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WORK PLANS

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RFI PHASE II WORK PLAN
(SECOND SUBMITTAL)

Prepared for

Navajo Refining Company
Artesia, New Mexico

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TABLE OF CONTENTS

Page

1.0 INTRODUCTION 1-1
- 1.1 PURPOSE OF THE RFI (PHASE II) WORK PLAN 1-1
- 1.2 SCOPE OF THE RFI WORK PLAN 1-1
- 1.3 ORGANIZATION OF THE RFI WORK PLAN 1-2

2.0 FACILITY BACKGROUND 2-1
- 2.1 FACILITY BACKGROUND 2-1
- 2.2 DESCRIPTION AND CURRENT STATUS OF SWMUs 2-4
- 2.3 ENVIRONMENTAL SETTING 2-4
  - 2.3.1 Topography and Surface Water 2-4
  - 2.3.2 Soils 2-5
  - 2.3.3 Geology 2-6
  - 2.3.4 Groundwater 2-7
- 2.4 IDENTIFICATION OF POTENTIAL RECEPTORS 2-8

3.0 DATA COLLECTION QUALITY ASSURANCE PLAN 3-1
- 3.1 DATA COLLECTION STRATEGY PLAN 3-2
  - 3.1.1 Three-Mile Ditch/Eagle Creek 3-2
    - 3.1.1.1 Description 3-2
    - 3.1.1.2 Data Collection Strategy . 3-3
      - 3.1.1.2.1 Ground Water Investigation . . 3-3
  - 3.1.2 Three-Mile Ditch/Eagle Creek 3-4
    - 3.1.2.1 Description 3-4
    - 3.1.2.2 Data Collection Strategy . 3-5
      - 3.1.2.2.1 Surface Water Investigation . . 3-5
      - 3.1.2.2.2 Ground Water Investigaton . . . 3-5
- 3.2 SAMPLING/ANAYLSIS STANDARD OPERATING PROCEDURES 3-7
  - 3.2.1 Hydrogeological Techniques 3-8
    - 3.2.1.1 Groundwater Elevation Measurements 3-8
    - 3.2.1.2 Hydrogeologic Parameters . 3-9
      - 3.2.1.2.1 Well Discharge Measurements . . 3-9
      - 3.2.1.2.2 Aquifer Tests . . 3-9
  - 3.2.2 Drilling Procedures 3-10
    - 3.2.2.1 Drilling Method 3-11
    - 3.2.2.2 Borehole Logs 3-12
    - 3.2.2.3 Drilling Safety and Underground Utility Detection 3-13
    - 3.2.2.4 Equipment Decontamination 3-13
    - 3.2.2.5 Well Construction and Development 3-13
      - 3.2.2.5.1 Well Construction 3-13
      - 3.2.2.5.2 Well Development 3-19

Page

3.2.2.6 Surveying of Sampling Locations 3-21
3.2.3 Sample Collection 3-21
3.2.3.1 Equipment Decontamination 3-21
3.2.3.2 Groundwater Sampling . . 3-22
3.2.3.3 Soil Sampling 3-24
3.2.3.4 Surface Soil Sampling . . 3-26
3.2.3.5 Surface Water/Sediment Sampling Methods 3-27
3.2.3.5.1 Sediment Sampling 3-27
3.3 QUALITY ASSURANCE PROJECT PLAN 3-28
3.3.1 Purpose and Scope 3-28
3.3.2 Project Organization and Responsibility 3-29
3.3.2.1 Overall Responsibility . 3-29
3.3.2.2 Subcontractor Responsibility 3-29
3.3.2.3 Quality Assurance 3-30
3.3.2.3.1 Overall QA Responsibility . 3-30
3.3.2.3.2 Field QA Responsibility . 3-30
3.3.2.3.3 Laboratory QA Responsibility . 3-30
3.3.2.3.4 QA Reports to Management . . 3-31
3.3.2.4 Performance and Systems Audits 3-31
3.3.3 Quality Assurance Objectives . . . 3-31
3.3.3.1 Quality Assurance Objectives 3-32
3.3.3.1.1 Accuracy . . . 3-32
3.3.3.1.2 Precision . . . 3-33
3.3.3.1.3 Completeness . 3-33
3.3.3.1.4 Comparability . 3-34
3.3.3.1.5 Representativeness 3-34
3.3.3.2 Field Data Quality Objectives (DQO's) 3-34
3.3.3.3 Analytical Laboratory Data Quality Objectives . . . 3-37
3.3.3.4 Level of Quality Assurance 3-37
3.3.3.5 Accuracy and Precision . 3-38
3.3.3.6 Method Detection Limits . 3-38
3.3.4 Sampling Procedures 3-38
3.3.4.1 Sampling Locations and Numbers 3-44
3.3.4.2 Sample Containers and Sample Preservation 3-45
3.3.4.3 Decontamination of Sampling Equipment 3-47
3.3.5 Sample Custody 3-47
3.3.5.1 Field Sampling Documentation 3-47
3.3.5.1.1 Documentation of Sample Acquisition 3-47

