raffinate (the so called "ammonium nitrate fertilizer solution"), and raffinate sludge. First, rather than establishing a plan for collection of valid data under the RFI, SFC relies on previously collected data whose statistical validity is not established. In fact, with respect to some of the parameters, the data are inadequate on their face for purposes of contaminant characterization. For instance, SFC relies on its own previous analyses of metals in the treated raffinate for the characterization of this source. Yet, SFC acknowledges in the Draft Work Plan that:

> "The ammonium nitrate fertilizer ... has been analyzed for many years **for most**, if not all of the non-organic Target Parameters as part of the fertilizer program under the NRC license." (p. 2-23)

Thus, these analyses did not determine the concentration of all the hazardous constituents (specifically, beryllium and silver were not determined), as is required by the EPA. Further, as acknowledged in the SFC's sources of data, Description of Current Conditions and Investigations Table 4-2 (attached; also see attached Appendix 2 of 1992 Completion Report for the Ammonium Nitrate Fertilizer Program), the detection limits for several hazardous constituents (cadmium, lead and selenium) were higher than the target level concentrations required for these elements in groundwater. Thus, SFC was incapable of detecting these hazardous constituents at the concentration at which EPA requires it to be characterized. Since SFC's previous analyses did not determine all hazardous constituents and did not measure the constituents using techniques with inappropriate sensitivity, its

reliance on previous analyses to characterize sources of contamination is grossly inadequate.

Further demonstration of the inadequacy of the RFI to reliably characterize sources of contamination associated with the raffinate process is based on SFC's neglect of existing information concerning the nature of the contamination at the site. First, SFC has stated in the Description of Current Conditions and Investigations (CCI) that

> "This report provides existing background information pertinent to the SFC Facility. ... Existing information on the nature and extent of contamination is also included." (p. 1-3).

The CCI, which is Task I of the RFI, is required by the AOC (Appendix II, p. 8) to include "the existing information on the nature and extent of contamination at the Facility" and the identification of "Hazardous waste or constituents, to extent known". Yet in SFC's presentation of the existing information concerning the treated raffinate and raffinate sludge (p. 4-24 of the CCI), it fails to cite an U.S. Nuclear Regulatory Commission (NRC) study of treated and untreated raffinate (see attached U.S. NRC 1992, Table 1). The information presented for the hazardous contaminants beryllium and silver in the NRC study is the only existing information for these constituents in the treated and untreated raffinate. In addition, this information is critical to the characterization of the sources of contamination, since only the NRC study provides data which can be used to infer that the concentrations of beryllium and vanadium in another possible source of contamination, the raffinate sludge, will exceed the target level concentration for solids. The importance of the NRC data in characterizing possible sources of contamination is supported by the existing groundwater data at the Facility. Indeed, SFC's has demonstrated in the FEI that 40% of the groundwaters analyzed at the Facility are in excess of the target level concentration for beryllium in groundwater (see attached FEI Table 72). This observation strongly suggests that there are sources of beryllium contamination. Thus, SFC's failure to include the NRC's information as part of their characterization studies, strongly undermines their attempt to characterize sources of contamination.

Finally, SFC's proposal for further characterization of some sources of contamination under the RFI is completely inadequate. The single analysis of the CaF_2 sludge in Unit 15A, and the single analysis of raffinate sludge in Unit 17A cannot be considered a technically sound or statistically valid characterization of these sources. A defensible RFI Draft Workplan would characterize the source(s) of contamination using multiple samples for each suspected source. For instance, standard statistics applied in source characterization may include average analyte concentration and the variance about the mean (statistics that compare whether the observed level is significantly above or below an action level), as well as, temporal and spatial trends. None of these well-accepted means for assessing statistical validity are applied or even discussed in the Draft Work Plan. Thus the limited number of analyses proposed in the RFI Draft Work Plan are clearly inappropriate to define the sources of contamination at the Facility.

Goal #3 - Define the degree and extent of contamination.

SFC's general approach to defining the degree and extent of contamination at the Facility is flawed in numerous significant respects.

General Approach

First, SFC proposed use of a phased implementation of investigation is conceptually flawed. The RFI Draft Work Plan proposes to define the degree and extent of contamination in the Phase II and Phase III investigations. The implementation of these phases of investigation is solely dependent upon the results of the Phase I investigation. If it is determined during the Phase I study that a Target Parameter is found at levels which exceeds the Target Value concentration, then a Phase II investigation will ensue. However, SFC's proposed Phase I studies do not provide adequate measures for source characterization and cannot assure that each source of contamination at the Facility will be found. Since the proposed characterization of the sources of contamination is inadequate, the determination of the degree and extent of contamination will be inadequate. Thus, the degree and extent of contamination at this Facility is likely to be seriously underestimated.

Second, if a Phase II media investigation is pursued, SFC proposes to limit the collection of data regarding the degree and extent of contamination to limited areas in the upper 2 feet of soil. In making this proposal, SFC ignores clear evidence in its own FEI of considerable lateral and vertical variability in contaminant concentrations at the site, which warrants a much more comprehensive sampling program. For instance, the FEI indicates that the concentrations of some contaminants (i.e., uranium, fluoride, and nitrate)[2] in the upper few feet of soil vary tremendously with lateral distances -- greater than a factor of 20 within individual units. See attached FEI Figure 104, which shows this magnitude of variation for uranium in the upper one foot of soil for Units 1, 3, 5, 20, 21, and 36. The FEI also clearly demonstrates vertical mobility of contaminants in soil, with contamination of solids by uranium to a depth of 20 feet. See attached FEI Table 29, which shows deep subsurface contamination in Boreholes BH-3, BH-3A, BH-9, BH-12A, BH-17, and BH-27. While uranium is not a RCRA target contaminant, its association with RCRA metal contaminants in the ore that was once processed at SFC makes it an important indicator of potential RCRA metal locations. The inadequacy of data collection during the Phase II investigation is exacerbated by the placement of monitoring wells and characterization sample locations at positions inappropriate for the purpose of determining the extent and severity of contamination (see, e.g., the discussion of Study Areas 3 and 4 below). Thus, as a result of the limited number of samples and the limitation of soil samples to the upper two feet, the Phase II investigation will undoubtly underestimate the degree and extent of contamination at the Facility.

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2 While not technically defined as "contaminants" under RCRA, fluoride and nitrates are other groundwater pollutants whose concentrations vary considerably both laterally and vertically. This variation is a good indication that RCRA contaminants may also vary significantly.

Third, the Draft Work Plan proposes no method for determining the completeness and statistical validity of the data that SFC intends to collect in order to meet this goal. Thus, the Draft Work Plan lacks any technical foundation for determining whether SFC has adequately identified the location of contaminants or assessed their severity in order to prepare for cleanup of the Facility.

Fourth, the RFI Draft Work Plan ignores the fact that the location and severity of contamination at the SFC facility is based in large part on groundwater contamination rather than soil contamination. Pore fluids, due to their sensitivity to sources of contamination, are much more likely to define the extent of subsurface contamination than are soil measurements (see attached FEI Figures 97 and 98). Rather than recognizing the importance of groundwater transport, the Draft Work Plan proposes a scheme which bases all of SFC's future investigations under the RFI on initial measurements of solids. As discussed above, however, even if solid measurements could be relied on, they are severely inadequate under this Draft Work Plan. Under the Draft Work Plan, groundwater will only be investigated if a single sample solid phase analysis from Phase I suggests that the Target Parameters are likely to have been exceeded. However, if the source of contamination has been removed or remediated, as is the case for Pond 2 in Study Area 2, then analysis of the surface soil would not indicate a source of contamination in this region. Yet, contamination of groundwater from this pond exists (see attached FEI Figures 97 and 98), and the degree and extent of this groundwater contamination would not be characterized under the proposed RFI Draft Work Plan. As a result, SFC will almost certainly underestimate the extent and location of groundwater contamination to a severe degree, thus jeopardizing the adequacy of the cleanup.

Fifth, the general approach outlined in the Work Plan fails to incorporate important measures proposed to the Nuclear Regulatory Commission (NRC) in the "Site Characterization Plan" (SCP) dated January 28, 1994. Although the SCP, like the RFI, has serious deficiencies (see comments on SCP by IEER and L. Lehman & Associates), it goes much farther than the RFI Draft Work Plan toward adequately defining the lateral and vertical extent of uranium contamination. In particular, SFC proposes to analyze some soil samples at depth, and about five times as many surface soil samples. Although the SCP sampling needs to be expanded (see IEER comments on SCP, comment #4), it provides a conceptual scheme for the RFI Draft Work Plan that should be followed. In fact, the SCP should be coordinated with the RFI Work Plan to provide for measurements of target parameters in all the samples collected during the Site Characterization Plan activities.

Finally, the RFI Draft Work Plan does not live up to SFC's claim in Section 3.1 that:

> "The investigation will be conducted in such a fashion to ensure that all information, data, and resulting decisions are technically sound, statistically valid, and properly documented." (p. 3-1).

Nor does it meet its claim in Section 4.4.2 that:

> "Outlier values will be included and identified with presentations of raw data." (p. 4-3).

Not only does the Draft Work Plan rely on unreliable and incomplete existing data, but SFC argues that those data are analogous to large areas of the Facility, without any rational justification for why they are comparable.

For example, although the Study Areas delineated in the Draft Work Plan are generally quite large and are composed of several smaller "units" representing disparate areas of previous industrial activity, SFC proposes only limited sampling in small portions of each Study Area. SFC proposes to analogize these limited samples to the entire Study Area, without providing any rational criteria or justification as to why they are comparable. Even in the small areas to be tested under the Draft Work Plan, the number and location of monitoring wells is inadequate to identify the location and size of contamination sources (see, e.g., the discussion of Study Area 1 below). Without a complete Data Collection Quality Assurance Plan and a description of the rationale used to assure that the data accurately and precisely represent an environmental condition at the Facility, as required by the AOC (see Appendix II Task II Section B), SFC cannot be allowed to claim that the RFI Draft Work Plan will result in information, data, and resulting decisions that will be technically sound, statistically valid and properly documented.

Deficiencies in the specific measures proposed for each Study Area are discussed below.

Specific Measures Proposed for Study Areas

Study Area 1 (SA-1; p. 2-10) - SFC proposes to collect a single sample of sludge in order to characterize an area of about 2400 square feet. By any reasonable standard, this is not a statistically valid characterization of a potential source region. Soil or sludge sampling objectives for hazardous waste facility assessments include estimating the mean, variance, and confidence intervals of soil concentration levels (see Sara, 1993). This objective can only be obtained through the acquisition of multiple samples. Moreover, EPA should reject SFC's attempt to rely on previous sludge analyses from Units 13 and 14A-14C to characterize possible sources in Study Area 1, since SFC cannot demonstrate that the data collected prior to the RFI can be compared to the results of the one sample proposed to be collected within the RFI.

Additionally the Draft Work Plan provides for monitoring wells that are both insufficient in number and poorly placed for purposes of defining the bounds of contamination of groundwater downstream from the potential sources. For instance, the most likely source in Study Area 1 (Unit 15A) is approximately 300 feet upgradient from the nearest monitoring well (MW64A/MW64). Since flow velocity is on the order of 5 feet per year in the upper aquifer, contamination from the source is not likely to reach the monitoring well for about 60 years. Thus, such a distant monitoring well would not provide sufficient information about the extent of contamination emanating from the source. At least one additional well should be installed, closer to the source.

Study Area 2 (p. 2-14) - SFC's proposal for characterization of this study area has numerous significant deficiencies. First, SFC only plans to obtain one sample from a study

area containing 10 units which do not have the same operational histories and which contained different possible sources of hazardous materials. Second, the Draft Work Plan attempts to broadly apply the results of its single proposed sludge sampling in Unit 17A to other parts of the entire study area based on the assumption that conditions for the different units are essentially similar. However, SFC has not provided a documented basis or any rationale for such a comparison.

Finally, the location, depth, and number of groundwater monitoring wells for this study area are inadequate to define the extent of the arsenic plume at the southwestern boundary of Unit 18 (Pond 2) in the deep sandstone/shale system. This is borne out by the comparison of isopleths of arsenic documented in the FEI (see attached Figure 98) and the Draft Ground Water Monitoring Interim Measures Work Plan (GMIM; see attached Appendix H). The RFI Draft Work Plan proposes to rely on the same wells used in the FEI, yet the existence of open isopleths of arsenic well above the target value (by a factor of 40) indicate that insufficient information is available from these wells to determine the true extent of arsenic contamination. It is important to note that this groundwater plume of contaminant arsenic extends beyond the restricted area of the facility. In addition, since a groundwater plume of arsenic is not observed in the shallow aquifer system, this suggests that vertical migration of arsenic in groundwater has occurred. These observations imply that the boundary area of the study area is incorrect, and they reemphasize the importance of determining the vertical extent of hydrological transport of contaminants. SFC has not determined how deep groundwater contamination extends and cannot rely on its existing wells to make this determination (see attached comments of L. Lehman & Associates). The RFI Draft Work Plan provides no indication that SFC will determine the vertical extent of the contaminant plume.

Study Area 3 (p. 2-19) - The stated objective of SFC's sampling effort for Phase I is to determine the concentration of Target Parameters in the material contained within a unit or study area. The RFI Draft Work Plan proposes to obtain a single sample from each different type of unit within the study area. However, the Draft Work Plan fails to provide sampling of several units (#9, #21, #39, #41, and #44) within this study area that are unique and thus need to be sampled in order to adequately assess the nature and degree of contamination. For instance, characterizing the tank farm at Unit #38 cannot substitute for characterizing the tank farm at Unit #39, because each unit has a different history and dates of usage. In addition, SFC does not propose to characterize the Yellowcake Storage Pad (Unit #21) at all, even though the EPA Administrative Order on Consent (Findings of Fact #19-21) clearly indicates that the area contains a variety of hazardous wastes.

Further, the RFI Draft Work Plan asserts that the single samples collected from the selected units within the study area will be representative of the concentration of the Target Parameters within the unit. However, this claim is contradicted by the FEI, which shows that within a unit the concentration of the contaminant uranium measured in the upper two feet of the soil varies by a factor of 20 (Units 1 and 21; see attached FEI Figure 104). Thus a single sample cannot be representative of a unit, and multiple samples must

be obtained from individual units to determine the statistical parameters of the concentration (average, variance, and confidence intervals) for each Target Parameter.

Moreover, in addition to the paucity of proposed sample locations, SFC's proposed sample location for Unit 1 is extremely likely to underestimate the degree of a possible source of hazardous material contamination (see attached FEI Figure 104). The information in this figure indicates that the concentration of uranium in the upper 1 foot of soil is between 5 and 40 microgram of uranium per gram of soil for the proposed location, while elsewhere in the unit (the northwestern portion) the concentration of uranium exceeds 100 microgram of uranium per gram of soil. The larger concentration of uranium elsewhere in this unit implies that the concentration of RCRA metals is likely to be higher there as well, since the source for some of these metals is the uranium ore processed in this unit.

SFC's proposal to limit its soil investigation to the upper 2 feet is also unlikely to adequately or even superficially describe the release of hazardous contaminants, since the FEI clearly shows in Table 29 (attached) that large concentrations of some of the contaminants (i.e. uranium) occurs below the depth of 2 feet, suggesting vertical mobility of hazardous contaminants. As described above, sampling under the RFI Work Plan should track sampling done under the SCP, which goes to much greater depths.

Comparison of Figures 77, 97, and 98 in the FEI (attached) with Figure 8 in the RFI Draft Work Plan, indicates both an insufficient number of monitoring wells and selection of monitoring well locations which will not detect the extent of hazardous material contamination. The RFI Draft Work Plan chooses four sets of wells in the vicinity of Unit 1 (MW3, MW20, MW11, and MW30) which all are below or at the Target Value for arsenic, yet other monitoring wells closer to the source (MW9, MW10, MW28, MW29, and MW32 in attached FEI Figure 97) clearly indicate that the Target Value for arsenic in groundwater is likely to be exceeded.

Study Area 4 (p. 2-22) - As with Study Areas 1-3 above, one Phase I sample is grossly inadequate to characterize a large study area (0.6 acre). Second, the Draft Work Plan's proposal for Study Area 4 highlights an additional problem likely to apply to several other units and study areas. This study area contains two units of known radiological contamination and possible hazardous contamination (i.e., arsenic in Units 5 and 20), one of which (Unit 20) is downgradient from the other (see attached FEI Figure 97 and GMIM Appendix H). However, there is only one monitoring well downgradient from the study area. Thus, it will be impossible to determine whether Unit 5 or Unit 20 is the likely source for non radioactive contaminants in groundwater above the Target Value. Accordingly, additional monitoring wells must be constructed within the study area.

Moreover, SFC's proposed sampling method for this study area will not result in statistically valid results. SFC states in the RFI Draft Work Plan that outlier values will not be included in summary data presentations or data evaluations. However, outliers could be important in Study Area 4 because variability of the concentration of uranium

and other possible hazardous constituents in the soil is on the order of a factor of 20. Based on the RCRA metal distribution being analogous to the uranium distribution in the soil within this study area, the three proposed samples to be collected during the RFI are likely to result in two samples having low concentrations of RCRA metals, while the third sample could contain substantially higher concentrations. Thus the three proposed sample locations are likely to result in one outlier (Unit 5). According to the inadequate information presented in Section 4.4.2, this one analysis, which is likely to show evidence for hazardous contaminants, would not be included in the summary data!

Study Area 5 (p. 2-23) - All units in this study area are associated with the ammonium nitrate "fertilizer" process and consist of ponds where the raffinate sludge and the ammonium nitrate solutions are stored. SFC states:

> "The fertilizer is contains (sic) almost pure ammonium nitrate in water with very low levels of metals due to the effectiveness of the raffinate treatment process." (p.2-23).

Yet, five of the eleven target parameter values for water are exceeded by the treated raffinate (see attached U.S. NRC, 1992, Table 1). Thus, the ammonium nitrate solution itself should be considered a RCRA waste and should therefore be tested for all Target Parameters contaminants. SFC does not propose to do this, but rather proposes to rely on its previous analyses of the ammonium nitrate "fertilizer" solutions to characterize this potential source of contamination. This is completely unacceptable, however, because the methods SFC used to measure raffinate constituents were not sensitive enough to measure some of the target parameters values listed in the RFI (see Table 1); nor were they completed using EPA approved procedures (see attached EPA comments on Ground Water Monitoring Interim Measures Work Plan). In addition not all target parameters were measured in previous analyses (e.g. silver and beryllium). Thus SFC should not be allowed to rely on its previous results to characterize this study area.

Finally, the Draft Work Plan's proposal for characterizing raffinate sludge in Unit 24D is utterly baseless. Although the Draft Work Plan states:

> "SA-2, in particular Unit 17 and Unit 18, characteristics will be used to evaluate Unit 24D..." (p.2-23),

in fact, Unit 18 itself is not being characterized at all. Thus, it can hardly form the basis for characterization of Unit 24D. Moreover, the only sampling that SFC proposes for Unit 24D is a single test of the **liquid** portion and not the raffinate sludge:

> "...Pond 4 (Unit 24D) contains raffinate sludge which is the recipient of metals derived from the raffinate treatment process. A sample will be obtained from the liquid portion of Unit 24D..." (p. 2-23).

Because most of the hazardous contaminants, and indeed the contaminant source in this study area is likely to be the sludge in the bottom of this unit, a single sample of the liquid in the Unit is completely inadequate to characterize its contaminants.

Study Area 6 (p. 2-25) - The RFI Draft Work Plan states that material in Unit 12 is similar to material in Study Area 1.

> "Phase I characterization will therefore be based on characterization results for Study Area 6. Phase II sampling for SA-6 will be performed in accordance with the reasoning and protocol outlined for SA-1"

Yet, there is no plan to characterize Study Area 6 as documented in Section 2.2.6.2 of the Work Plan. This nonsensical statement may be a typographical error. However, if indeed SFC intends to rely on characteristics of Study Area 1 in order to characterize Study Area 6, then it will have to provide a clear documented justification for the use of this analogy (i.e. analytical results that can be compared for the two areas).