Page

3.3.5.1.2 Documentation of Sample Preservation 3-48
3.3.5.1.3 Chain of Custody 3-48
3.3.5.1.4 Tags 3-50
3.3.5.1.5 Field Tracking Forms 3-51
3.3.5.2 Laboratory Operations . . 3-51
3.3.5.3 Evidence Files 3-55
3.3.6 Calibration Procedures and Frequency 3-55
3.3.6.1 Field Calibration Procedurs 3-55
3.3.6.2 Chemistry Laboratory Calibration Procedures . . . 3-55
3.3.7 Analytical Procedures 3-56
3.3.8 Data Reduction, Validation and Reporting 3-56
3.3.8.1 Data Reduction 3-56
3.3.8.2 Data Validation 3-57
3.3.8.2.1 Review of Analytical Program . 3-57
3.3.8.2.2 Examination of Results 3-57
3.3.8.2.3 Recalculation of Results 3-58
3.3.8.3 Data Reporting 3-58
3.3.9 Internal QC Checks and Frequency . 3-58
3.3.9.1 Internal QC Checks and Frequency - Laboratory . . . 3-58
3.3.9.2 Internal QC Checks and Frequency - Field 3-59
3.3.10 Performance and Systems Audits . . 3-59
3.3.10.1 Performance Audits . . . 3-60
3.3.10.1.1 Laboratory Performance Audit 3-60
3.3.10.1.2 Field Performance Audit 3-61
3.3.10.2 Systems Audit 3-61
3.3.10.2.1 Laboratory Systems Audit . 3-62
3.3.10.2.2 Field Systems Audit 3-64
3.3.10.3 Detailed Laboratory Performance and Systems Audit . 3-64
3.3.10.4 Nonconforming Items and Disposition 3-69
3.3.10.5 Schedule of Audits . . . 3-72
3.3.11 Prevenative Maintenance 3-72
3.3.11.1 Laboratory Maintenance . 3-72
3.3.11.2 Field Maintenance 3-72
3.3.12 Data Assessment 3-74
3.3.13 Corrective Action 3-74
3.3.14 Quality Assurance Reports to Management 3-75

Page

4.0 DATA MANAGEMENT PLAN 4-1
4.1 DATA MANAGEMENT 4-1
4.2 DATA PRESENTATION 4-1
4.3 STATISTICAL PROCEDURES 4-3
4.4 SCHEDULE 4-3

LIST OF FIGURES

Page

Figure 2.1 General Location Map 2-2

Figure 2.2 Facility Map 2-3

Figure 3.1 Well Construction Detail Cross Section . . . 3-15

Figure 3.2 Quality Assurance Audit Finding Report 3-67

Figure 3.3 Standard Audit Report Format 3-68

Figure 3.4 Nonconformance and Disposition Action Report 3-71

Figure 4.1 Schedule of RFI Workplan Activities 4-4

LIST OF TABLES

Page

Table 3.1 Organic Surrogate Spike Recovery Limits 3-39

Table 3.2 Matrix Spike Recovery Limits 3-40

Table 3.3 Precision, Accuracy and Completeness Objectives 3-41

Table 3.4 Hazardous Substance List (HSL) and Required Detection Limits (RDL) for Volatile Compounds 3-42

Table 3.5 Detection Limits for Elements Determined by Indiuctively Coupled Plasma Emission or Atomic Absorbtion Spectroscopy and Cyanide 3-43

Table 3.6 Sample Containers, Preservatives, and Holding Times for Low Concentration Test Parameters 3-46

Table 3.7 Schedule of Audits to be Performed 3-73

Table 3.8 QA Reports to Management 3-76

Table 4.1 Uses of Tables and Graphics 4-2

1.0 INTRODUCTION

This RFI Phase II Work Plan has been adapted from the original Phase I Work Plan prepared by Earth Technology Corporation for Navajo Refining Company. The Earth Technology work plan is presented in its entirety, with minor editing for Sections 1.0, 2.0, and 4.0. Specific Phase II data collection strategies in Section 3.0 are submitted by Mariah Associates, Inc. for Navajo Refining Company. Section 5.0, the Health and Safety Plan and Section 6.0, the Community Relations Plan are not included in this submittal.

1.1 PURPOSE OF THE RFI (PHASE II) WORK PLAN

The Navajo Refinery (EPA ID No. NMD 048918817) located in Artesia, New Mexico, is regulated under the Resource Conservation Recovery Act (RCRA) and the Hazardous and Solid Waste Amendments (HSWA). One of the major provisions of HSWA (Section 3004-6) requires corrective action for releases of hazardous waste or constituents from solid waste management units (SWMUs) which are suspected to be sources of releases to the environment. The U.S. EPA conducted a Preliminary Review (PR) of all SWMUs at Navajo Refinery. Based on that review and additional information, the U.S. EPA determined that a RCRA Facility Investigation (RFI) on SWMUs at the facility was necessary. The purpose of the Work Plan is to provide the U.S. EPA with a logical and coherent approach for conducting additional investigations that will allow a determination of the nature and extent of releases of hazardous waste or constituents. The second phase will focus on specific releases from SWMUs identified in the permit.

1.2 SCOPE OF THE RFI WORK PLAN

The required scope of the RFI Work Plan is outlined in Section C (Corrective Action for Continuing Releases) and in Section F

(Scope of Work for a RCRA Facility Investigation at Navajo Refinery) of the Permit issued to the facility on March 25, 1988.

1.3 ORGANIZATION OF THE RFI WORK PLAN

This Work Plan is organized into four sections. The remainder of this section outlines the organization of this Work Plan. Section 2.0 provides a synopsis of the history of the facility, the current status of SWMUs at the facility and identifies potential receptors. Section 3.0 provides summary descriptions of the SWMUs at the facility at which RFI activities are to be conducted and outlines the strategy for conducting the investigations necessary to address the requirements of Task III of the permit. Section 4.0 provides a Data Management Plan.

2.0 FACILITY BACKGROUND

2.1 FACILITY BACKGROUND

Navajo Refinery is located at 501 East Main Street in Artesia, Eddy County, New Mexico. The general location of the facility is shown in Figure 2.1. An overall facility map is shown in Figure 2.2.

The facility is a petroleum refinery which began operations in the 1930s. The ownership of the facility has changed numerous times since beginning operations. The facility consists of two separate North and South divisions (Figure 2.2). In 1969, Navajo purchased both divisions and began to integrate the operation into a single refinery capable of processing New Mexico sour crude (an asphalt-based crude) in the South Division and New Mexico intermediate crude (a paraffin-based crude) in the smaller North Division. The facility has the capacity to refine about 40,000 barrels of crude per day. The South Division produces about five-sixths of the total.

The major refining processes at the facility are: crude oil fractionation, fluidized catalytic cracking, alkylation, reforming, and desulfurization. Several auxiliary activities are associated with these processes which separate impurities from the feedstocks and products or are required for the operation and maintenance of the refinery. The units associated with these auxiliary activities include: boiler, cooling towers, storage tanks, water purification facilities, desalting units, and drying and sweetening units.

The production activities at the Navajo Refinery generate a variety of solid wastes and waste water streams. RCRA solid waste (oil-water separator sludges, heat exchanger bundle cleaning sludges, slop oil emulsion solids and, when produced, leaded tank bottoms) are disposed of at the facility's RCRA permitted North