Goal #4 - Identify actual and potential receptors.

The accurate determination of actual and potential receptors (i.e. the people or wildlife exposed to the hazardous contamination) is dependent upon an adequate characterization of the source of contamination and proper determination of contaminant release and transport processes (see Sara, 1993). Thus the ability to achieve Goal #4 depends heavily on satisfaction of Goals 1, 2, and 3. If SFC does not adequately and accurately characterize the potential pathways of contamination, and the source, degree, and extent of contamination, then the actual and potential receptors cannot be specified with confidence. As discussed above, and in the comments of L. Lehman & Associates, the Work Plan falls far short of achieving the first three goals; thus, the Work Plan provides no basis for achieving the fourth goal.

Goal #5 - Support the development of alternatives from which a corrective measure will be selected by EPA.

Selection of alternative strategies implies that sufficient information is provided to evaluate the alternatives and justify the acceptance of a particular alternative. However, given the gross inadequacy of SFC's proposal for characterizing the contamination at this Facility, there is no foundation for the development of alternatives from which corrective measures could be selected by the EPA.

CONCLUSION

As discussed above, the RFI Draft Work Plan is seriously flawed, and cannot be relied on to provide an adequate basis for the ultimate cleanup of the SFC Facility. It must be substantially revised before it can meet the criteria established in the AOC.

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Sequoyah Fuels Corporation, Draft RCRA Facility Investigation Work Plan, January 28, 1994.

Sequoyah Fuels Corporation, Site Characterization Plan, January 28, 1994.

U.S. Environmental Protection Agency, Comments on: Sequoyah Fuels Corporation Ground Water Monitoring Interim Measures Work Plan, as incorporated in FAX from Efren Ordonez, EPA Region 6, to Lance Hughes, November 11, 1993.

U.S. Nuclear Regulatory Commission, Raffinate and groundwater sample analyses for the Sequoyah facility (NRC Inspection Report No. 40-8027/92-06), Letter to Sequoyah Fuels Corporation, September 21, 1992.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
1445 ROSS AVENUE, SUITE 1200
DALLAS, TX 75202-2733

TELEFAX COVER SHEET

DATE: 11/4/93

TO: LANCE HUGHES

ORGANIZATION: NACE

FAX: (918) 458-0322 PHONE: (918) 458-4322

NUMBER OF PAGES TO FOLLOW: 8

FROM: EFREN ORDONEZ

ORGANIZATION: EPA, Region 6

FAX: (214)655-2182 PHONE: 214/655-2181

Remarks: Enclosed please find the comments provided to Sequoyah.

Ground Water Monitoring Interim Measures Work Plan Comments

General Comments

- Comments, as appropriate, regarding information contained in the Facility Environmental Investigation Report (1991) will be made during development of the RFI Work Plan.

Section 3.0, Paragraph 2, Page 3-1

- Within this paragraph SFC states that the FEI characterized the presence and extent of licensed material and other constituents in the ground water systems beneath the facility. It is not clear whether "other constituents" refer to hazardous constituents defined under the Resource Conservation and Recovery Act (RCRA). The nature and extent of hazardous constituents released from the facility will be determined within the RCRA Facility Investigation (RFI). Therefore, the referenced statement in the Ground Water Monitoring Interim Measure Work Plan (GWMIMWP) shall be deleted or modified to indicate the nature and extent of contamination will be addressed in the RFI.

Section 3.1, Page 3-2

- Comments, as appropriate, regarding the geology at the site will be made during the RFI Work Plan development.

Section 3.2, Page 3-4

- Comments, as appropriate, regarding the hydrogeology at the site will be made during the RFI Work Plan development.

Section 4.0, Paragraph 1, Page 4-1

- This paragraph states that the FEI revealed the extent to which process leaks and spills over the 20 years of operations had impacted the surrounding soils and ground water. The nature and extent of hazardous constituents released from the facility will be determined within the RCRA Facility Investigation (RFI). Therefore, the referenced statement in the GWMIMWP shall be deleted or modified to indicate the nature and extent of contamination will be addressed in the RFI.

Section 4.2, Paragraph 2, Page 4-2

- The GWMIMWP indicates that Roberts/Schornick and Associates utilized the procedures and protocols required by the EPA in conducting a RCRA Facility Investigation for completing the FEI. The GWMIMWP should indicate that EPA did not approve ★

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any workplans associated with the FEI.

Section 4.2, Paragraph 3, Page 4-3

- This paragraph states, "As areas of ground water impact were identified the investigation expanded with the installation of additional wells to determine the full extent of the impact. It is not clear what is defined by "areas of ground water impact". The nature and extent of hazardous constituents released from the facility will be determined within the RCRA Facility Investigation (RFI). Therefore, the referenced statement in the GWMIMWP shall be deleted or modified to indicate the nature and extent of contamination will be addressed during the RFI.

Section 4.2, Page 4-4

- Comments, as appropriate, regarding the chemical constituents associated with past and present operations at the facility will be made during the RFI Work Plan development.

Section 4.3, Page 4-5

- This section indicates that after the FEI was submitted in July 1991, several additional ground water monitoring wells were installed to further delineate and bound ground water impact previously identified during the FEI. Two comments related to the above statement are: (1) SFC should indicate what entity the FEI was submitted to in July 1991, and (2) the nature and extent of hazardous constituents released from the facility will be determined within the RFI. The referenced statement in the GWMIMWP shall be deleted or modified to indicate the above issues.

Section 4.5, Page 4-6

- This section of the GWMIMWP indicates that the FEI ground water monitoring well system has undergone a series of sampling events during the time period of 1990 to 1993. The GWMIMWP should indicate that none of these sampling events were performed pursuant to any EPA requirements.

Section 4.5.1, Page 4-7

- This section of the GWMIMWP discusses results from Sample Event No. 3 (March 7-8, 1991) performed by SFC. Several statements within this section indicate that the levels of constituents detected during the above sampling event present no known environmental hazard. A determination of the hazards associated with the environmental releases of

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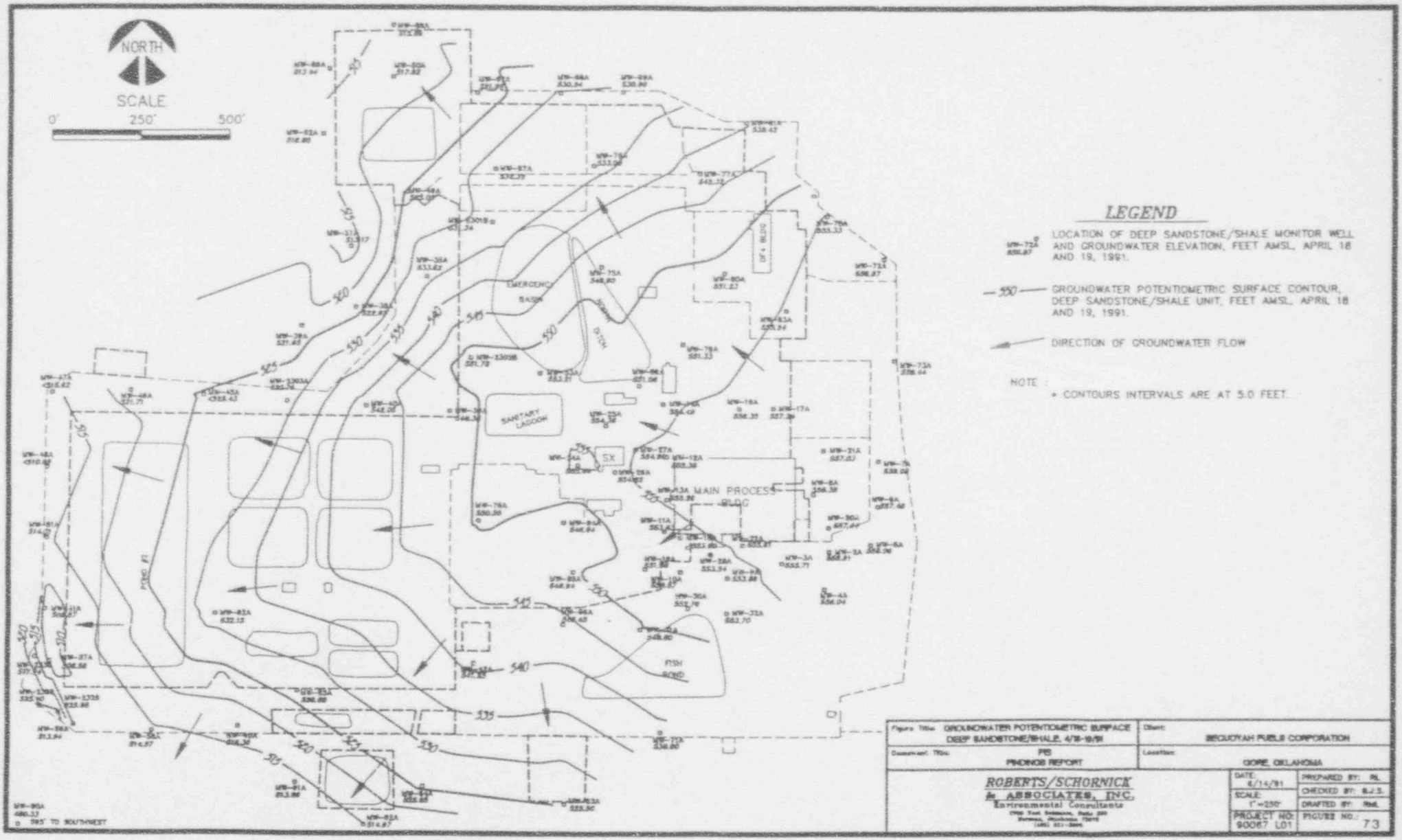
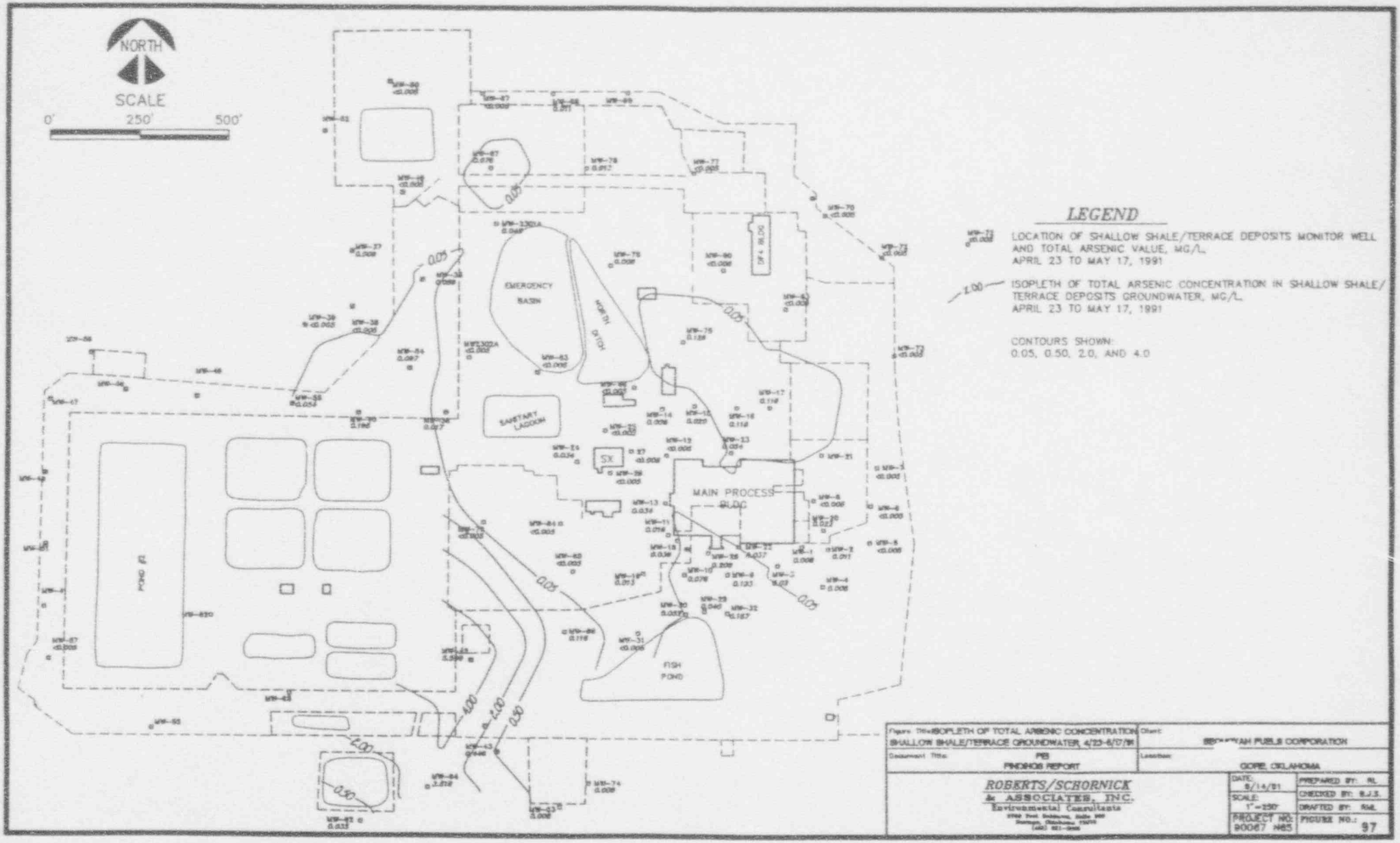

NORTH
SCALE
0'
250'
500'
LEGEND
LOCATION OF DEEP SANDSTONE/SHALE MONITOR WELL AND GROUNDWATER ELEVATION, FEET AMSL, APRIL 18 AND 19, 1991.
GROUNDWATER POTENTIOMETRIC SURFACE CONTOUR, DEEP SANDSTONE/SHALE UNIT, FEET AMSL, APRIL 18 AND 19, 1991.
DIRECTION OF GROUNDWATER FLOW
NOTE :
+ CONTOURS INTERVALS ARE AT 5.0 FEET.
EMERGENCY BASIN
SANITARY LAGOON
MAIN PROCESS BLDG
FISH POND
DIKE #1
DIKE #2
DIKE #3
DIKE #4
SX
Figure Title: GROUNDWATER POTENTIOMETRIC SURFACE DEEP SANDSTONE/SHALE, 4/18-19/91
Client: SEQUOYAH FUELS CORPORATION
Document Title: PEI FINDINGS REPORT
Location: GORE, OKLAHOMA
ROBERTS/SCHORNICK & ASSOCIATES, INC.
Environmental Consultants
DATE: 4/14/91
SCALE: 1" = 250'
PROJECT NO: 90067 L01
FIGURE NO.: 73
PREPARED BY: RL
CHECKED BY: B.J.S.
DRAFTED BY: RHL


NORTH
SCALE
0'
250'
500'
EMERGENCY BASIN
EASTART LAGOON
MAIN PROCESS BLDG
FISH POND
POND #1
SX
DRY WELDG
MAIN DITCH
LEGEND
LOCATION OF SHALLOW SHALE/TERRACE DEPOSITS MONITOR WELL AND TOTAL ARSENIC VALUE, MG/L, APRIL 23 TO MAY 17, 1991
ISOPLETH OF TOTAL ARSENIC CONCENTRATION IN SHALLOW SHALE/TERRACE DEPOSITS GROUNDWATER, MG/L, APRIL 23 TO MAY 17, 1991
CONTOURS SHOWN:
0.05, 0.50, 2.0, AND 4.0
Figure Title: ISOPLETH OF TOTAL ARSENIC CONCENTRATION SHALLOW SHALE/TERRACE GROUNDWATER, 4/23-5/17/91
Client:
Document Title: PBS FINDINGS REPORT
Location: CUSHING, OKLAHOMA
ROBERTS/SCHORNICK & ASSOCIATES, INC.
Environmental Consultants
DATE: 8/14/91
SCALE: 1" = 250'
PROJECT NO: 90067 H65
PREPARED BY: RL
CHECKED BY: B.J.S.
DRAFTED BY: RML
FIGURE NO.: 97

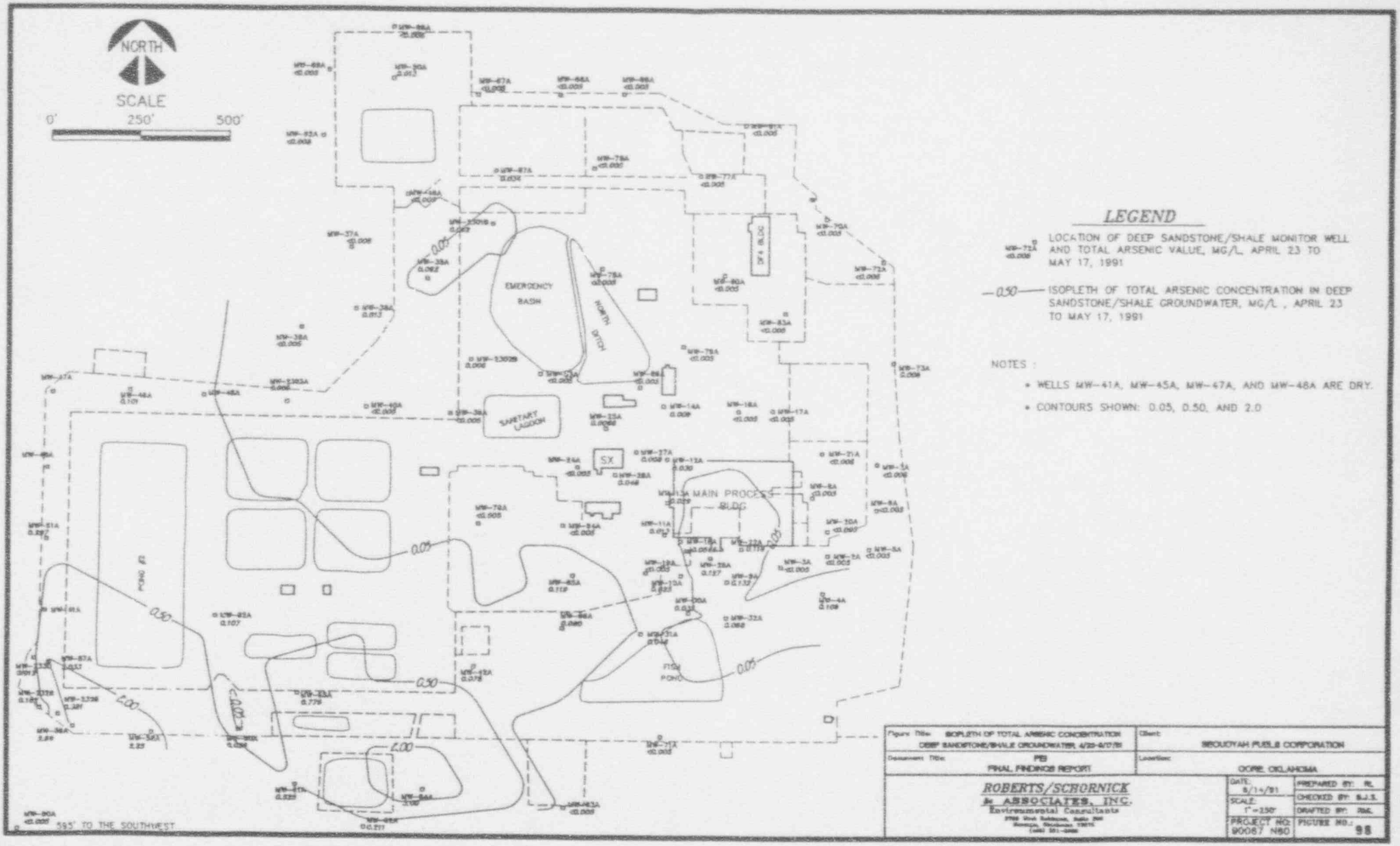

NORTH
SCALE
0'
250'
500'
EMERGENCY BASIN
NORTH DITCH
SURFACT LAGOON
SX
MAIN PROCESS BLDG
POND #1
FISH POND
595' TO THE SOUTHWEST
LEGEND
LOCATION OF DEEP SANDSTONE/SHALE MONITOR WELL AND TOTAL ARSENIC VALUE, MG/L, APRIL 23 TO MAY 17, 1991
0.50 ISOPLETH OF TOTAL ARSENIC CONCENTRATION IN DEEP SANDSTONE/SHALE GROUNDWATER, MG/L, APRIL 23 TO MAY 17, 1991
NOTES :
• WELLS MW-41A, MW-45A, MW-47A, AND MW-48A ARE DRY.
• CONTOURS SHOWN: 0.05, 0.50, AND 2.0
Figure Title: ISOPLETH OF TOTAL ARSENIC CONCENTRATION DEEP SANDSTONE/SHALE GROUNDWATER, 4/23-5/17/91
Client: SEQUOYAH FUELS CORPORATION
Document Title: FSI FINAL FINDINGS REPORT
Location: GORE, OKLAHOMA
ROBERTS/SCHORNICK & ASSOCIATES, INC. Environmental Consultants
DATE: 6/14/91
SCALE: 1"=250'
PROJECT NO: 90067 N80
PREPARED BY: RL
CHECKED BY: S.J.S.
DRAFTED BY: RML
FIGURE NO.: 9S