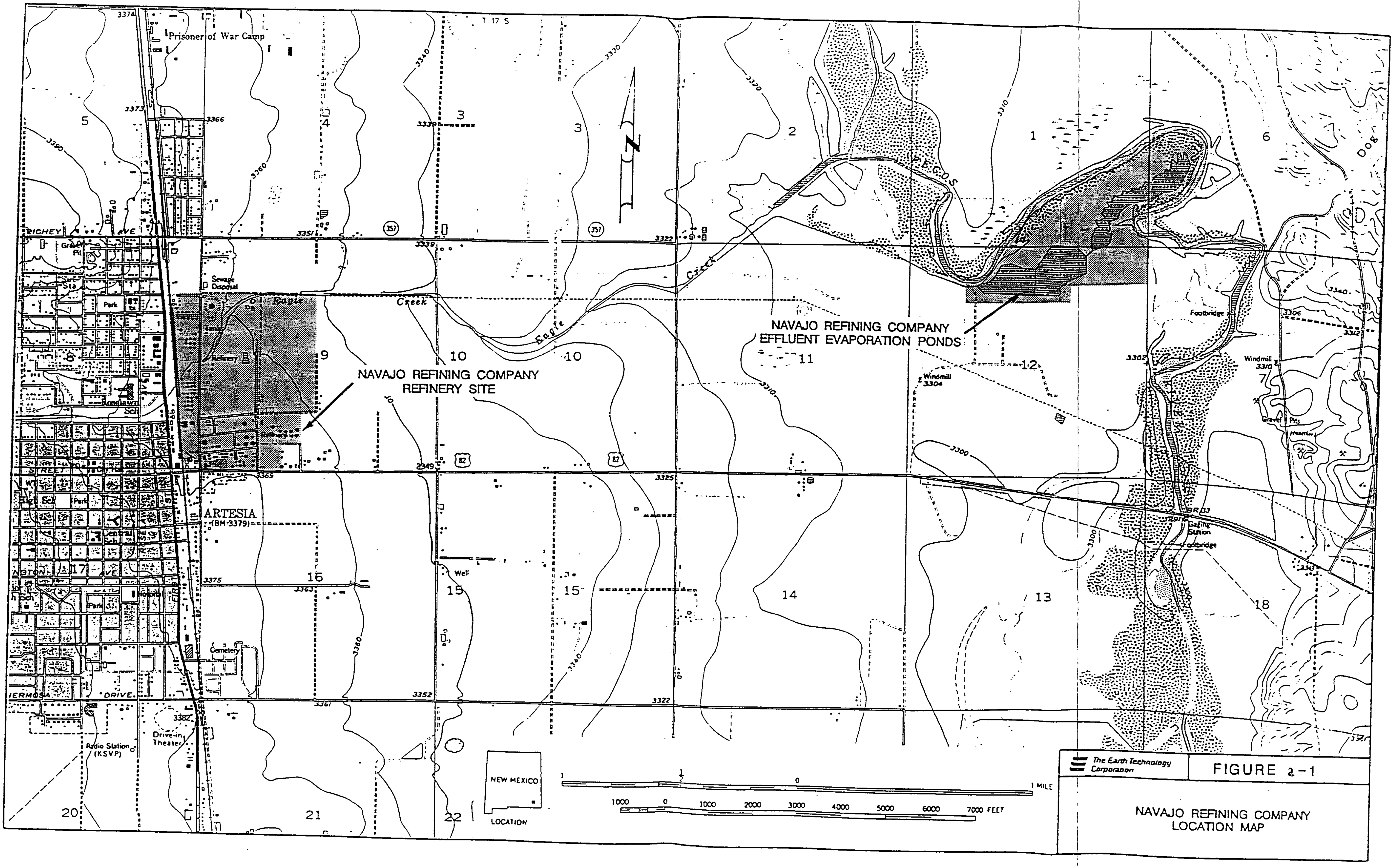


FIGURE 2-1

NAVAJO REFINING COMPANY LOCATION MAP

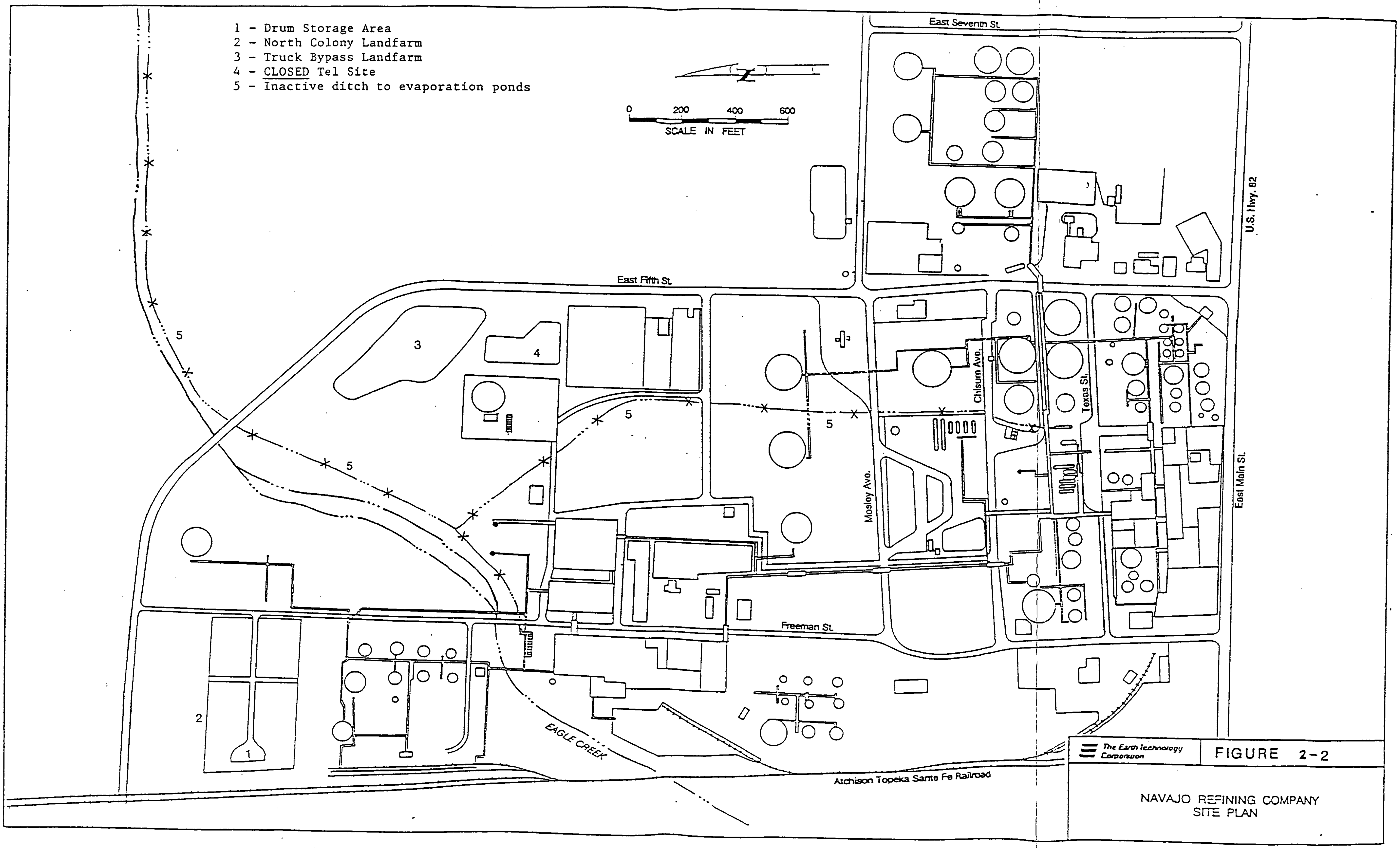


FIGURE 2-2

NAVAJO REFINING COMPANY
SITE PLAN

Colony Landfarm. The wastewater management system presently employed by Navajo consists of a wastewater treatment plant and a system of evaporation ponds.

2.2 DESCRIPTION AND CURRENT STATUS OF SWMUs

A RCRA Preliminary Review (PR) was completed at the facility and submitted to EPA in April of 1986. The PR identified 15 Solid Waste Management Units (SWMUs) at the facility. The US EPA Region VI issued a Hazardous Waste Permit to the facility effective March 25, 1988.

2.3 ENVIRONMENTAL SETTING

The environmental setting for the refinery was provided in the RFA conducted at the facility and is summarized in the subsections that follow.

2.3.1 Topography and Surface Water

The facility is located in the eastern plains of New Mexico on a broad plateau developed on flat-lying bedrock. The average elevation of the city of Artesia is 3,340 feet above MSL. The plain on which Artesia lies slopes eastward about 33 feet per mile. Surface drainage is dominated by small ephemeral creeks and arroyos which flow eastward to the Pecos River, located approximately three miles east of the facility.

Natural surface drainage at the facility is to the north and east. The major drainage in the immediate area of the site is Eagle Creek which runs southwest to northeast through the Navajo Refinery, and then runs eastward into the Pecos River. The refinery's Three-Mile Ditch parallels Eagle Creek on its south side. Use of the Three-Mile Ditch for waste water conveyance was discontinued in 1987. Waste water is now conveyed to Pond #2 through a high density polyethylene (HDPE) pipe. The North Colony and drum storage area, located in the northern drainage area are surrounded by a dike.

A large portion of the Navajo Refinery is within the 100-year floodplain of either Eagle Creek or the Pecos River. However, Eagle Creek's channel has been rectified from west of Artesia to the Pecos, and the area of rectification is being extended. A dam check is also being constructed west of Artesia along Eagle Creek. According to the PR prepared for this facility, once these measures are completed, they should effectively remove Artesia and the refinery from Eagle Creek's 100-year floodplain. Portions of the Three-Mile Ditch and the Evaporation Ponds lie within the Pecos River flood plain. However, the construction of flood control dams upstream of the facility have reduced the risk of flooding at the facility. Since 1960, no discharge along the Pecos has exceeded 700 cfs.

2.3.2 Soils

Soils at the refinery are primarily of the Pima and Karro series. The Truck Bypass Landfarm is mainly Pima soils whereas the North Colony landfarm is about 60% Pima soils and 40% Karro soils. The frost-free season for Pima and Karro soils is 195 to 210 days. Extended periods of cold weather are rare and frost action potential is slight. In general, soils in the area do not freeze at depths greater than a few inches for more than a few days at a time. The top two feet of soil within the Truck Bypass Landfarm are fill material generated as a result of construction in other parts of the refinery.

The Pima and Karro soils have similar properties. Pima soils are deep, well drained, dark colored, calcarious soils, which occur on floodplains of narrow drainageways (e.g., Eagle Draw). These soils have moderate shrink-swell potential, and are subject to periodic flooding. Runoff from Pima soils is slow, permeability is moderately slow, and the water-holding capacity is high. The effective rooting depth is greater than five feet, and the water table is deeper than five feet.

The Karro soils are highly calcarious. Calcium carbonate typically accumulates at a depth of about 45 inches. These soils are found on level to gently sloping terrains and are susceptible to wind erosion. Runoff is slow and water-holding capacity is high. Permeability is moderate, and the effective rooting depth and the water table are both over five feet deep.

2.3.3 Geology

The geology of the Artesia area is marked by a sequence of Permian formations overlain by Quaternary alluvium. The uppermost formation is the Pecos River Valley alluvium. The westernmost extent of this alluvium is approximately 2.5 miles east of the refinery area.

The uppermost Permian formation in the Artesia area is the Seven Rivers Formation. This formation is approximately 200 feet thick in the Artesia area, and consists of a sequence of evaporates, carbonates, gypsum and shale, with isolated sand and fractured anhydrite/gypsum lenses. The bottom of this formation is marked by the Bower sand. It is not certain whether this unit is an extensive or discontinuous deposit.

Below the Seven Rivers Formation lies the Queen Formation (Permian), which consists of about 700 feet of evaporates, sands, and shales. The sands are 10 to 50 feet thick, and are predominantly near the top of the formation.

The San Andres Formation (Permian) lies beneath the Queen Formation, and is composed of limestone and dolomite containing irregular and erratic solution cavities which range up to several feet in diameter. This formation is approximately 100 feet thick.

The Permian formations dip one to three degrees towards the southeast. A normal fault trending N40E, with the northwest block downthrown, has been mapped approximately 2.5 miles east of the refinery. This fault displaces all of the above mentioned Permian formations.