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TABLE 4-2. CHEMICAL ANALYSIS RESULTS

AMMONIUM NITRATE FERTILIZER
1992 Season Average (2)

ANALYSIS	As	Ba	Cd	Cr	Pb	Hg	Se	Ag	U
Total Metals, mg/l Pond 6	0.72	0.34	<0.01	<0.02	<0.10	<0.0002	<0.01	NA (1)	<0.006

RAFFINATE SLUDGE
March, 1993

ANALYSIS	As	Ba	Cd	Cr	Pb	Hg	Se	Ag	U
Total Metals, mg/kg Pond 4	350.0	5450.0	<5.0	70.0	120.0	0.15	27.1	8.0	4200
Leachable Metals, mg/l Pond 4	0.16	0.57	0.037	<0.05	<0.1	0.0004	0.09	<0.05	NA
Total Metals, mg/kg Clarifier 4A	154.2	NA	<0.3	40.0	41.4	NA	3.0	1.0	16000
Leachable Metals, mg/l Clarifier 4A	<0.001	<0.01	<0.005	<0.01	<0.02	0.0025	<0.002	<0.01	NA

FLUORIDE SLUDGE
March, 1993

ANALYSIS	As	Ba	Cd	Cr	Pb	Hg	Se	Ag	U
Total Metals, mg/kg Fluoride Holding Basin 1	141.0	14.0	<0.3	22.8	2.8	NA	<3.0	1.9	NA
Total Metals, mg/kg Fluoride Holding Basin 2	2.5	13.6	<0.3	16.4	2.0	NA	<3.0	1.8	NA
Total Metals, mg/kg Fluoride Setting Basin 1	67.1	23.3	<0.3	18.3	4.4	NA	<3.0	2.0	NA
Total Metals, mg/kg Fluoride Setting Basin 2	17.2	20.5	<0.3	13.9	3.1	NA	<3.0	5.3	NA
Total Metals, mg/kg Fluoride Clarifier	3.5	14.4	<0.3	11.1	2.5	NA	<3.0	<0.3	NA
Leachable Metals, mg/l Composite Sample (3)	0.018	0.30	<0.025	<0.05	<0.01	<0.0002	<0.01	<0.05	NA
Total Metals, mg/kg Composite Sample (2)	NA	NA	NA	NA	NA	NA	NA	NA	1245

NOTES

(1) In the tables the term "NA" means "not available"

(2) Only a partial list of parameters are included here

Sequoyah Fuels Corporation, Description of Current Conditions and Investigations, November 1, 1993

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APPENDIX 2

AVERAGE CONCENTRATIONS OF ELEMENTS
IN AMMONIUM NITRATE FERTILIZER SOLUTION

1992 APPLICATIONS					
Element	Unit	Sequoyah	Rabbit Hill	George's Fork East	George's Fork West
As	mg/l	0.76	0.69	0.69	0.74
B	mg/l	1.07	0.94	1.07	1.03
Ba	mg/l	0.36	0.30	0.34	0.34
Cd	mg/l	<0.01	<0.01	<0.01	<0.01
Co	mg/l	0.21	0.18	0.18	0.20
Cr	mg/l	0.03	0.02	<0.01	0.016
Cu	mg/l	2.53	2.33	2.61	2.51
F	mg/l	8.56	9.60	10.30	10.30
Fe	mg/l	<0.02	<0.02	<0.02	<0.02
Hg	mg/l	<0.0002	<0.0002	<0.0002	<0.0002
Mg	mg/l	95.24	87.66	96.26	93.91
Mn	mg/l	12.29	11.46	12.37	11.62
Mo	mg/l	15.78	14.36	15.23	14.55
Ni	mg/l	6.22	5.60	6.16	5.82
Pb	mg/l	<0.1	<0.1	<0.1	<0.1
Se	mg/l	<0.1	<0.1	<0.1	<0.1
V	mg/l	0.26	0.23	0.20	0.22
Zn	mg/l	0.77	0.71	0.80	0.77
U	µg/l	5.95	<5.0	8.0	5.55
NO3 N	mg/l	7090.0	6580.0	8195.0	8070.0
NH3 N	mg/l	6965.0	6420.0	7510.0	7540.0
Ra-226	pCi/l	0.15	0.30	0.25	0.25
Th-230	pCi/l	<0.40	<0.40	<0.40	<0.40

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION IV
611 RYAN PLAZA DRIVE, SUITE 400
ARLINGTON, TEXAS 76011-8064

Cancc Arjun

has untreated raffinate samples.

SEP 21 1992

In Reply Refer To:
License No. SUB-1010
Docket No. 40-8027

Sequoyah Fuels Corporation
(Subsidiary of General Atomics)
ATTN: James J. Sheppard, President
P.O. Box 610
Gore, Oklahoma 74435

Gentlemen:

SUBJECT: RAFFINATE AND GROUNDWATER SAMPLE ANALYSES FOR THE SEQUOYAH FACILITY (NRC INSPECTION REPORT NO. 40-8027/92-06)

This refers to the sample analysis for solution samples collected at the Sequoyah facility during an inspection conducted on April 6-10, 1992. During the inspection, samples were collected from two ground-water monitoring wells (Nos. MW91A and MW93A) and a treated raffinate pond (Pond 3E), as well as a sample of untreated raffinate collected from the centrifuge building. As we noted in the subject inspection report, the samples were sent to Oak Ridge National Laboratory for constituent analysis.

The enclosures provided with this letter summarizes the data obtained from this review. For ease in comparison, the data is provided in table form with sample results converted to similar units as well as an attachment which includes the data as received from Oak Ridge.

We are continuing our review with staff members from the Office of Nuclear Materials Safety and Safeguards to evaluate the information as it applies to your environmental monitoring program. Therefore, no response to this letter is required.

Should you have any questions regarding this letter we will be pleased to discuss them with you.

Sincerely,

E. J. Callan, Director
Division of Radiation Safety
and Safeguards

Enclosures:
As stated

ENCLOSURE

Table 1

CONSTITUENT	WELL		RAFFINATE	
mg/l	MW91A	MW93A	Untreated	Treated
Ag	<0.005	<0.005	<0.22	<0.005
Al	4.9	<0.05	1600	<0.05
As	<0.01	<0.05	50.0	0.43
B	0.08	0.90	4.5	1.1
Ba	0.077	0.068	4.5	0.440
Be	<0.001	<0.001	0.30	0.0013
Ca	53	110.0	1400.0	300.0
Cd	<0.001	<0.005	<0.22	.026
Co	0.0065	<0.004	2.2	0.16
Cr	0.018	0.0082	7.0	0.019
Cu	<0.007	<0.007	22.0	2.8
Fe	9.6	<0.005	1500.0	0.43
Hg	0.00003	No data	0.013	0.00028
Li	<15.0	<15.0	<660.0	<15.0
Mg	30.0	42.0	250.0	54.0
Mn	1.4	0.075	100.0	7.0
Mo	0.013	<0.04	130.0	9.6
Na	38	240.0	1500.0	1100.00
Ni	0.02	<0.004	36.0	5.4
NO_3	20	30	51000	27000
P	<0.30	0.78	170.0	19.0
Pb	<0.05	<0.05	8.4	<0.07
Sb	<0.05	<0.05	<2.2	0.082
Se	0.005	<0.05	<2.2	0.12
Si	13.0	5.7	130.0	2.3
Sn	<0.05	<0.05	2.2	<0.05
Sr	0.32	1.3	28.0	1.9
Ti	<0.02	<0.02	25.0	<0.02

CONSTITUENT	WELL		RAFFINATE	
mg/l	MW91A	MW93A	Untreated	Treated
V	0.01	<0.002	98.0	0.032
Zn	0.031	<0.005	17.0	0.35
Zr	<0.02	<0.02	80.0	<0.02
pCi/l				
G. ALPHA	3.78	7.03	1837360	3.24
Ra-226	2.16	<0.89	143206	1.46
Th-230	0.16	0.08	972720	0.51
U-nat	1.22	2.27	170226	4.05

Detection Limits:

arsenic	0.01 mg/l
barium	0.10 mg/l
beryllium	0.01 mg/l
cadmium	0.001 mg/l
chromium	0.01 mg/l
lead	0.01 mg/l
mercury	0.001 mg/l
molybdenum	0.01 mg/l
nickel	0.01 mg/l
selenium	0.001 mg/l
vanadium	0.01 mg/l

TABLE 72: SUMMARY OF GROUNDWATER LABORATORY ANALYTICAL DATA, SPECIAL WELL SAMPLINGS
UNIT AND GROUNDWATER INVESTIGATIONS
SEQUOYAH FUELS CORPORATION

WELL NO: / SAMPLE DATE:	MW-7 3-7/8-91	MW-7 5-2-91	MW-7A 5-2-91	MW-10 3-7/8-91	MW-10 DUP 3-7/8-91	MW-10 5-2-91	MW-10A 5-2-91	MW-12 5-1-91	MW-12A 5-1-91	MW-18 5-1-91	MW-18A 5-1-91	MW-25 3-7/8-91
TOTAL METALS, MG/L												
ANTIMONY	<0.003	---	---	<0.003	<0.003	---	---	---	---	---	---	<0.003
ARSENIC	<0.001	---	---	0.108	0.127	---	---	---	---	---	---	0.004
BARIUM	0.15	---	---	0.44	0.69	---	---	---	---	---	---	2.26
BERYLLIUM	<0.01	---	---	0.02	0.03	---	---	---	---	---	---	<0.01
CADMIUM	<0.005	---	---	<0.005	0.007	---	---	---	---	---	---	0.006
CHROMIUM	<0.01	---	---	<0.01	<0.01	---	---	---	---	---	---	<0.01
COPPER	<0.01	---	---	0.06	0.09	---	---	---	---	---	---	<0.01
IRON	1.66	0.15	0.10	3.30	4.44	0.80	1.65	0.15	0.73	1.42	0.12	1.68
LEAD	<0.02	---	---	0.06	0.10	---	---	---	---	---	---	<0.02
MAGNESIUM	13.3	---	---	20.9	28.4	---	---	---	---	---	---	378
MANGANESE	---	0.01	0.01	---	---	10.30	0.06	0.02	0.40	7.48	0.02	---
MERCURY	<0.0002	---	---	0.0002	0.0002	---	---	---	---	---	---	<0.0002
MOLYBDENUM	<0.01	---	---	0.01	0.02	---	---	---	---	---	---	<0.01
NICKEL	<0.01	---	---	0.61	0.72	---	---	---	---	---	---	0.03
SELENIUM	0.004	---	---	<0.002	<0.002	---	---	---	---	---	---	<0.002
SILVER	<0.01	---	---	0.04	0.06	---	---	---	---	---	---	0.04
THALLIUM	<0.001	---	---	<0.001	0.001	---	---	---	---	---	---	<0.001
URANIUM	0.0093	0.0125	0.0305	52.6	49.9	39.5	0.0215	2.83	16.96	4.03	0.022	21.0
VANADIUM	0.01	---	---	0.09	0.14	---	---	---	---	---	---	0.03
ZINC	0.051	---	---	0.463	0.578	---	---	---	---	---	---	0.009
DISSOLVED METALS, MG/L												
ARSENIC	---	0.057	0.027	---	---	0.190	0.094	0.001	0.02	0.034	0.04	---
CALCIUM	---	39.4	42.7	---	---	91.9	102	85.6	2170	80.2	47.3	---
IRON	---	<0.02	0.02	---	---	0.80	0.03	0.05	0.68	1.27	0.03	---
POTASSIUM	---	1.1	1.4	---	---	6.9	7.8	1.3	12.3	4.2	1.3	---
MAGNESIUM	---	13.4	17.4	---	---	23.5	0.06	25.8	683.0	22.7	14.3	---
MANGANESE	---	<0.01	<0.01	---	---	11.1	<0.01	<0.01	0.40	6.13	0.01	---
SODIUM	---	74.5	51.7	---	---	63.4	155	68.9	2840	68.4	40.1	---
URANIUM	---	0.0012	0.0012	---	---	28.3	<0.0003	2.48	14.73	1.23	0.0063	---
OTHER												
AMMONIA AS N, MG/L	---	<0.1	<0.1	---	---	3.6	2.2	<0.1	<0.1	1.5	<0.1	---
NITRATE AS N, MG/L	---	1.1	3.5	---	---	96.6	0.4	29.3	91.7	44.5	4.9	---
TOTAL KJELDAHL NITROGEN, MG/L	---	<0.1	<0.1	---	---	3.8	2.3	0.1	0.2	1.4	<0.1	---
CHLORIDE, MG/L	---	<1	7	---	---	60	48	14.1	10300	78.1	71.9	---
DISSOLVED ORGANIC CARBON, MG/L	---	3	4	---	---	5	6	12	1	8	2	---
TOTAL ORGANIC CARBON, MG/L	---	1	1	---	---	7	4	2	<1	10	2	---
FLUORIDE, MG/L	---	0.9	0.7	---	---	5.0	1.2	1.0	0.2	1.9	1.3	---
PHOSPHATE, MG/L	---	0.2	0.2	---	---	<0.1	<0.1	0.2	0.2	0.2	<0.1	---
SILICA, MG/L	---	13.3	13.6	---	---	10.2	7.93	16	20.6	9.75	15.1	---
SULFATE, MG/L	---	115	40	---	---	58	8	60	102	67	30	---
TOTAL DISSOLVED SOLIDS, MG/L	---	320	320	---	---	780	530	490	17140	550	250	---

TABLE 72: CONTINUED

WELL NO.: / SAMPLE DATE:	MW-25 5-1-91	MW-25A 5-1-91	MW-35 5-2-91	MW-49A 5-1-91	MW-50 5-9-91	MW-50A 5-1-91	MW-57A 5-2/8-91	MW-59A 3-7/8-91	MW-59A	MW-59A DUP	MW-63 5-2-91	MW-63A 5-2-91
TOTAL METALS, MG/L									almost background			
ANTIMONY	---	---	---	---	---	---	---	<0.003	---	---	---	---
ARSENIC	---	---	---	---	---	---	---	1.71	---	---	---	---
BARIUM	---	---	---	---	---	---	---	0.25	---	---	---	---
BERYLLIUM	---	---	---	---	---	---	---	<0.01	---	---	---	---
CADMIUM	---	---	---	---	---	---	---	0.022	---	---	---	---
CHROMIUM	---	---	---	---	---	---	---	<0.01	---	---	---	---
COPPER	---	---	---	---	---	---	---	<0.01	---	---	---	---
IRON	0.52	0.70	0.30	0.20	0.42	0.25	3.42	3.75	0.98	9.1	0.13	146
LEAD	---	---	---	---	---	---	---	<0.02	---	---	---	---
MAGNESIUM	---	---	---	---	---	---	---	590	---	---	---	---
MANGANESE	0.85	0.24	11.6	0.13	3.27	0.25	1.83	---	0.30	0.36	1.03	0.20
MERCURY	---	---	---	---	---	---	---	<0.0002	---	---	---	---
MOLYBDENUM	---	---	---	---	---	---	---	<0.01	---	---	---	---
NICKEL	---	---	---	---	---	---	---	0.02	---	---	---	---
SELENIUM	---	---	---	---	---	---	---	0.015	---	---	---	---
SILVER	---	---	---	---	---	---	---	<0.01	---	---	---	---
THALLIUM	---	---	---	---	---	---	---	<0.001	---	---	---	---
URANIUM	27.40	1.56	0.212	0.0056	0.0063	0.59	0.013	0.0424	0.0078	0.0089	0.003	0.0048
VANADIUM	---	---	---	---	---	---	---	0.04	---	---	---	---
ZINC	---	---	---	---	---	---	---	0.008	---	---	---	---
DISSOLVED METALS, MG/L												
ARSENIC	0.005	0.007	0.198	0.002	<0.001	0.012	1.10	---	3.13	3.11	<0.001	0.015
CALCIUM	1020	1710	434	266	532 (511)	440	2140 (2300)	---	7860	2760	29.0	46.3
IRON	0.43	0.53	0.15	0.10	0.04	0.15	0.27	---	<0.02	<0.02	0.02	0.02
POTASSIUM	4.3	6.7	2.1	3.8	4.1 (4.0)	6.6	7.9 (6.96)	---	5.1	5.0	0.6	1.4
MAGNESIUM	313	581	127	111	224 (204)	337	638 (636)	---	7.64	744	7.02	22.9
MANGANESE	0.69	0.23	11.6	0.13	3.2	0.24	1.53	---	0.23	0.18	1.02	0.09
SODIUM	161	650	197	191	700 (640)	374	496 (436)	---	717	594	26.3	60.2
URANIUM	10.36	1.48	0.191	0.0032	0.0018	0.55	0.0045	---	0.0047	0.0045	<0.0003	0.00105
OTHER												
AMMONIA AS N, MG/L	<0.1	<0.1	3.4	<0.1	<0.1	<0.1	1.1 (1.5)	---	2.0	1.9	0.2	0.2
NITRATE AS N, MG/L	1250	305	531	22.8	5.3	21.1	2610 (2400)	---	2650	2640	0.2	0.1
TOTAL KJELDAHL NITROGEN, MG/L	0.2	<0.1	3.5	0.1	<1.0	<0.1	0.8	---	2.0	2.1	0.2	3.2
CHLORIDE, MG/L	30.1	5290	59	132	331	114	210	---	95	95	68	19
DISSOLVED ORGANIC CARBON, MG/L	2	3	18	27	33	2	12	---	4.9	5.1	7	2
TOTAL ORGANIC CARBON, MG/L	2	<1	14	16	13	2	41	---	7.9	8.3	6	3
FLUORIDE, MG/L	0.2	0.2	0.4	0.5	0.3	0.3	0.2	---	0.3	0.3	0.9	1.2
PHOSPHATE, MG/L	<1	<1	0.1	<0.1	0.1	<0.1	0.2 (<0.1)	---	<0.1	<0.1	<0.1	0.2
SILICA, MG/L	25.7	16.2	20.8	9.24	21 (22)	8.83	11.1 (13.7)	---	---	---	19.9	13.5
SULFATE, MG/L	13	58	170	790	2940	3020	286	---	294	302	32.1	45.3
TOTAL DISSOLVED SOLIDS, MG/L	9200	10300	3990	1960	5090	4260	19500	---	17,800	17,100	170	340