2.3.4 Ground Water

The principal aquifers in the Artesia area are the San Andres and the Upper Queen Formations. The San Andres is known locally as the deep or artesian aquifer. It has been heavily developed for industrial, municipal, and agricultural use. The quality of water from this aquifer ranges from 500 to over 5,000 ppm TDS. Water is generally derived from depths ranging from 850 to 1,250 feet below ground surface. This aquifer is recharged in the Sacramento Mountains to the west of Artesia. Extensive use of this aquifer in recent decades has lowered the piezometric head of this aquifer to its current level of 50 to 80 feet below ground level. The aquifer is confined by overlying shales and evaporates of the Queen Formation.

The shallow aquifer consists of the sands of the Upper Queen Formation. The sands are confined by overlying shales and anhydrites of the Seven Rivers Formation, and are separated from the San Andres aquifer by 700 feet of carbonates, shales, and evaporates. The Upper Queen exhibits nearly 100 feet of artesian head, and yields water containing 500 to 1,500 ppm TDS. Water levels range form 40 to 60 feet below ground level. In the Artesia area, the potentiometric surface of the shallow aquifer slopes gently east and southeast, following regional stratigraphic dips. South of Artesia, the potentiometric surface forms a shallow trough due to extensive water use for irrigation.

Based on USGS sources, if the San Andres and the Queen aquifers are hydraulically connected water will tend to flow upward from the deep to the shallow aquifer.

According to lithologic logs from site monitoring wells, the Seven Rivers Formation, which overlies the Queen Formation, contains water of poor quality in fractured anhydrite and sand lenses at a depth of 15 to 30 feet. This water is under artesian pressure with static water levels three to five feet above the saturated zones. Regionally, this uppermost aquifer may have been utilized to provide low quality water for stock use, but has not been confirmed to bed in any current use. The water of this aquifer is highly variable in quality, volume, areal extent, and saturated thickness.

Adjacent to the Pecos River, the Pecos Valley alluvium contains ground water at a depth of six to 12 feet. Historically, this water has not been utilized due to its poor quality. The alluvium is predominantly silty sand, possibly containing lenses of higher permeability material. Ground water flow is sub-parallel to the Pecos River Valley, and is generally towards the river, although during periods of high river flow, the hydraulic gradient may be away from the river into the alluvium. However, this reversal has not been adequately documented.

2.4 IDENTIFICATION OF POTENTIAL RECEPTORS

The community of Artesia is located directly adjacent to the facility. The PR conducted at the facility concluded that it does not appear likely that releases from SWMUs at the refinery would affect ground water quality in the deep artesian aquifers (San Andres and Queen Formation). Artesian pressure and depth from ground surface appear to be adequate to prevent downward migration of waste constituents.

The PR indicates that the deep artesian aquifers (San Andres and Queen Formations) have been extensively developed for irrigation purposes but the shallow ground water in the Pecos River Valley alluvium is not currently utilized for any purpose due to poor water quality. The PR concluded that since the river alluvium's westernmost extent is approximately 2.5 miles east of the city of Artesia, a release of waste constituents from the SWMUs constructed in the alluvium would not pose a significant health threat to the population of Artesia.

The PR indicated that the Three-Mile Ditch and the Evaporation Ponds could be susceptible to inundation in the event of major flooding. The PR report speculated that in the event of inundation, hazardous wastes and constituents contained in the Three-Mile Ditch and the Evaporation Ponds could have been released to surface water.

The PR concluded that it is unlikely that any public water supplies would be affected by releases into the Pecos River. Aquifers more than 1,000 feet deep are used for water supplies in the Artesia area.

3.0 DATA COLLECTION QUALITY ASSURANCE PLAN

The Data Collection Quality Assurance Plan (DCQAP) incorporates the site specific sampling strategy, standard operating procedures (SOPs) used for the data collection and a quality assurance project plan (QAPP). Navajo's consultant shall, in performing the DCQAP, provide for each SWMU information and verification of:

Environmental Setting

- the hydrogeologic conditions at each of the facilities,
- the surface and sub-surface soils as well as the confining zones and bedrock formations,
- the chemical nature and physical description of surface water bodies and sediments within these waters, and
- the climate in the vicinity of the facility.

Contamination Characterization - Vertical and Horizontal Extent

- Evaluation of the ground water quality at Evaporation Ponds and the Three-Mile Ditch/Eagle Creek SWMUs.
- Evaluation of the surface-water quality at the Three-Mile Ditch/Eagle Creek area

Potential Receptors

- An evaluation of the human populations and environmental systems that are susceptible to contaminant exposure from the facility.

Existing data from previous investigation/assessments conducted at the Navajo Refinery will be compiled in order to augment the information obtained during the RFI field investigation. Prior to utilization of the historical information an evaluation of data usability will be performed. This section is organized into a presentation of work plans (sampling strategies) for each SWMU identified for study.

3.1 DATA COLLECTION STRATEGY PLAN

This section provides descriptions of each of the SWMUs subject to investigation; i.e., Evaporation Ponds 1, 2, and 3, and Three-Mile Ditch/Eagle Creek. Additionally, sampling strategies for the two SWMUs are presented which, when implemented, will result in the characterization of the areal and vertical extent of impact, and rate of migration for each unit.

3.1.1 Evaporation Ponds 1, 2, and 3

A characterization of the ground water and soils associated with Evaporation Ponds 1, 2, and 3 is required per the Permit.