FEI

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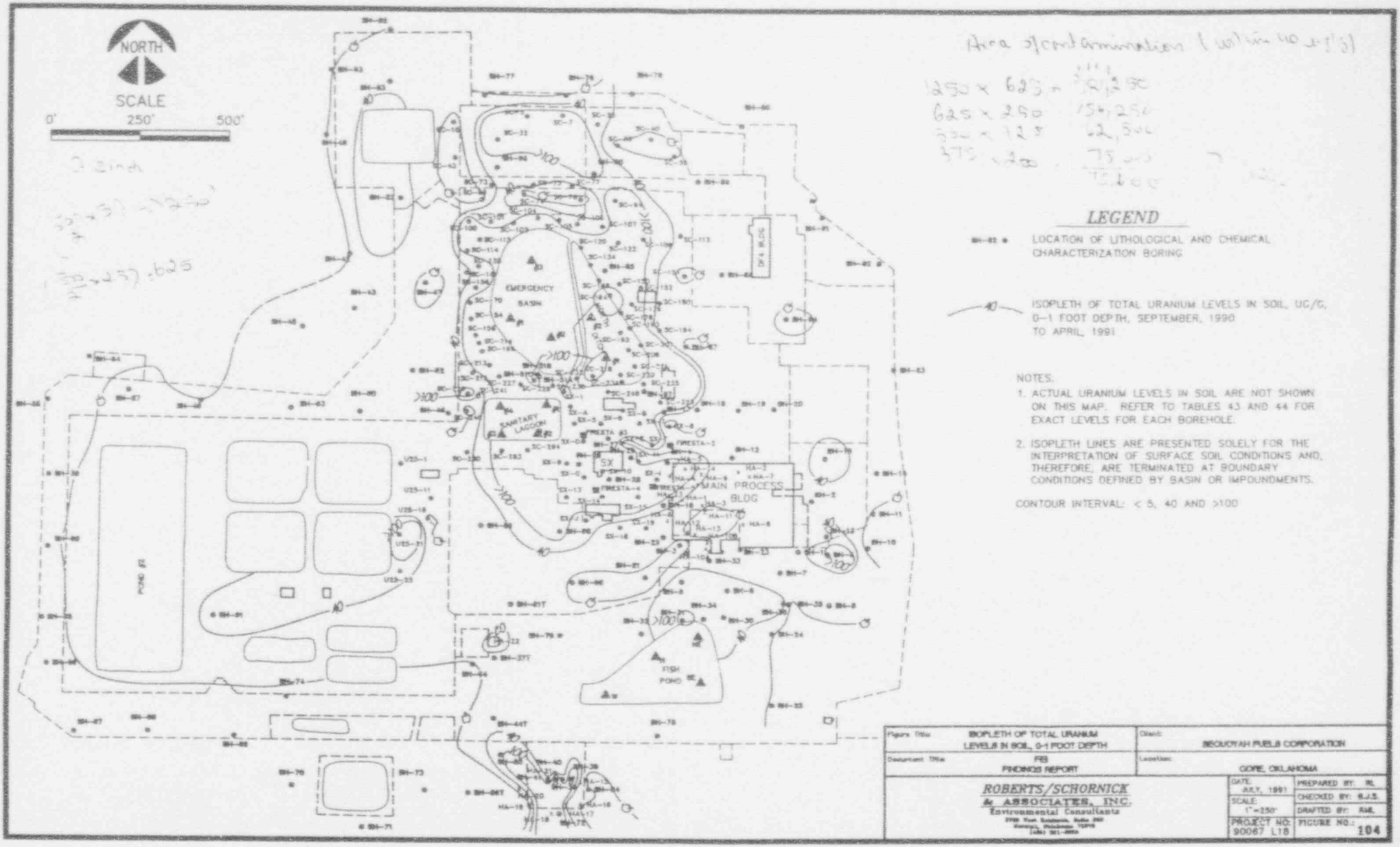

NORTH
SCALE
0'
250'
500'
EMERGENCY BASIN
SANITARY LAGOON
MAIN PROCESS BLDG
FISH POND
POND #2
SX
LEGEND
LOCATION OF LITHOLOGICAL AND CHEMICAL CHARACTERIZATION BORING
ISOPLETH OF TOTAL URANIUM LEVELS IN SOIL, UG/G, 0-1 FOOT DEPTH, SEPTEMBER, 1990 TO APRIL, 1991
NOTES:
1. ACTUAL URANIUM LEVELS IN SOIL ARE NOT SHOWN ON THIS MAP. REFER TO TABLES 43 AND 44 FOR EXACT LEVELS FOR EACH BOREHOLE.
2. ISOPLETH LINES ARE PRESENTED SOLELY FOR THE INTERPRETATION OF SURFACE SOIL CONDITIONS AND, THEREFORE, ARE TERMINATED AT BOUNDARY CONDITIONS DEFINED BY BASIN OR IMPOUNDMENTS.
CONTOUR INTERVAL: < 5, 40 AND >100
Figure Title: ISOPLETH OF TOTAL URANIUM LEVELS IN SOIL, 0-1 FOOT DEPTH
Document Title: FRS FINDINGS REPORT
Client: SEQUOYAH FUELS CORPORATION
Location: GORE, OKLAHOMA
ROBERTS/SCHORNICK & ASSOCIATES, INC.
Environmental Consultants
DATE: JULY, 1991
SCALE: 1"=250'
PROJECT NO: 90067 L18
PREPARED BY: RL
CHECKED BY: S.J.S.
DRAFTED BY: RAE
FIGURE NO.: 104

TABLE 29: CONTINUED

SAMPLE LOCATION	SAMPLE NUMBER	*DEPTH INTERVAL FEET	DATE SAMPLED	URANIUM UG/G	FLUORIDE UG/G	NITRATE UG/G
	S-16	12.5 - 13.0		<5.0	NA	NA
	S-17	13.0 - 13.3		<5.0	NA	NA
	---	13.3 - 15.0		NR	NA	NA
	S-18	15.0 - 15.5		<5.0	NA	NA
	S-19	15.5 - 16.0		<5.0	NA	NA
	S-20	16.0 - 16.5		<5.0	NA	NA
	S-20, SPIKE	16.0 - 16.5		<5.0	NA	NA
	S-21	16.5 - 17.0		<5.0	NA	NA
	S-22	17.0 - 17.5		<5.0	NA	NA
	S-23	17.5 - 18.0		<5.0	NA	NA
	S-24	18.0 - 18.4		<5.0	NA	NA
	S-24, SPIKE	18.0 - 18.4		90% RECOVERY	NA	NA
BH-2A (MW-8A)	S-1	18.0 - 20.0	10/7/90	<5.0	NA	NA
	S-2	20.0 - 22.0		<5.0	NA	NA
	S-3	22.0 - 24.0		<5.0	NA	NA
	S-4	24.0 - 26.0		<5.0	NA	NA
	S-5	26.0 - 28.0		<5.0	NA	NA
	S-6	28.0 - 30.0		<5.0	NA	NA
	S-7	30.0 - 32.0		<5.0	NA	NA
BH-3 (MW-18)	S-1	0.0 - 0.5	9/24/90	<5.0	NA	NA
	S-2	0.5 - 1.0		<5.0	NA	NA
	S-3	1.0 - 1.2		<5.0	NA	NA
	---	1.2 - 5.0		NR	NA	NA
	S-4	5.0 - 5.5		<5.0	NA	NA
	S-5	5.5 - 6.0		<5.0	NA	NA
	S-6	6.0 - 6.5		<5.0	NA	NA
	S-7	6.5 - 7.0		<5.0	NA	NA
	S-8	7.0 - 7.5		<5.0	NA	NA
	S-9	7.5 - 8.0		<5.0	NA	NA
	S-10	8.0 - 8.5		<5.0	NA	NA
	S-11	8.5 - 9.0		<5.0	NA	NA
	S-12	9.0 - 9.5		<5.0	NA	NA
	S-13	9.5 - 10.0		<5.0	NA	NA
	S-14	10.0 - 10.5		<5.0	NA	NA
	S-15	10.5 - 11.0		158	NA	NA
	S-16	11.0 - 11.5		356	NA	NA
	---	11.5 - 15.0		NR	NA	NA
	S-17	15.0 - 15.5		65.8	NA	NA
	S-18	15.5 - 16.0		14.2	NA	NA
	S-19	16.0 - 16.5		5.5	NA	NA
	S-20	16.5 - 17.0		<5.0	NA	NA
	S-21	17.0 - 17.5		10.6	NA	NA
	S-22	17.5 - 18.0		7.2	NA	NA
	S-23	18.0 - 18.5		14.3	NA	NA
	S-24	18.5 - 19.0		11.8	NA	NA

TABLE 29: CONTINUED

SAMPLE LOCATION	SAMPLE NUMBER	*DEPTH INTERVAL FEET	DATE SAMPLED	URANIUM UG/G	FLUORIDE UG/G	NITRATE UG/G
	S-25	19.0 - 19.5		13.0	NA	NA
	S-26	19.5 - 20.0		32.3	NA	NA
	S-27	20.0 - 20.5		29.3	NA	NA
	S-28	20.5 - 21.0		6.8	NA	NA
				94.1% RECOVERY	NA	NA
BH-3A (MW-18A)	S-1	18.0 - 20.0	10/10/90	50.0	154.0	39.9
	S-2	20.0 - 22.0		68.6	292.5	12.0
	S-3	22.0 - 24.0		53.6	218.3	10.1
	S-4	24.0 - 26.0		21.0	419.6	10.6
	S-5	26.0 - 28.0		17.0	516.9	3.2
	S-6	28.0 - 30.0		19.0	488.7	6.3
	S-7	30.0 - 32.0		16.0	447.4	3.0
	S-8	32.0 - 34.0		20.0	NA	NA
	S-9	34.0 - 36.0		8.8	NA	NA
	S-10	36.0 - 38.0		<5.0	343.4	39.2
	S-11	38.0 - 40.0		<5.0	363.2	38.8
BH-4 (MW-12)	S-1	0.0 - 0.5	9/25/90	<5.0	NA	NA
	S-2	0.5 - 1.0		5.8	NA	NA
	S-3	1.0 - 1.5		9.1	NA	NA
	S-4	1.5 - 1.8		<5.0	NA	NA
	---	1.8 - 5.0		NR	NA	NA
	S-5	5.0 - 5.5		<5.0	NA	NA
	S-6	5.5 - 6.0		<5.0	NA	NA
	S-7	6.0 - 6.5		6.1	NA	NA
	S-8	6.5 - 7.0		<5.0	NA	NA
	S-9	7.0 - 7.5		8.4	NA	NA
	S-10	7.5 - 8.0		<5.0	NA	NA
	S-11	8.0 - 8.5		<5.0	NA	NA
	S-12	8.5 - 9.0		<5.0	NA	NA
	S-13	9.0 - 9.5		<5.0	NA	NA
	S-14	9.5 - 10.0		<5.0	NA	NA
	S-15	10.0 - 10.5		<5.0	NA	NA
	S-16	10.5 - 11.0		<5.0	NA	NA
	S-17	11.0 - 11.5		<5.0	NA	NA
	S-18	11.5 - 12.0		<5.0	NA	NA
	S-19	12.0 - 12.5		<5.0	NA	NA
	S-20	12.5 - 13.0		<5.0	NA	NA
	S-21	13.0 - 13.2		<5.0	NA	NA
	---	13.2 - 15.0		NR	NA	NA
	S-22	15.0 - 15.5		<5.0	NA	NA
	S-23	15.5 - 16.0		<5.0	NA	NA
	S-24	16.0 - 16.5		<5.0	NA	NA
	---	16.5 - 20.0		NR	NA	NA
	S-25	20.0 - 20.5		<5.0	NA	NA
	S-26	20.5 - 21.0		<5.0	NA	NA

TABLE 29: CONTINUED

SAMPLE LOCATION	SAMPLE NUMBER	*DEPTH INTERVAL FEET	DATE SAMPLED	URANIUM UG/G	FLUORIDE UG/G	NITRATE UG/G
	S-3	22.0 - 24.0		<5.0	NA	NA
	S-4	24.0 - 26.0		<5.0	NA	NA
	S-5	26.0 - 28.0		<5.0	NA	NA
	S-6	28.0 - 30.0		<5.0	NA	NA
	S-7	30.0 - 32.0		<5.0	NA	NA
BH-9	S-1	0.0 - 0.5	9/29/90	72.0	NA	NA
(MW-10)	S-2	5.0 - 5.5		7.1	NA	NA
	S-3	5.5 - 6.0		<5.0	NA	NA
	S-4	6.0 - 6.5		<5.0	NA	NA
	S-5	6.5 - 7.0		<5.0	NA	NA
	S-6	7.0 - 7.5		7.2	NA	NA
	S-7	7.5 - 8.0		<5.0	NA	NA
	S-8	8.0 - 8.4		<5.0	NA	NA
	---	8.4 - 10.0		NR	NA	NA
	S-9	10.0 - 10.5		58.0	NA	NA
	S-10	10.5 - 11.0		45.0	NA	NA
	S-10 DUP	10.5 - 11.0		46.2	NA	NA
	S-11	11.0 - 11.5		212	NA	NA
	S-12	11.5 - 12.0		288	NA	NA
	S-13	12.0 - 12.5		1940	NA	NA
	---	12.5 - 15.0		NR	NA	NA
	S-14	15.0 - 15.5		121	NA	NA
	S-15	15.5 - 16.0		8.8	NA	NA
	S-16	16.0 - 16.5		12.0	NA	NA
	S-17	16.5 - 17.0		13.0	NA	NA
	S-18	17.0 - 17.5		51.0	NA	NA
	S-19	17.5 - 18.0		119	NA	NA
	S-20 SPIKE	18.0 - 18.5		88.0	NA	NA
				87.7% RECOVERY	NA	NA
BH-9A	S-1	18.0 - 20.0	10/7/90	18.0	NA	NA
(MW-10A)	---	20.0 - 22.0		NR	NA	NA
	S-2	22.0 - 24.0		<5.0	NA	NA
	S-3	24.0 - 26.0		<5.0	NA	NA
	S-4	26.0 - 28.0		<5.0	NA	NA
	S-5	28.0 - 30.0		<5.0	NA	NA
	S-6	30.0 - 32.0		<5.0	NA	NA
	S-7	32.0 - 34.0		<5.0	NA	NA
	S-8	34.0 - 35.0		<5.0	NA	NA
	S-9	35.0 - 36.0		<5.0	NA	NA
BH-10	S-1	0.0 - 0.5	9/29/90	<5.0	NA	NA
(MW-5)	S-2	0.5 - 1.0		<5.0	NA	NA
	S-3	1.0 - 1.5		<5.0	NA	NA
	S-4	1.5 - 2.0		<5.0	NA	NA
	S-5	2.0 - 2.5		<5.0	NA	NA

TABLE 29: CONTINUED

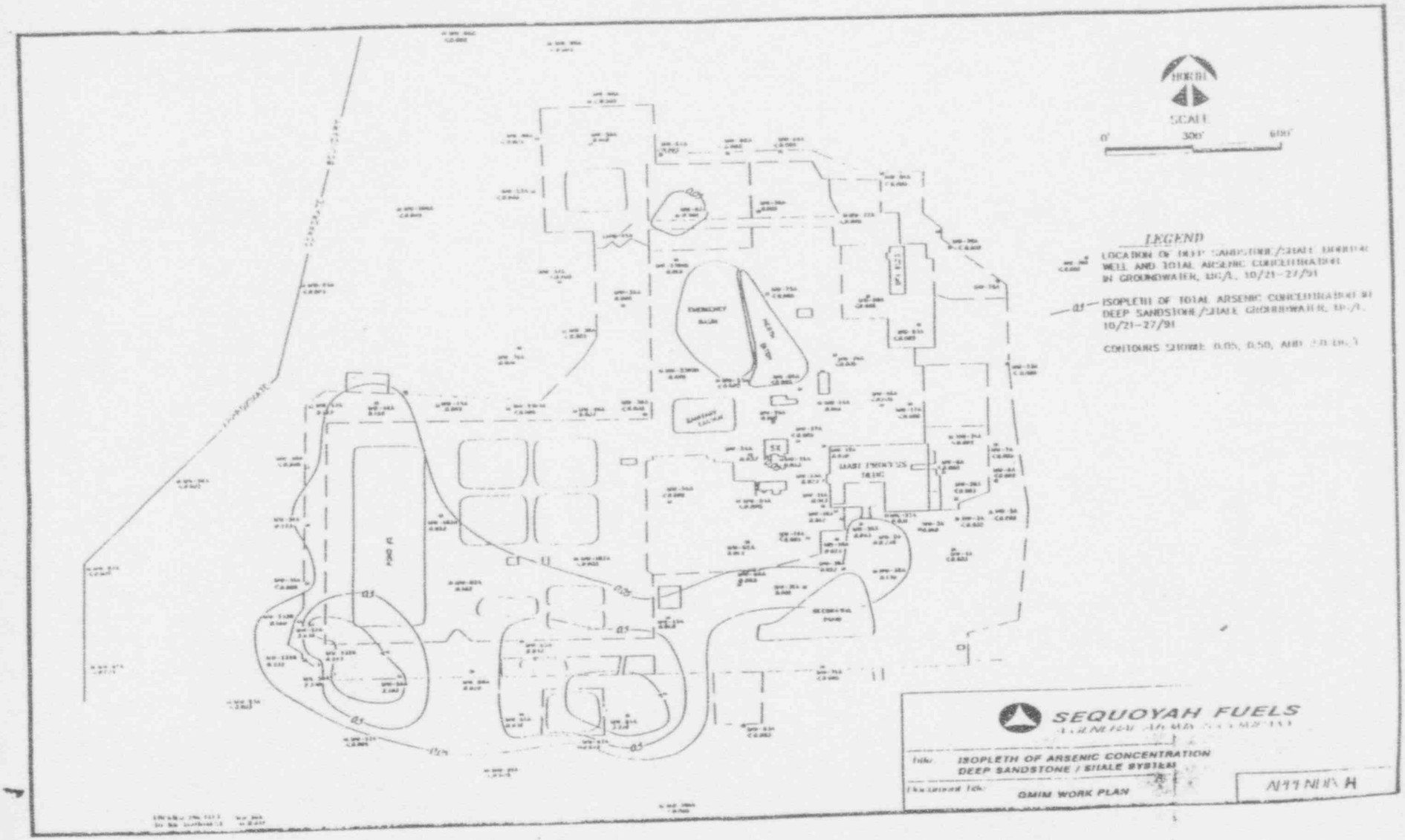
SAMPLE LOCATION	SAMPLE NUMBER	*DEPTH INTERVAL FEET	DATE SAMPLED	URANIUM UG/G	FLUORIDE UG/G	NITRATE UG/G
	S-11	9.5 - 10.0		<5.0	535.0	6.1
	---	10.0 - 15.0		NR	NA	NA
	S-13	15.0 - 15.5		<5.0	511.0	5.3
	S-14	15.5 - 16.0		<5.0	NA	6.4
	S-15	16.0 - 16.5		<5.0	537.0	6.3
	S-16 SPIKE	16.5 - 17.0		<5.0	NA	6.4
				96.9% RECOVERY		
BH-12A	S-1	20.0 - 22.0	11-08-90	91.0	298.0	466.0
(MW-23A)	S-2	22.0 - 24.0		33.0	249.0	489.0
	S-3	24.0 - 26.0		151.0	237.0	448.0
	S-4	26.0 - 28.0		72.0	171.0	363.0
	S-5	28.0 - 30.0		196.0	264.0	565.0
	S-6	30.0 - 32.0		29.0	145.0	497.0
BH-13	---	0.0 - 0.3	10/2/90	NR		
(MW-20)	S-1	0.3 - 0.5		<5.0	291.0	51.9
	S-2	0.5 - 1.0		17.0	246.0	44.4
	S-3	1.0 - 1.8		6.4	NA	104.4
	---	1.8 - 5.0		NR	NA	NA
	S-4	5.0 - 5.5		<5.0	NA	82.0
	S-5	5.5 - 6.0		<5.0	240.0	39.6
	S-6	6.0 - 6.5		<5.0	NA	16.3
	S-7	6.5 - 7.0		<5.0	432.0	4.5
	S-8	7.0 - 7.5		<5.0	NA	0.5
	S-9	7.5 - 8.0		<5.0	581.0	1.0
	S-10	8.0 - 8.5		<5.0	NA	1.7
	S-11	8.5 - 9.0		<5.0	464.0	2.2
	S-12	9.0 - 10.0		NR	NA	NA
	S-13	10.0 - 10.5		<5.0	486.0	2.2
	S-14	10.5 - 11.0		<5.0	NA	3.0
	S-15	11.0 - 11.5		<5.0	544.0	4.3
	S-16	11.5 - 12.0		<5.0	NA	4.3
	S-17	12.0 - 12.5		<5.0	552.0	6.0
	S-18	12.5 - 13.0		<5.0	NA	5.7
	S-19	13.0 - 13.5		<5.0	622.0	8.0
				86.4% RECOVERY		
BH-13A	S-1	18.7 - 20.0	10/7/90	<5.0	NA	NA
(MW-20A)	S-2	20.0 - 22.0		<5.0	NA	NA
	S-3	22.0 - 24.0		<5.0	NA	NA
	S-4	24.0 - 26.0		<5.0	NA	NA
	S-5	26.0 - 27.0		<5.0	NA	NA
	S-6	27.0 - 29.0		<5.0	NA	NA
	S-7	29.0 - 31.0		<5.0	NA	NA
	S-8	31.0 - 33.0		<5.0	NA	NA