Note: This investigation encompasses all of the ponds located adjacent to the Pecos River.

3.1.1.1 Description

The evaporation ponds, which have been used since the 1930s, are located approximately three miles east of the Navajo Refinery (Figure 2.2). The area of the ponds is approximately 100 acres and they range in depth from two to five feet. The ponds are contained by earthen dikes that are six to 12 feet high and 30 to 45 feet wide at their base. The ponds are unlined and built on silts, sands, and clays of the Pecos valley alluvium. The ponds are located on a terrace approximately 10 feet above the channel of the Pecos River and in the 100 year floodplain.

The ponds receive approximately 650,000 gallons of wastewater per day from the refinery wastewater treatment plant, via a 20,000 linear foot enclosed conduit. The conduit, constructed of high-density polyethylene with thermally-welded joints, replaced an open earthen ditch in 1987. Wastewaters typically contain 2,000 to 4,000 mg/l total dissolved solids. Ground water in the area of the Pecos River is of very poor quality with TDS levels averaging in excess of 15,000.

The ponds are in series and are numbered from upstream to downstream as Ponds 1, 2, and 3. Pond 1 which is out of service reportedly contains approximately 60,000 tons of sludge.

3.1.1.2 Data Collection Strategy

3.1.1.2.1 Ground Water Investigation

The ground water investigation will include the following activities:

- Measurement of water levels in monitor wells and piezometers
- Installation of monitor wells to delineate vertical extent of contamination and to provide hydrogeologic baseline information
- Collection of samples from new monitor wells
- Performing aquifer tests to determine in-situ hydraulic conductivity

Static water level measurements will be obtained from monitor wells and piezometers in the vicinity of the evaporation ponds. The measurements will be taken with an electric tape on a bi-monthly schedule for one year to determine seasonal variation of ground water flow. Procedures for obtaining static water levels are included in Section 3.2.1.1.

Three monitor wells will be installed to define vertical extent of contamination and provide hydrogeologic baseline information. One monitor well (approximately 100 feet deep) will be installed adjacent to MW-4. A second monitor well (approximately 60 feet deep) will be installed adjacent to piezometer P-87-19, the point of highest recorded xylene concentration. A third monitor well (approximately 60 feet deep) will be installed adjacent to OCD-3, the point of highest volatile concentration north of the ponds.

Aquifer response tests will be performed on the three newly installed monitor wells. Rising-level permeability tests will be accomplished as detailed in Section 3.2.1.2.2.

3.1.2 Three-Mile Ditch/Eagle Creek

A characterization of the areal and vertical extent, and the rate of migration for contaminant impacts is required by the Permit. The RFI Phase I study documented significant metals and organics impact to surface water and sediments in Eagle Creek and to shallow ground water in the vicinity of Three-Mile Ditch.

3.1.2.1 Description

A three-mile long unlined earthen ditch (approximately 20,000 linear feet) conveyed wastewater from the refinery to Evaporation Pond 1 from the 1930s until 1987. The ditch is three to four feet wide and one to two feet deep and is bermed along its course to prevent overflow or influx of surface water. The ditch has a slope of approximately 0.004 ft/ft and lies approximately parallel to the path of Eagle Creek. The ditch parallels the natural drainage of Eagle Creek but is not in the creek. Furthermore, the base of the conveyance ditch is approximately five to 10 feet above the creek bed.

In the past, sludge was removed from the bottom of the ditch and placed along the berms. None of the ditch wastes have been removed from the site. 3,400 tons of sludge reportedly remain in the ditch.

3.1.2.2 Data Collection Strategy

3.1.2.2.1 Surface Water-Sediment Investigation

The surface water sediment investigation will include the following activities.

- Sampling sediments in Eagle Creek to determine the areal extent of contaminant impact
- Sediment samples will be collected from the Eagle Creek streambed at 1000-foot intervals. Samples will be analyzed for HSL volatile organics, oil and grease, arsenic, chromium, and lead.

3.1.2.2.2 Ground Water Investigation

The ground water investigation will include the following activities:

- Installation of piezometer array to define ground water flow geometry
- Installation of monitor wells to delineate vertical extent of contamination and to provide hydrogeologic baseline information
- Collection of samples from new monitor wells
- Collection of shallow ground water samples using "Hydropunch" technology to delineate areal extent of shallow contamination
- Measurement of water levels in all available monitor wells and piezometers
- Performing aquifer tests to determine in-site hydraulic conductivity

A shallow piezometer array will be installed along the 20,000-foot extent of Three-Mile Ditch at 1500-foot intervals. Piezometer locations will offset the ditch course approximately 500 ft alternating to the north and south. Existing monitor wells 45, 46, 47, MW-8, and MW-9 will be used instead of piezometers to complete the arrays. Approximately 10 piezometers will be installed.

Static water level measurements will be obtained from monitor wells and piezometers in the vicinity of the Three-Mile Ditch. The measurements will be taken with an electric tape on a bi-monthly schedule for one year to determine seasonal variations of ground water flow. Procedures for obtaining static water levels are included in Section 3.2.1.1.