TABLE 29: CONTINUED

SAMPLE LOCATION	SAMPLE NUMBER	*DEPTH INTERVAL FEET	DATE SAMPLED	URANIUM UG/G	FLUORIDE UG/G	NITRATE UG/G
	S-7	6.0 - 6.5		264	NA	NA
	S-8	6.5 - 7.0		966	NA	NA
	S-9	7.0 - 7.5		941	NA	NA
	S-10	7.5 - 8.0		25.0	NA	NA
	S-11	8.0 - 8.5		13.0	NA	NA
	---	8.5 - 10.0		NR	NA	NA
	S-12	10.0 - 10.5		5.2	NA	NA
	S-13	10.5 - 11.0		5.6	NA	NA
	S-14	11.0 - 11.5		5.3	NA	NA
	S-15	11.5 - 12.0		5.8	NA	NA
				119.4% RECOVERY		
BH-17A (MW-14A)	S-1	22.0 - 24.0	10-10-90	<5.0	517.0	62.4
	S-2	24.0 - 26.0		<5.0	523.0	44.7
	S-3	26.0 - 28.0		<5.0	416.0	48.6
	S-4	28.0 - 30.0		<5.0	457.0	40.7
	S-5	30.0 - 32.0		<5.0	333.0	31.9
BH-18 (MW-15)	S-1	0.0 - 0.5	9/29/90	14.1	NA	NA
	S-2	0.5 - 1.0		<5.0	NA	NA
	S-3	1.0 - 1.5		<5.0	NA	NA
	---	1.5 - 5.0		NR	NA	NA
	S-4	5.0 - 5.5		<5.0	NA	NA
	S-5	5.5 - 6.0		<5.0	NA	NA
	S-6	6.0 - 6.5		<5.0	NA	NA
	S-7	6.5 - 7.0		<5.0	NA	NA
	S-8	7.0 - 7.5		<5.0	NA	NA
	S-9	7.5 - 8.0		<5.0	NA	NA
	S-10	8.0 - 8.5		<5.0	NA	NA
	S-11	8.5 - 9.0		<5.0	NA	NA
	S-12	9.0 - 9.5		<5.0	NA	NA
	---	9.5 - 10.0		NR	NA	NA
	S-13	10.0 - 10.5		<5.0	NA	NA
	S-14	10.5 - 11.0		<5.0	NA	NA
	S-15	11.0 - 11.3		<5.0	NA	NA
	S-16	11.5 - 12.0		<5.0	NA	NA
	S-17	12.0 - 12.5		<5.0	NA	NA
	S-18	12.5 - 13.0		<5.0	NA	NA
	S-19	13.0 - 13.5		<5.0	NA	NA
				99.6% RECOVERY		
BH-19 (MW-16)	---	0.0 - 1.0	9/30/90	NR	NA	NA
	S-1	1.0 - 1.5		<5.0	140.0	22.4
	---	1.5 - 5.0		NR	NA	NA
	S-2	5.0 - 5.5		<5.0	NA	6.5
	S-3	5.5 - 6.0		<5.0	481.0	4.3
	S-4	6.0 - 6.5		<5.0	NA	4.7

TABLE 29: CONTINUED

SAMPLE LOCATION	SAMPLE NUMBER	*DEPTH INTERVAL FEET	DATE SAMPLED	URANIUM UG/G	FLUORIDE UG/G	NITRATE UG/G
(MW-24)	S-2	0.5 - 1.0		6.9	NA	NA
	S-3	1.0 - 1.5		<5.0	NA	NA
	S-4	1.5 - 2.0		<5.0	NA	NA
	---	2.0 - 5.0		NR	NA	NA
	S-5	5.0 - 5.5		5.7	NA	NA
	S-6	5.5 - 6.0		<5.0	NA	NA
	S-7	6.0 - 6.5		<5.0	NA	NA
	S-8	6.5 - 7.0		8.6	NA	NA
	---	7.0 - 10.0		NR	NA	NA
	S-9	10.0 - 10.5		<5.0	NA	NA
	S-10	10.5 - 11.0		<5.0	NA	NA
	S-11	11.0 - 11.5		<5.0	NA	NA
	S-12	11.5 - 12.0		<5.0	NA	NA
	S-13	12.0 - 12.5		<5.0	NA	NA
	S-14	12.5 - 13.0		<5.0	NA	NA
	S-15	13.0 - 13.5		<5.0	NA	NA
	S-16	13.5 - 14.0		<5.0	NA	NA
	S-17	14.0 - 14.5		<5.0	NA	NA
	S-18	14.5 - 15.0		<5.0	NA	NA
	S-19	15.0 - 15.5		<5.0	NA	NA
	S-20	15.5 - 16.0		<5.0	NA	NA
	S-21	16.0 - 16.5		<5.0	NA	NA
	S-22	16.5 - 17.0		<5.0	NA	NA
	S-23	17.0 - 17.5		<5.0	NA	NA
	S-24	17.5 - 18.0		<5.0	NA	NA
				83% RECOVERY		
BH-26A (MW-24A)	S-1	26.0 - 28.0	11-07-90	<5.0	442.0	52.1
	S-2	28.0 - 30.0		<5.0	322.0	25.3
	S-3	30.0 - 32.0		17.0	372.0	206.0
	S-4	32.0 - 34.0		14.0	353.0	138.0
	S-5	34.0 - 35.5		19.0	405.0	179.0
BH-27 (MW-25)	S-1	0.0 - 0.5	10/3/90	1211	438.0	21.8
	S-2	0.5 - 1.0		4503	NA	22.1
	---	1.0 - 5.0		NR	NA	NA
	S-3	5.0 - 5.5		7940	472.0	696.0
	S-4	5.5 - 6.0		6421	NA	867.0
	S-5	6.0 - 6.5		3800	439.0	677.0
	S-6	6.5 - 7.0		2545	NA	604.0
	S-7	7.0 - 7.5		2100	504.0	471.0
	S-8	7.5 - 8.0		828	NA	377.0
	---	8.0 - 10.0		NR	NA	NA
	S-9	10.0 - 10.5		54.0	592.0	42.0
	S-10	10.5 - 11.0		11.0	NA	35.0
	S-11	11.0 - 11.5		8.3	550.0	150.0
	S-12	11.5 - 12.0		7.0	NA	143.0


NORTH
SCALE
0'
300'
600'
LEGEND
LOCATION OF DEEP SANDSTONE/SHALE MONITOR WELL AND TOTAL ARSENIC CONCENTRATION IN GROUNDWATER, UG/L, 10/21-27/91
ISOPLETH OF TOTAL ARSENIC CONCENTRATION IN DEEP SANDSTONE/SHALE GROUNDWATER, UG/L, 10/21-27/91
CONTOURS SHOWN: 0.05, 0.50, AND
SEQUOYAH FUELS
ISOPLETH OF ARSENIC CONCENTRATION
DEEP SANDSTONE / SHALE SYSTEMS
GMM WORK PLAN
APPENDIX H

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COMMENTS ON SEQUOYAH FUELS CORPORATION'S DRAFT RCRA FACILITY INVESTIGATION WORKPLAN

L. Lehman & Associates
March 3, 1994

INTRODUCTION

At the request of Native Americans for a Clean Environment (NACE), L. Lehman & Associates has reviewed the Draft RCRA Facility Investigation Workplan (RFI) submitted by Sequoyah Fuels Corporation (SFC) to the U.S. Environmental Protection Agency (EPA) on January 28, 1994. The review evaluates the Plan with respect to our area of expertise, hydrology and contaminant transport. Additional relevant documents that we have reviewed are included in a Reference section at the end of these comments. Photocopies of all referenced figures are included as Appendix A at the end of this review.

GENERAL COMMENTS

In our opinion the RFI Workplan in its present form, is inadequate to meet SFC's own stated objectives, and those outlined in the Administrative Order on Consent, U.S. EPA Docket No. VI-005-(h)93-H, Page 8. This Workplan provides merely a crude survey of the so-called "Target Parameters", at the surface of this site. If this plan is to have a realistic chance of meeting its intended purpose the level of data collection and analysis must be substantially increased.

Inadequate Hydrologic Data

Section 1.3 lists 5 objectives of the RFI:

1) to characterize the potential pathways of contaminant migration
2) to characterize the sources of contamination
3) to define the degree and extent of contamination
4) to identify actual or potential receptors
5) to support the development of alternatives from which a corrective measure will be selected by the EPA.

Objectives 1, 3, 4, and 5 require an in-depth understanding of the site hydrology, incorporating the important local hydrologic features and boundary conditions, understanding the relationships and interaction between hydrostratigraphic units, locating and quantifying areas of recharge and discharge, as well as measuring constitutive properties of the geologic materials present. In short, a reasonable site hydrologic conceptual model is needed. This information is basic to modeling receptor exposure and remediation proposals. Yet, the RFI presents no plan to collect the data necessary to develop an accurate site hydrologic conceptual model while currently available information is insufficient to do so.

For example, both the Illinois and Arkansas Rivers lie within 1/2 mile of the site. These rivers should be expected to be important components of the local groundwater system. The Carlisle fault zone lies within 1/2 mile of the site. Fault zones often act as important flow conduits or barriers to groundwater flow. None of these potentially important hydrologic features have been scientifically studied for linkages to the site groundwater system. In order to characterize all potential pathways and receptors the effects of the rivers and the fault zone on groundwater flow need to be examined within the RFI as part of a broad study of the regional hydrologic system, with sufficient detail to support groundwater modeling activities.

Many questions also remain about the vertical hydrologic connection between bedrock units. Previous sampling in the 1991 Facility Environmental Investigation (FEI), has shown the existence of well developed contaminant plumes in both the "shallow shale/terrace" unit as well as the "deep sandstone/shale" unit. Meanwhile page 2-3 of the RFI describes the sandstone separating these units as a "dense, nearly impermeable, highly cemented, non-porous sandstone aquitard". This raises the question: How do well developed plumes form in the "deep" unit if it is hydraulically separated from the upper unit by an aquitard? It would seem that fracture flow, discontinuity of the "aquitard", or some other mechanism is allowing relatively rapid transport of contaminants to the unit below. It also raises questions about vertical connection and conditions below the "deep" unit.

Page 2-1 of the RFI points out the existence of 390 feet of the Atoka Formation limestones, shales and sandstones. SFC's 1991 FEI, the most complete study to date, examined only the top 40 feet of this stratigraphy. The RFI Workplan makes no mention of new studies or sampling below these uppermost units which comprise only the upper 10% of the Atoka bedrock. Given the likelihood of significant groundwater flow within the limestone, shale and sandstone units below the saturated zone, and the likely vertical flow connection between the upper two units evidenced by the plume maps of Figures 78, 80, 82 and 98 of the FEI (attached to this review as Appendix A), the potential for deeper Atoka units to act as transport pathways appears high. These potential deep pathways need to be evaluated in order to reliably estimate risk and dose levels associated with the site.

The FEI (page 34), briefly mentions an injection well that was drilled in the early 1970's and later abandoned. According to Kerr-McGee Corporation's 1985 Monitor Locations Site Map and well descriptions, this well was located just south of Unit 8, and nearly in the middle of the processing area. This map lists the well's depth at 400 feet. This information indicates that the Atoka Formation has been penetrated by SFC activity to depths well below any of the FEI or other monitoring wells. Whether or not this well has impacted the vertical groundwater flow regime and/or allowed the transmission of contaminants to depths much greater than the upper 40 feet is unknown. Due to the potential that this well may have acted as a conduit for vertical flow, the RFI should include plans for examining the effects, if any, this well has had on deep groundwater zones. Sampling for contamination to depths comparable to the abandoned injection well is the only way to insure unknown contamination does not exist there.

Information on pressure distributions, contaminant levels and hydrologic properties of Atoka units below 40 feet are minimum data requirements needed to resolve these vertical flow issues. This data could be collected incrementally deeper until a determination can be made, based on modeling and analysis, that sufficient information is available for complete pathway analysis, and that the site hydrology is well understood. The RFI should incorporate a plan that would resolve the vertical flow mechanisms that operate at the site by collecting in situ data and doing appropriate follow-up modeling studies.

The above hydrologic unknowns are the most obvious gaps in information relating to the site. Certainly, other general and specific questions will arise when site modeling for dose calculations or other transport related predictions are attempted. In order to arrive at a reasonably accurate site hydrologic conceptual model and to provide complete data for calculations and models, the RFI may need to be adjusted as it is being implemented to accommodate unexpected data needs. For example, modeling might show that flow velocity predictions are very sensitive to estimated infiltration rates. An additional study could then be undertaken while work is still ongoing to firmly establish infiltration at the site. The most efficient way to join model development and data collection is to begin modeling work as early in the characterization process as possible. For this reason we recommend that the RFI Workplan include plans for a contemporaneous modeling effort, beginning as early in the process as possible. Modeling and data collection can then work together to determine most important data needs, maximizing the efficiency of expensive field work.

To date, work at the SFC Gore site has examined a rather 2-dimensional piece of the hydrologic picture, which encompasses the immediate processing area only. Any attempted modeling or dose calculations based on the information available, can at best predict only contaminant movement in the upper 10% of the saturated zone and immediately in the processing area. Any modeling or dose calculations attempted beyond those immediate confines which is based on currently available data, would

contain unacceptably large uncertainty and be very sensitive to assumptions about the effects of the rivers, the fault zone, vertical flow significance and flow conditions outside the processing area.

Inadequate Phase I Screening

The second major flaw in the RFI Workplan is the plan for Phase I screening. All subsequent characterization is contingent on Phase I detecting a "Target" contaminant based on very few samples taken only at the surface. In many cases determination of Study Units as sources is based on sampling an alternative Study Unit, so that some Study Units are not sampled in Phase I at all. This limited yet crucial initial screening implies the following assumptions:

1) some Study Units can be represented accurately by others
2) very few samples are needed to characterize Study Units
3) subsurface contamination can be identified at the surface
4) all past sources are current sources
5) no contamination has moved in the subsurface
6) there are no subsurface sources.

None of these assumptions are shown to be justifiable based on site information.

SFC's rationale seems to be that if 1 or 2 samples from a Study Unit or like Unit indicate that a contaminant is below the "Target Value", then no further study is needed to determine if RCRA constituents exist in groundwater or soils beneath or adjacent to the Study Unit. This is not consistent with current groundwater flow theory or the history of the site. Groundwater generally moves in three dimensions and sources may be flushed over time. Buried contaminant sources cannot always be detected at the surface.

The Phase I sampling should be the most comprehensive of the three phases. In order to detect unknown sources and plumes, a systematic sampling grid in three dimensions needs to be developed which would sample for all the "Target Parameters" at the surface, in unsaturated soils and within the saturated zone. Only then can unknown and unexpected contamination be found. Looking for contamination only where it is expected, within the Study Units, provides absolutely no method for detecting unknown or unexpected contamination.

The number of Phase I samples is too low to allow reasonable statistical analysis of the collected data. Contamination levels within geologic materials and pond sediment can have high local variability. The degree of variability should be part of the characterization analysis in order to provide the quality of information needed for remedial and other decision making. As part of the above full spatial survey a statistical analysis should be done to determine the minimum number of samples needed

from each area, or population, to meet some level of statistical confidence in the data obtained. There exist well developed methods within the field of Geostatistics that could be applied to this task.

The Phase I screening does nothing to identify unknown or unexpected contamination sources and attempts to screen out those which currently have low concentrations at the surface. It also indicates a troubling lack of appreciation for basic groundwater flow mechanics.

Inadequate Off-Site Investigation

Page 2-1 of the RFI states that SFC has "intimate knowledge of both the environmental conditions on-site as well as off-site". This supposed knowledge of off-site conditions is based heavily on the FEI. However, examination of the FEI shows very little off-site investigation. With respect to hydrology the FEI was intensely focused on the on-site processing area itself including the upper 30-40 feet of the saturated zone, unsaturated soil analyses and surface water discharge. The only off-site groundwater information comes from the 1991 sampling of 18 local residential wells. None of these wells were properly constructed as monitoring wells nor were any of these wells tested for any RCRA contaminants (See Table 67 of the FEI). This certainly cannot be viewed as intimate knowledge of groundwater conditions off-site. The only surface water information in the FEI, which might be viewed as "off-site", are analysis of permitted outfalls. Here again, analyses were not performed for RCRA contaminants.

Quality off-site data for the area around SFC's Gore site is almost non-existent. SFC's confidence in extrapolating processing area data collected in Phase I to off-site locations shows again a disturbing lack of appreciation for groundwater flow mechanics as well as hydrologic systems in general.

The RFI Workplan needs to include adequate off-site data collection to enhance detection of unknown and unexpected contamination. This data gathering can be combined with the study of local hydrologic features recommended above. Off-site saturated and unsaturated zone sampling is especially important considering the raffinate spreading program carried on for years around the SFC site. This raffinate "fertilizer" contains low levels of several RCRA metals and was spread in large quantities over surrounding fields (See SFC's Ammonium Nitrate Fertilizer 1990 Completion Report).

Phase II and III Inadequate

Even if the Phase I sampling plans outlined in the RFI Workplan could adequately trigger the Phase II activities, Phase II plans would be inadequate to meet the RFI stated objectives. Figures 6-13 of the Draft RFI Workplan show that all groundwater monitoring wells are tightly clustered around the Study Areas. This does not allow the

detection of contaminant plumes that may have traveled significant distances from their sources. Monitoring wells should also be located downstream of the Study Areas.

For example, wells are absent from the area between the processing area and Study Area 5 where the stormwater impoundment is located. This area is downstream for surface and groundwater from many of the Study Areas. This zone was not studied in the FEI, nor is it examined in the RFI Workplan. Monitoring wells are needed in this area to characterize conditions there. The area west of Study Area 2 also needs groundwater characterization. Large nitrate plumes in FEI Figures 79 and 80 in this area extend off the plume map indicating significant flow toward the west and insufficient characterization of groundwater conditions there. More downstream wells are also needed toward the northwest away from the processing area as well as to the west and south of the raffinate ponds in Study Area 5.

The Phase II groundwater sampling is also weak in the vertical direction. As discussed above only the upper 40 feet of the saturated zone is covered. Information on pressure distributions, contaminant levels and hydrologic properties of Atoka units below 40 feet are minimum data requirements needed to resolve this issue. The RFI should incorporate a plan that would resolve the vertical flow mechanisms that operate at the site by collecting in situ data and doing appropriate follow-up modeling studies.

The Phase III activity is not at all specified. In reality what is presented in the Draft RFI Workplan is a two Phase program.

Summary

Overall, the RFI Workplan would bring very little new information to bear on the problem of remediation and decommissioning. Data collected up to the present is insufficient to determine the full vertical or areal extent of RCRA contamination. Further, insufficient information exists upon which to base characterization of all potential pathways and receptors or to evaluate remediation schemes. This RFI falls far short of presenting a framework which could provide the needed data. It's methodology is geared more toward minimizing data collection than toward understanding conditions and risks that exist at the site.

It is our opinion that the RFI Workplan as it exists, requires major revision if it is expected to meet the objectives stated in the Administrative Order on Consent and in the plan itself. Important questions need to be clearly posed, the data needed objectively determined, and the plan for obtaining data realistically laid out.

COMMENTS BY PAGE

Page 2-1: In Section 2.1 SFC claims to have "intimate knowledge of both the environmental conditions on-site as well as off-site". This statement is not supported by our review of available documents, including the FEI. SFC has almost exclusively looked at the surface and near surface conditions in the proce sing area alone. Large data gaps exist relating to deep groundwater, near and off-site conditions, as well as the hydrologic context of the site.

Page 2-2: Paragraph 4 states that the deep sandstone is "essentially impermeable (except for joints or fractures)". This contradictory statement needs clarification. Fracture permeability can be large.

Page 2-2: The last sentence states that "No additional information is needed to characterize the geological setting at SFC." This statement is totally unjustified and somewhat alarming. Again, virtually nothing is known of conditions at depth (below 40 feet) and there is scant information available about off-site hydrologic features which may impact the site hydrology.

Page 2-3: Section 2.1.2 states that "The FEI identified two (2) zones with limited interconnection that support groundwater flow systems." These two zones occupy the upper 50 ft of a 390 ft stratigraphic section. Are there flow systems below these two, and if so are they hydraulically connected to the upper two? Unknown, unexpected contamination could exist at depths below 50 feet.

Page 2-3: In Paragraph 4, in reference to the so-called "deep" unit, it is stated "There appears to be no major communication with the groundwater contained within the overlying shale or terrace deposits." This statement is not consistent with Figures 78, 80, 82 and 98 of the FEI which show well developed plumes of uranium, nitrate, fluoride and arsenic, respectively, in the purported isolated deeper unit. If there is no communication between the upper and lower unit, then how did the plumes arrive there? Are there sources within the lower unit? Is fracture flow significant? Is the sandstone discontinuous? These questions are unaddressed in the RFI Workplan.

Page 2-3: The final paragraph states that no additional studies of hydrology are needed due to thorough knowledge of the site. This assertion is totally baseless. There exist many unanswered questions about the site hydrology as outlined throughout this commentary.

Page 2-5: Paragraph 3 refers to a discussion of the stormwater impoundment in Section 2.1.4.3. This section does not exist. The stormwater impoundment appears to have been left out of the RFI Workplan even though it is downstream of the processing area and southern ponds (SA-5) for surface and groundwater. The area of the stormwater pond, which did not exist in 1991, was also left out of the FEI.

Page 2-5: Paragraph 5 states: "Investigation of facility impacts will not be conducted on .... surface water described above unless site studies indicate that impacts to off-site locations may have occurred." Explanation is needed here as to how off-site impacts can be indicated at the site, especially for unknown or unexpected contamination. They seem to be relying heavily on historical studies which are not conclusive. There is no substitute for off-site sampling.

Page 2-6: The stormwater runoff Phase I sampling appears to involve a single sample as described at the end of this page. A single sample from one event will not insure accurate characterization. The character of individual runoff events will vary in intensity and duration causing variation in the runoff's ability to transport contamination. A reasonable program of sampling multiple events should be undertaken allowing statistical analysis and a more complete representation of the runoff character.

Page 2-7: What is the justification for using four times the Target Parameter Values as the trigger for Phase II activity for stormwater runoff, when the Target Values themselves are used elsewhere? This criteria appears arbitrary or designed with some anticipation of levels expected.

Page 2-7: As above there is no justification given for using four times the Target Parameter Values as the trigger for Phase II activity for sediments, when the Target Values themselves are used elsewhere. This criteria appears arbitrary or designed with some anticipation of levels expected.

Page 2-8: Paragraph 5 and 6 appear to contradict the above mentioned four times Target Values trigger, stating simply that "Target Values" will be used.

Page 2-9: The end of Paragraph 2 says that even if Phase II indicates groundwater contamination, Phase III study may not take place unless it is "deemed necessary", without any specification as to the basis or methodology for determining necessity.

Page 2-9: Section 2.2.1 outlines the study plan for Study Area 1. Here can be seen one of the weaknesses of the RFI strategy. The history of this study area

shows that arsenic was placed in Unit 15A, a settling pond, at some time in the past. Examination of Figures 97 and 98 in the FEI shows that arsenic plumes exist below this study area. Yet, according to the plan, if the single sample collected from pond 15A shows arsenic below the Target Level, due to attenuation from flushing over time or simply sampling inaccuracy, no further study will be done. Obviously, this area requires further characterization. The incorporation of a three-dimensional, statistically valid, Phase I sampling plan as outlined above would eliminate such loop-holes.

Page 2-12: Here again, in Study Area 2, a RCRA contaminant (arsenic) is known to exist above its Target Value within the groundwater. The Phase II media investigation will not be triggered unless arsenic is found at appropriate levels in the pond sediment. If this arsenic has migrated from Study Area 1 then arsenic would not necessarily exist in the pond sediment in Study Area 2 and this RFI Workplan would have no mechanism for characterizing the plume. A situation can easily be envisioned under this plan which might lead to no further study of this arsenic plume. If an attenuated source of arsenic existed at Study Area 1 which is not sampled above its Target Value and there are no other arsenic sources, then the RFI Workplan has no mechanism to detect or characterize this plume.

Page 2-15: Study Area 3 represents the most diverse and most intensely polluted Study Area on the site. This approximate 15 acre zone is covered by only 13 Phase I characterization samples. This sparse coverage does not insure that all existing RCRA contamination will be detected. A statistically valid sampling plan needs to be developed and implemented for all Study Areas.

Page 2-21: In Study Area 4, sampling where wastes have been buried should be much more thorough. Due to the lack of specific information on location and types of wastes buried for some of these Units, sampling should be done at sufficient density to detect local and unknown contamination. Sampling in burial areas also needs to be done <u>below</u> the waste as well as around the perimeter. Sampling only around the perimeter does not allow for detection of contamination that might be migrating downward.

Page 2-23: For Study Area 5, a single sample will be taken from the "liquid portion of Unit 24D". These ponds south of the main processing area were used to contain raffinate which is known to contain low levels of RCRA contaminants. The sludge in these ponds should be expected to contain metals that settle out and accumulate at much higher levels than exist in the raffinate itself. The selection of a sample from the liquid portion of the Unit is not explained in the RFI Workplan and is a rather curious

choice. To insure that sources and contamination are detected and properly characterized the pond sediment itself should be sampled. Further, samples should be collected from all Units, as well as below and adjacent to these ponds. The FEI and other studies contain almost nothing relating to these ponds and so the RFI needs to contain provision for a complete characterization.

Page 2-25: No Phase I sampling at Study Area 6. Here is a clear example of the RFI Workplan's lack of provision for unexpected or unknown contamination.

Page 2-27: No Phase I sampling at Study Area 7. Another example of the RFI Workplan's lack of provision for unexpected or unknown contamination.

Page 2-27: No Phase I sampling at Study Area 8. Another example of the RFI Workplan's lack of provision for unexpected or unknown contamination.

Page 2-29: The program for establishing background levels is too general. The determination of environmental impact will hinge on the development of background level data. The plan should specify numbers and specific locations of background samples.

Page 3-4: The Quality Assurance Program needs to include a program of providing some duplicate samples to an independent laboratory for analyses. This would insure reliability and reproducibility of analyses performed by the SFC Laboratories.

Page 4-3: The term "outlier" needs to be defined and justified to insure actual measurements that are simply higher than expected or desired are not discarded.

REFERENCES

Kerr-McGee Corporation, Monitor Locations Sequoyah Facility, Site Map and well descriptions # 110-C-1021, Aug. 8, 1985.

Sequoyah Fuels Corporation, Ammonium Nitrate Fertilizer Program, 1989 Completion Report, April, 1990.

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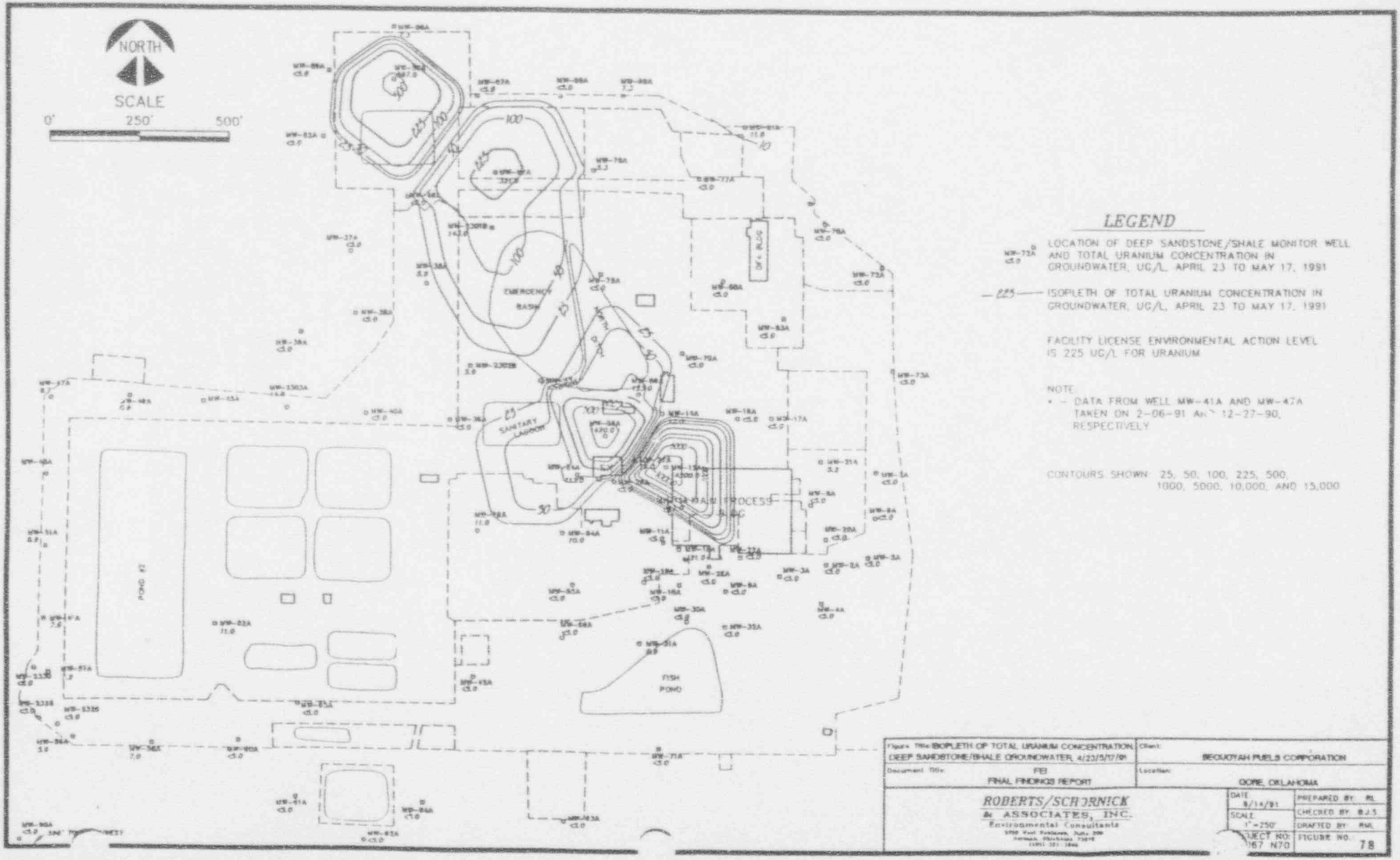
Sequoyah Fuels Corporation, Preliminary Plan for Decommissioning (PPCD), February, 1993.

Sequoyah Fuels Corporation Draft Groundwater Monitoring Interim Measures Workplan, September 2, 1993.

B.B. Tucker, R.L. Westerman, and G.V. Johnson, Sequoyah Fuels Corporation Fertilizer Program Report, Oklahoma State University, 1988.

APPENDIX A

(FEI, Figure 78)



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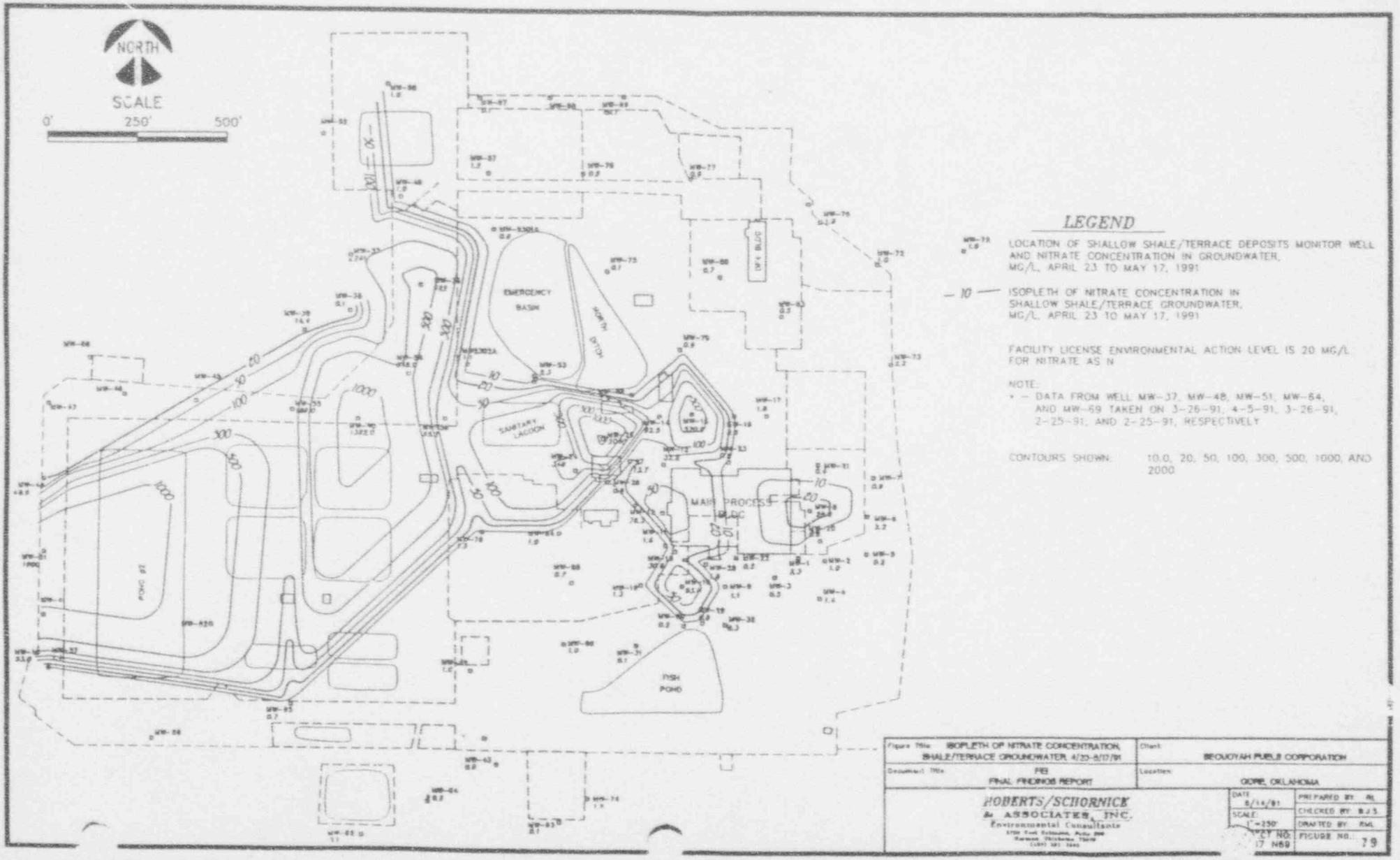

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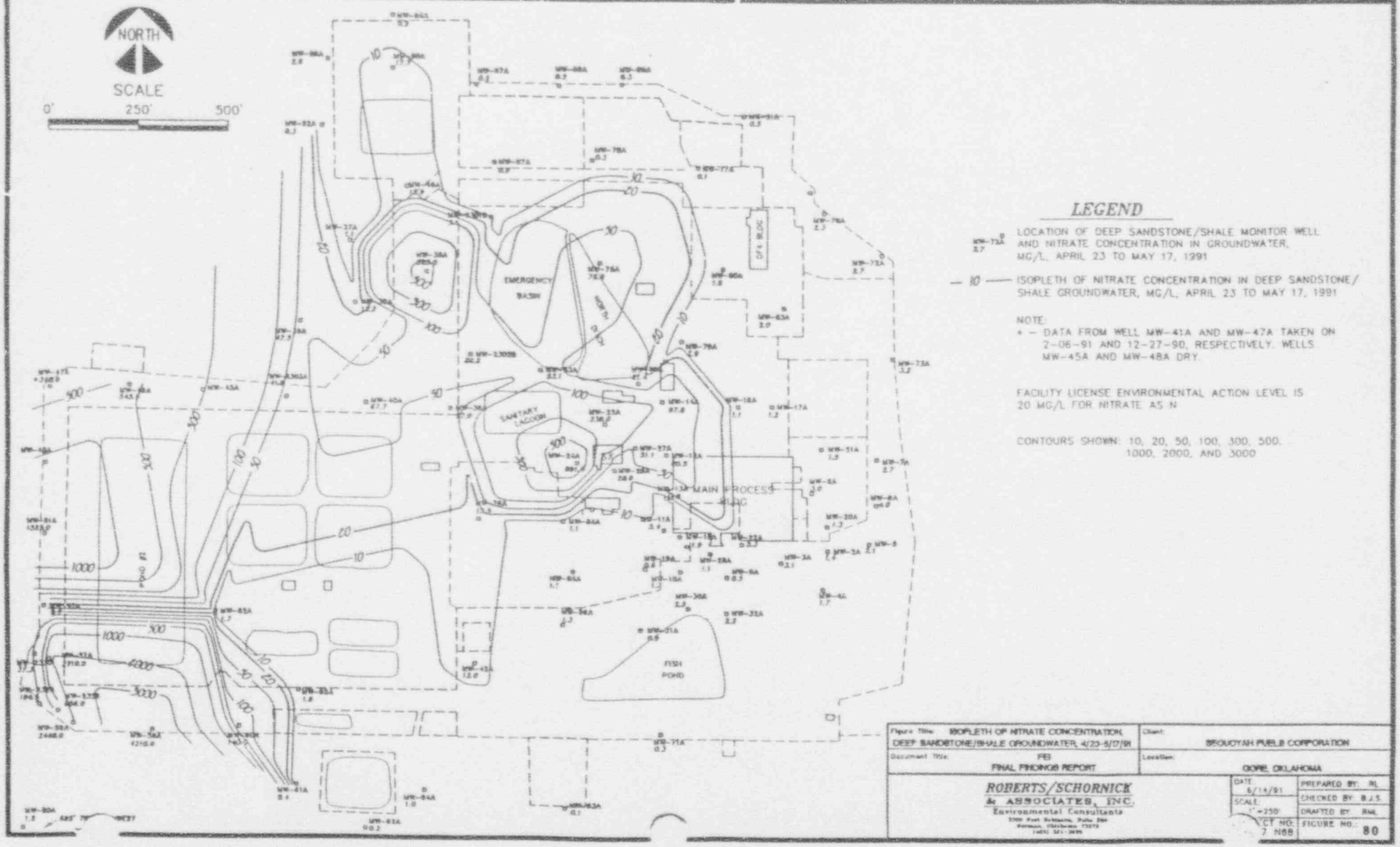

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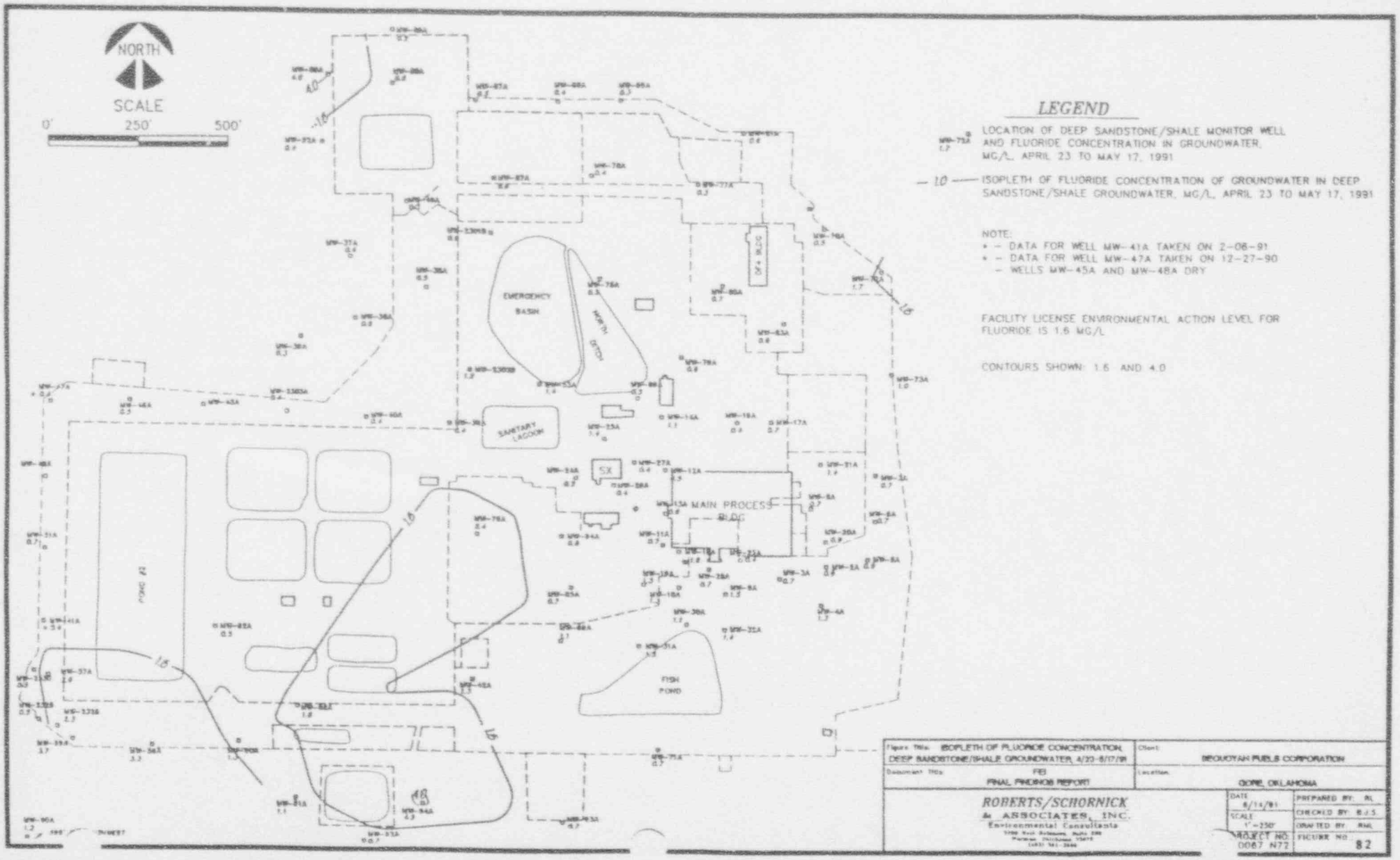

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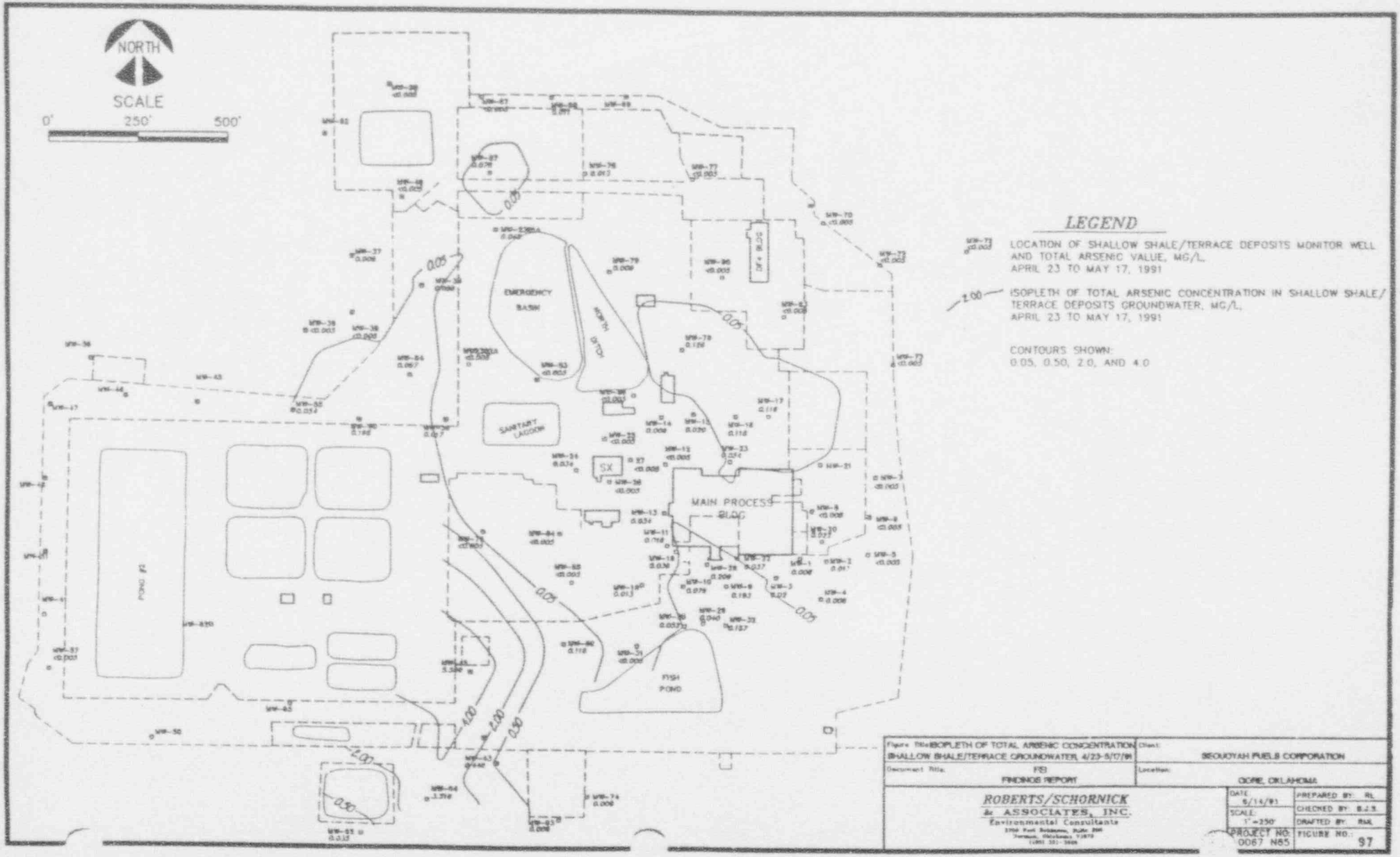

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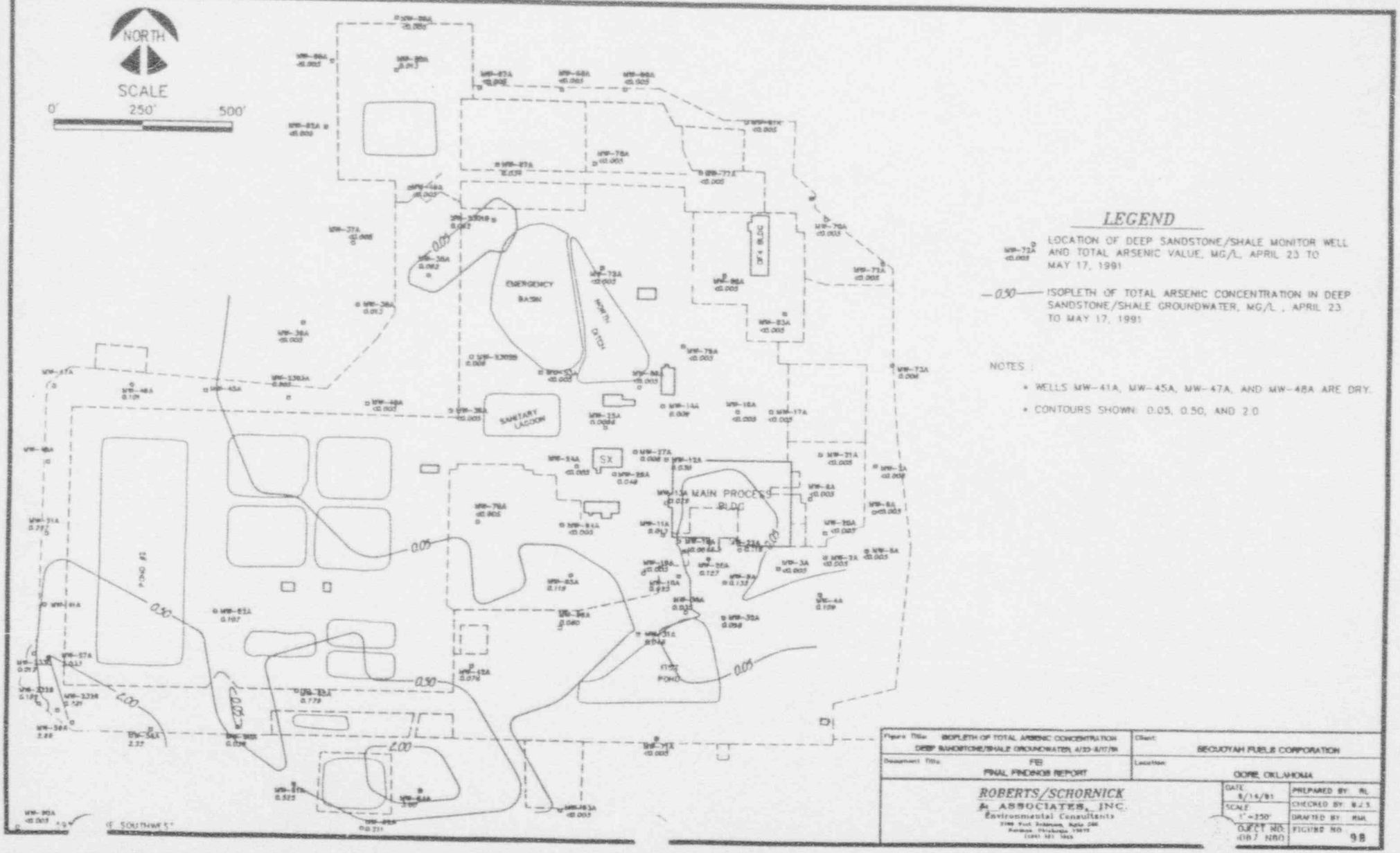
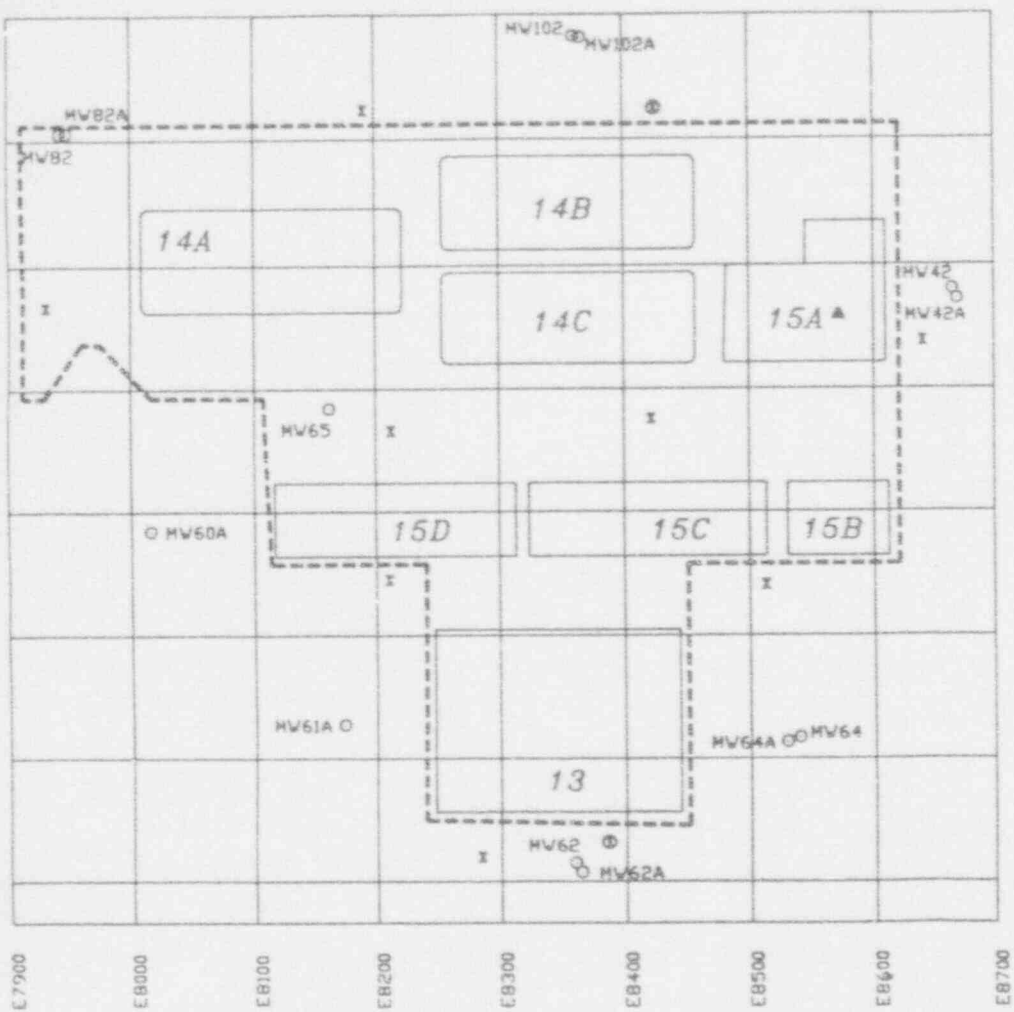




STUDY AREA UNITS

13 - FLUORIDE HOLDING BASIN NO.1 (SOUTH)
14A - FLUORIDE CLARIFIER
14B - FLUORIDE SETTLING BASIN NO.1 (NORTH)
14C - FLUORIDE SETTLING BASIN NO.2 (SOUTH)
15A - FLUORIDE SLUDGE BURIAL (NORTHERN AREA EAST & WEST PITS)
15B - FLUORIDE SLUDGE BURIAL (SOUTHEAST AREA PIT 3)
15C - FLUORIDE SLUDGE BURIAL (SOUTHEAST AREA PIT 4)
15D - FLUORIDE SLUDGE (SOUTHWEST AREA)

N

LEGEND

- STUDY AREA PERIMETER
- UNIT PERIMETER
- ○ RFI MONITOR WELL
- ▲ CHARACTERIZATION SAMPLE LOCATION
- ⊕ SATURATED ZONE SOIL SAMPLE LOCATION
- I SOIL SAMPLE LOCATION

SCALE IN FEET

SEQUOYAH FUELS CORPORATION

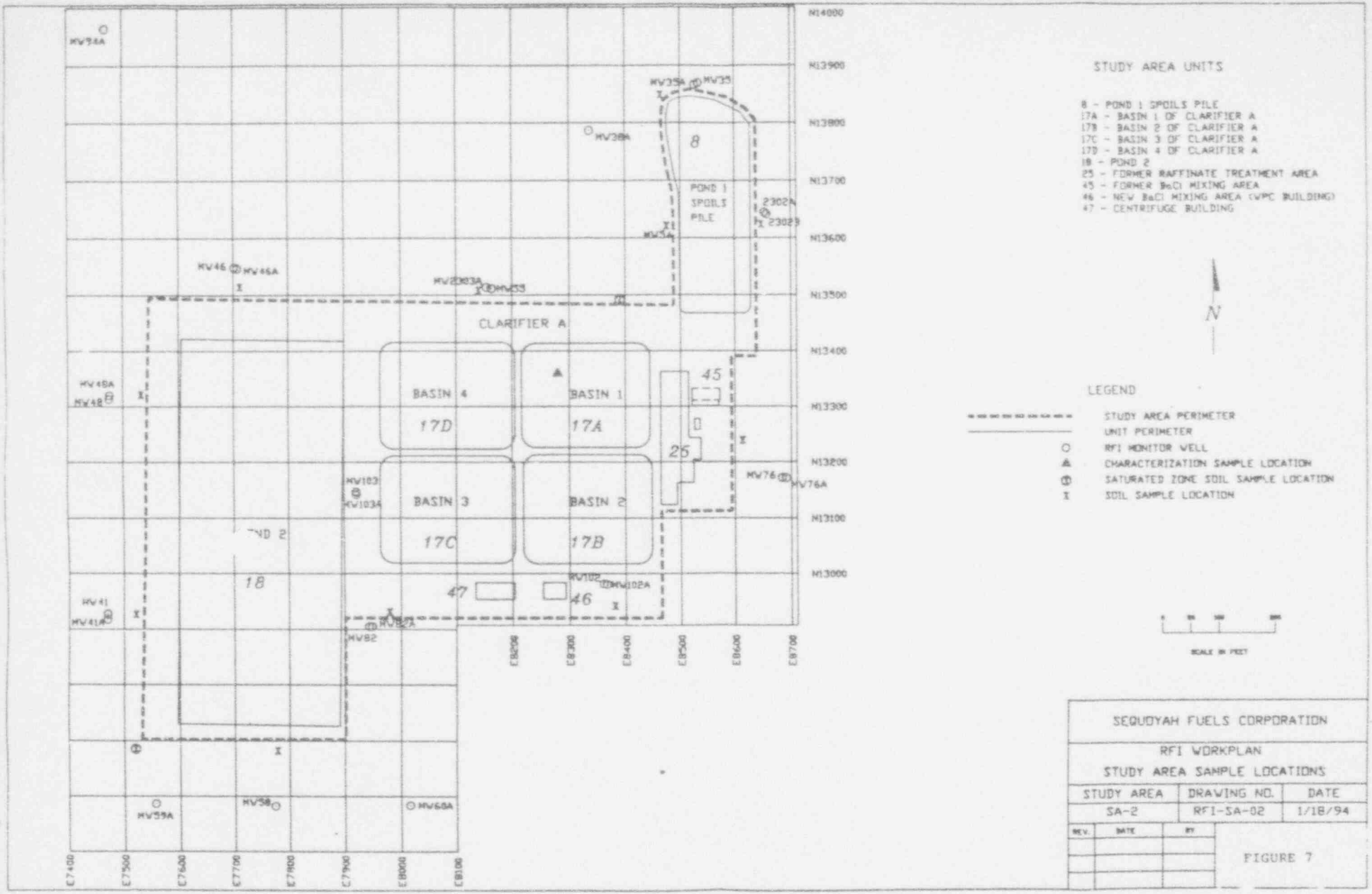
RFI WORKPLAN
STUDY AREA SAMPLE LOCATIONS

STUDY AREA	DRAWING NO.	DATE
SA-1	RFI-SA-01	1/18/94

REV.	DATE	BY

FIGURE 6

(RFI, Figure 6)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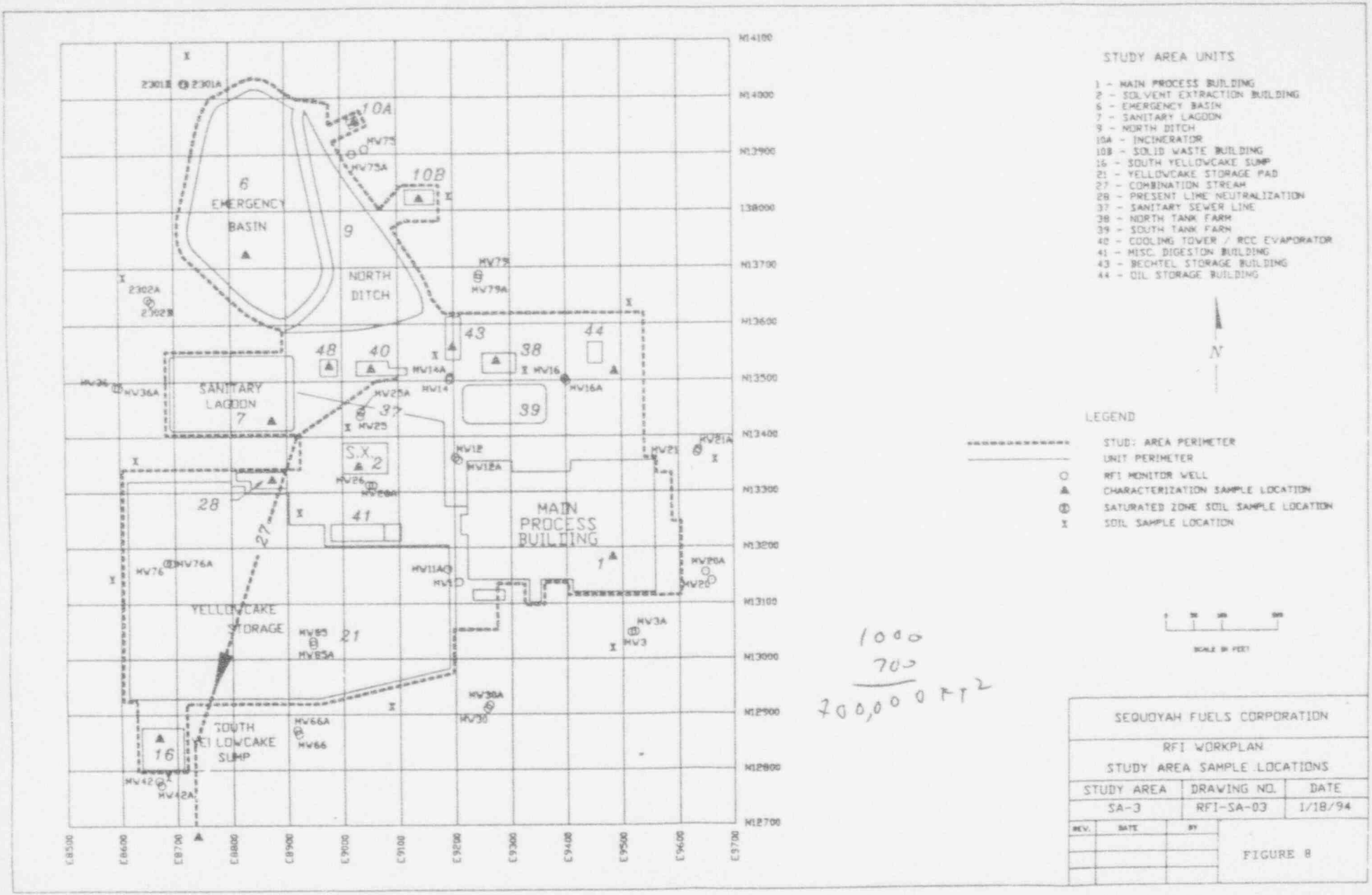
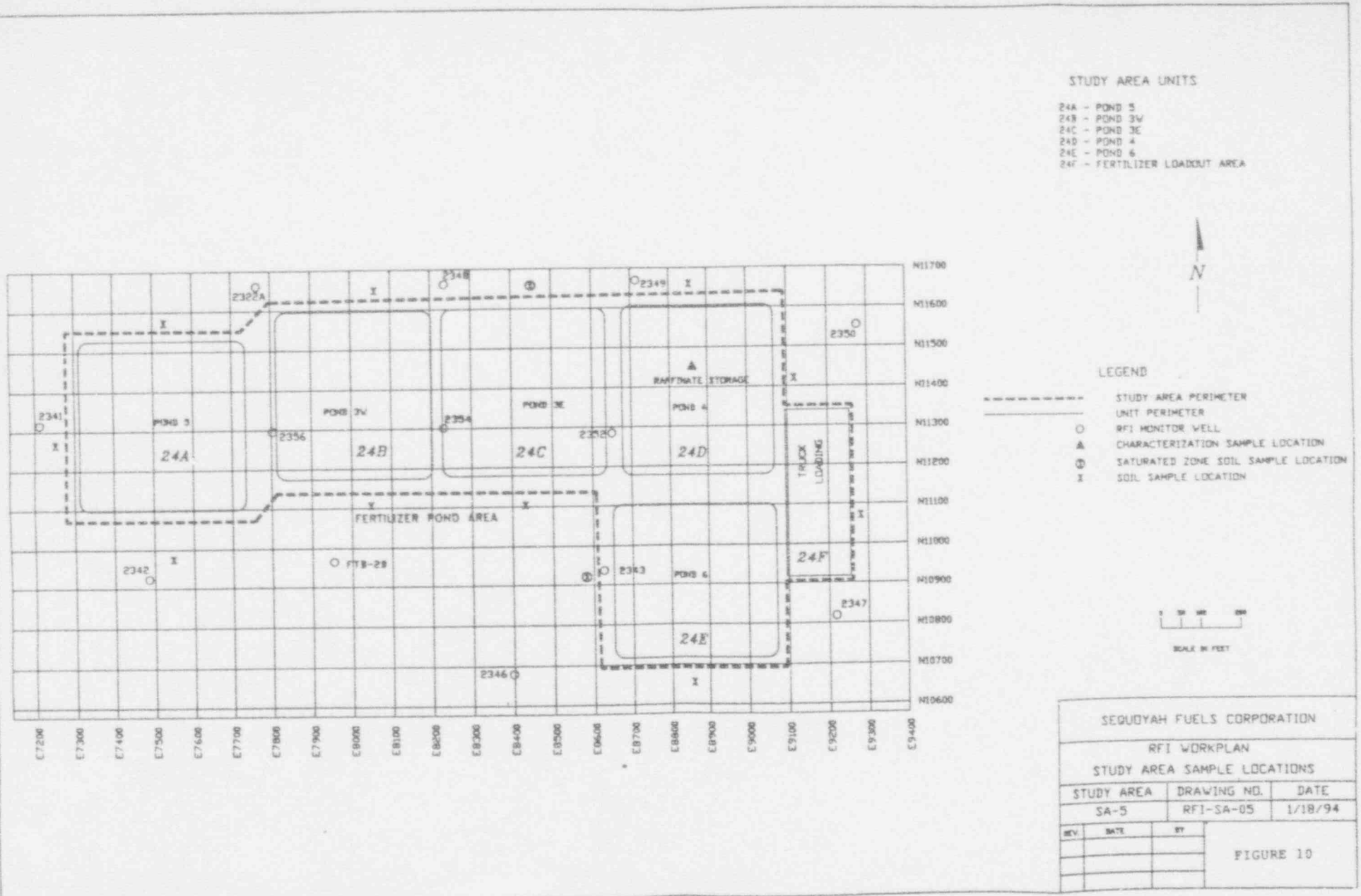
47
46
HV102
HV102A
HV41
HV41A
HV82
HV82A
HV59A
HV58
HV60A
STUDY AREA UNITS
8 - POND 1 SPOILS PILE
17A - BASIN 1 OF CLARIFIER A
17B - BASIN 2 OF CLARIFIER A
17C - BASIN 3 OF CLARIFIER A
17D - BASIN 4 OF CLARIFIER A
18 - POND 2
25 - FORMER RAFFINATE TREATMENT AREA
45 - FORMER BaCl MIXING AREA
46 - NEW BaCl MIXING AREA (WPC BUILDING)
47 - CENTRIFUGE BUILDING
N
LEGEND
STUDY AREA PERIMETER
UNIT PERIMETER
RFI MONITOR WELL
CHARACTERIZATION SAMPLE LOCATION
SATURATED ZONE SOIL SAMPLE LOCATION
SOIL SAMPLE LOCATION
SCALE IN FEET
SEQUOYAH FUELS CORPORATION
RFI WORKPLAN
STUDY AREA SAMPLE LOCATIONS
STUDY AREA
SA-2
DRAWING NO.
RFI-SA-02
DATE
1/18/94
REV.
DATE
BY
FIGURE 7

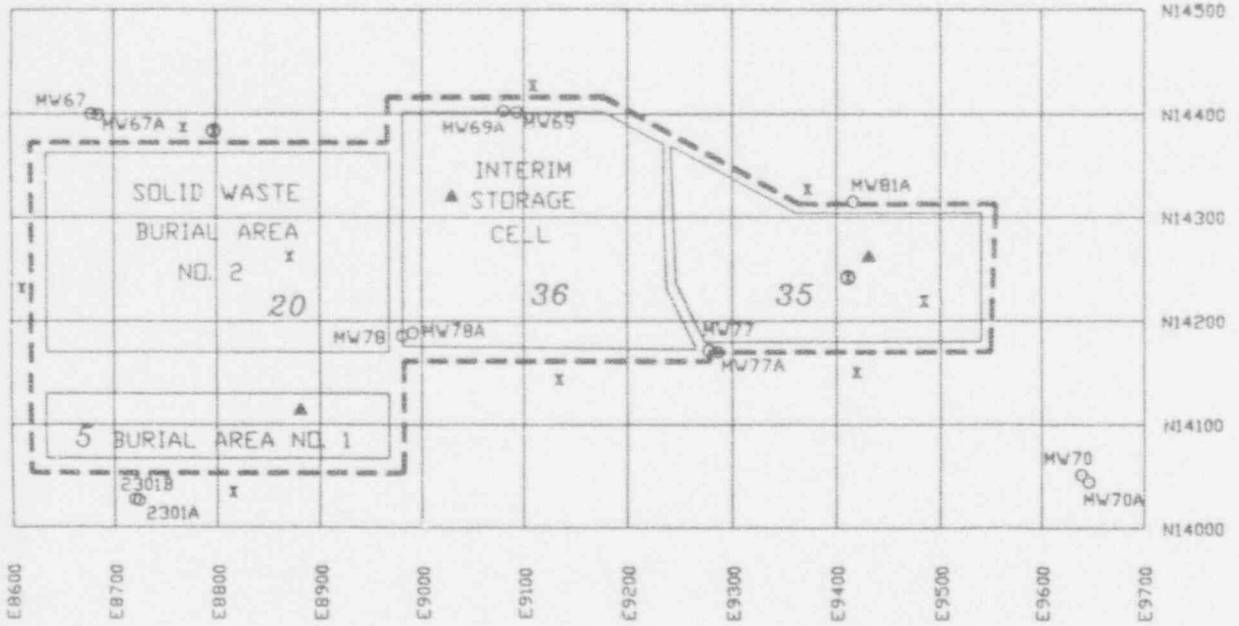
(RFI, Figure 7)


STUDY AREA UNITS
1 - MAIN PROCESS BUILDING
2 - SOLVENT EXTRACTION BUILDING
6 - EMERGENCY BASIN
7 - SANITARY LAGOON
9 - NORTH DITCH
10A - INCINERATOR
10B - SOLID WASTE BUILDING
16 - SOUTH YELLOWCAKE SUMP
21 - YELLOWCAKE STORAGE PAD
27 - COMBINATION STREAM
28 - PRESENT LIME NEUTRALIZATION
37 - SANITARY SEWER LINE
38 - NORTH TANK FARM
39 - SOUTH TANK FARM
40 - COOLING TOWER / RCC EVAPORATOR
41 - MISC. DIGESTION BUILDING
43 - BECHTEL STORAGE BUILDING
44 - OIL STORAGE BUILDING
N
LEGEND
STUDY AREA PERIMETER
UNIT PERIMETER
RFI MONITOR WELL
CHARACTERIZATION SAMPLE LOCATION
SATURATED ZONE SOIL SAMPLE LOCATION
SOIL SAMPLE LOCATION
SCALE IN FEET
EMERGENCY BASIN
NORTH DITCH
SANITARY LAGOON
MAIN PROCESS BUILDING
YELLOWCAKE STORAGE
SOUTH YELLOWCAKE SUMP
SX
1000
700
700,000 FT2
SEQUOYAH FUELS CORPORATION
RFI WORKPLAN
STUDY AREA SAMPLE LOCATIONS
STUDY AREA
DRAWING NO.
DATE
SA-3
RFI-SA-03
1/18/94
REV.
DATE
BY
FIGURE 8

(RFI, Figure 8)



(RFI, Figure 10)



STUDY AREA UNITS

5 - SOLID WASTE BURIAL AREA NO. 1 (SOUTH)
20 - SOLID WASTE BURIAL AREA NO. 2 (NORTH)
35 - SCRAP METAL STORAGE AREA
36 - INTERIM STORAGE CELL

N

LEGEND

- STUDY AREA PERIMETER
- UNIT PERIMETER
- RFI MONITOR WELL
- CHARACTERIZATION SAMPLE LOCATION
- SATURATED ZONE SOIL SAMPLE LOCATION
- SOIL SAMPLE LOCATION

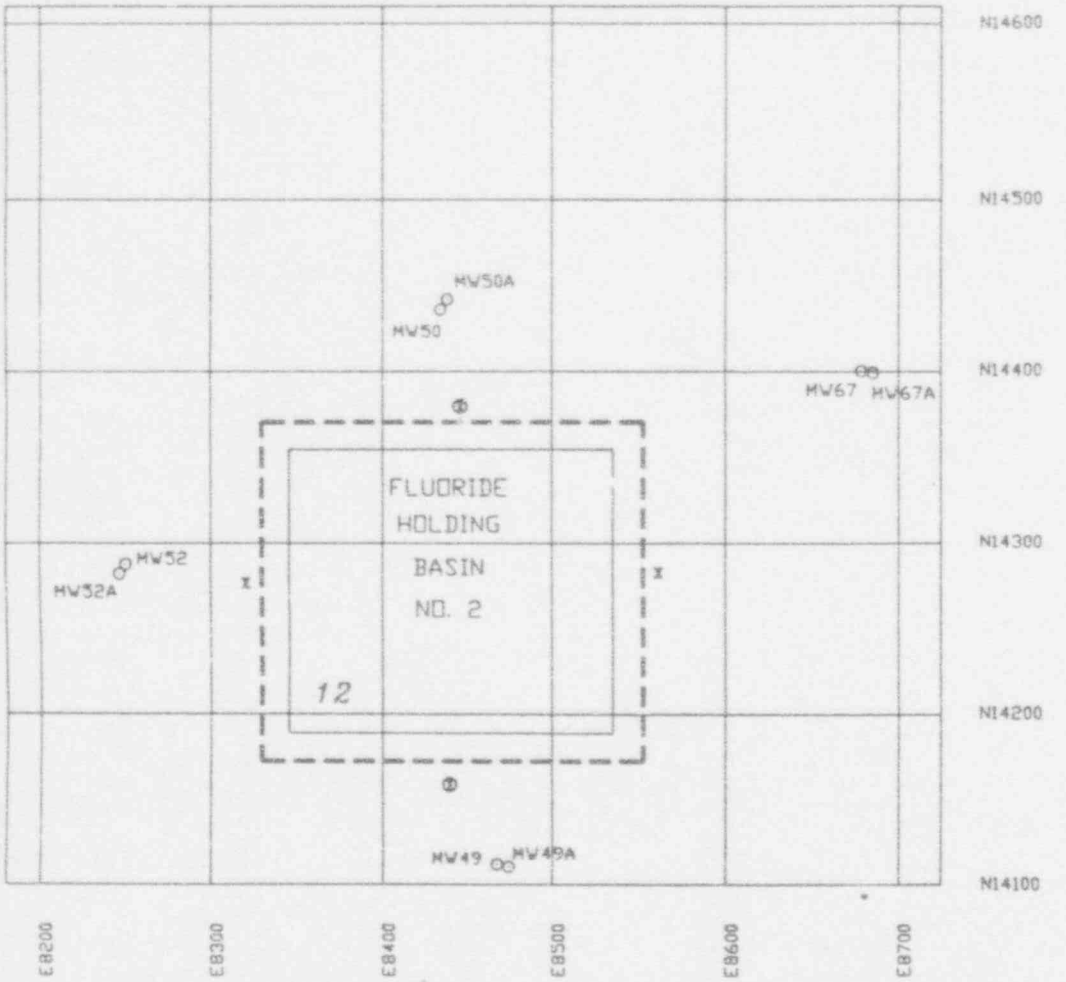
0 50 100 200

SCALE IN FEET

SEQUOYAH FUELS CORPORATION		
RFI WORKPLAN STUDY AREA SAMPLE LOCATIONS		
STUDY AREA	DRAWING NO.	DATE
SA-4	RFI-SA-4	1/18/94

REV.	DATE	BY	
			FIGURE 9

(RFI, Figure 9)



STUDY AREA UNITS

12 - FLUORIDE HOLDING BASIN NO. 2

N

LEGEND

STUDY AREA PERIMETER

UNIT PERIMETER

RFI MONITOR WELL

SATURATED ZONE SOIL SAMPLE LOCATION

SOIL SAMPLE LOCATION

0 50 100 200

SCALE IN FEET

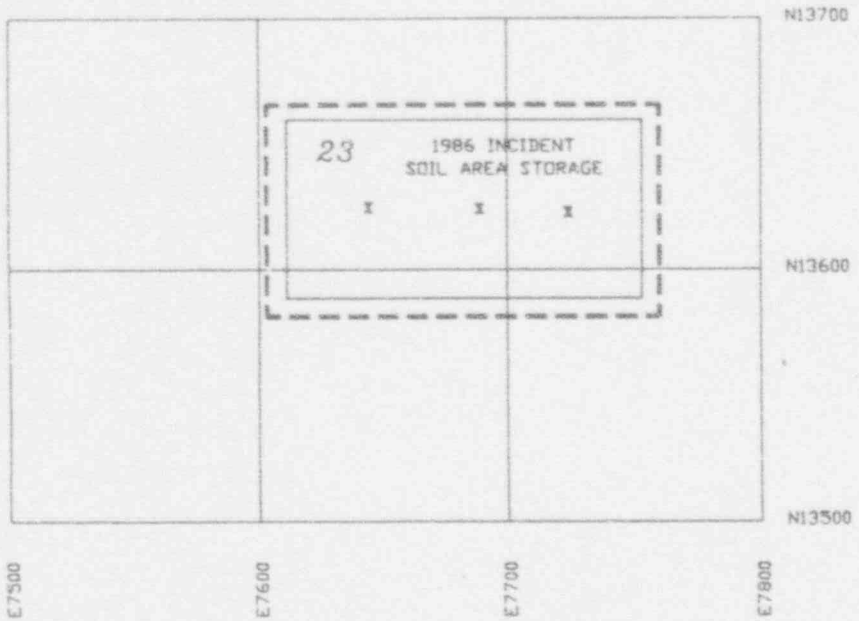
SEQUOYAH FUELS CORPORATION		
RFI WORKPLAN STUDY AREA SAMPLE LOCATIONS		
STUDY AREA	DRAWING NO.	DATE
SA-6	RFI-SA-06	1/18/94

REV.	DATE	BY

FIGURE 11

(RFI, Figure 11)

(RFI, Figure 12)



STUDY AREA UNITS

23 - 1986 INCIDENT SOIL AREA STORAGE

N

LEGEND

STUDY AREA PERIMETER

UNIT PERIMETER

X SOIL SAMPLE LOCATION

0 50 100 200

SCALE IN FEET

SEQUOYAH FUELS CORPORATION		
RFI WORKPLAN STUDY AREA SAMPLE LOCATIONS		
STUDY AREA	DRAWING NO.	DATE
SA-8	RFI-SA-08	1/18/94

REV.	DATE	BY	
			FIGURE 13

(RFI, Figure 13)