Ground water samples will be obtained from traverses crossing the area of previously documented volatile plumes south of the evaporation ponds. A "hydropunch" sampler will be used since only limited areal extent could be documented from existing wells in Phase I. Samples will be analyzed for HSL volatiles, lead, chromium, and arsenic. "Hydropunch" sampling methods may be limited by turbidity problems. Samples for metals will be filtered using a peristaltic pump and 45 micron filter.

Three north-south oriented traverses, approximately 5000 feet apart, will be sampled at 300-foot intervals. Traverses are located perpendicular to easterly directed ground water flow. One traverse will be located approximately 1000 feet west of the evaporation pond complex. Sampling will proceed north and south until the edge of the plume is determined.

Two deep monitor wells will be installed to define vertical extent of contamination and provide hydrogeologic baseline information. One monitor well (approximately 80 feet deep) will be installed adjacent to MW-8, the location of chromium problems identified in Phase I. A second monitor (approximately 80 ft deep) well will be installed in the vicinity of NMD-TR-012 since the volume of ditch sludges is greatest in this area. Confining layers encountered will be sampled for permeability analysis. Monitor wells will be sampled for volatiles and the metals, chromium, lead, and arsenic. Metal samples will be filtered using a peristaltic pump and 45 micron filters. Sampling and field measurement procedures are detailed in Section 3.2.1.1.

Aquifer tests will be performed on select monitor wells and the two newly installed deep wells. Rising level permeability tests will be accomplished as detailed in Section 3.2.1.2.2

3.2 SAMPLING/ANALYSIS STANDARD OPERATING PROCEDURES

This section describes the procedures to be followed by all personnel performing release investigations, sample collection, field measurements, and field tests at Navajo Refinery. The types, locations and number of samples to be collected have been described above in Section 3.1. The procedures presented below are designed to produce:

- Data that are of a consistently high quality, and tailored to the needs and goals of the project,
- Samples that are representative of the media under investigation,
- Samples that are identified, preserved, and transported in a manner that ensures that they remain intact and produce legally valid data, and
- Data that are compatible in both type and quality to that produced by previous investigations.

All drilling, well installation, well purging, sampling methods, and related field activities will conform to state and U.S. EPA requirements. Well permits will be acquired from the appropriate agencies, and well logs and construction forms will be filed by Navajo's consultant and its subcontractors.

3.2.1 Hydrogeological Techniques

This subsection reviews procedures for characterizing ground water releases from the Evaporation Ponds. These procedures include ground water elevation measurements and hydrogeologic parameters. Drilling methods and sample collection techniques are described in Sections 3.2.2 and 3.2.3.2.

3.2.1.1 Ground water Elevation Measurements

The depth to ground water (static water level) is an important element in determining changes in horizontal and vertical flow gradients. In this investigation, ground water elevation will be measured prior to each sampling event by the use of an electronic Water Level Indicator (WLI). The WLI, which has marks on it at regular intervals to indicate distance, will be lowered into the well until it contacts the water surface. Measurements will be to the nearest 0.01 foot and will be made from a clearly marked reference point on the top of each well casing; the actual depth to ground water will be this distance minus the elevation of the well casing above the ground surface. Each well will be sounded twice for depth to water; the variation must be less than 0.1 foot between the two measurements. All equipment likely to contact the ground water will be constructed of inert material and decontaminated prior to and following use.

A calibration check will be made in the field by taking a water level measurement with the WLI and checking the measurement with a steel tape. The difference between the two measurements should be less than 0.1 foot per 100 feet of depth to water. The results of those calibration checks will be logged in the field logbook.

If problems develop with the WLI, measurements will be made using a calibrated steel tape. The measurement will be accomplished by positioning one end of the tape on the reference point on the top of the well casing and lowering the weighted end into the well until it just makes contact with the surface of the ground water. The tape is chalked with carpenter's chalk, and the water level is indicated by the wet portion of the chalk. The distance from the top of the well casing to the ground water will be read directly off the tape to the nearest 0.1 foot.

In the event of surface contamination of the ground water, a clear acrylic bailer or hydrocarbon-water interface probe will be used to measure the thickness of any hydrophobic contaminant layer.

3.2.1.2 Hydrogeologic Parameters

Hydrologic parameters such as hydraulic conductivity, transmissivity, and similar characteristics will be obtained as necessary from the tests described below or from the extensive hydrogeologic literature available on the site.

3.2.1.2.1 Well Discharge Measurements

Well discharge rate is obtained by measuring the time necessary for the ground water to fill a container of known volume. This rate will be recorded in the logbook in gallons per minute (gpm).

3.2.1.2.2 Aquifer Tests

Slug tests will be conducted to quantify key hydraulic parameters such as transmissivity and hydraulic conductivity. Slug tests will be conducted by Navajo's consultant at selected wells around the Evaporation Ponds.

The procedures to be followed during the slug test are as follows:

1. The static water level will be measured and recorded.
2. A solid PVC slug (1.75" x 5 ft.) or bailer will be lowered into the well with a nylon rope.
3. The PVC slug will remain in the well until the water level in the well returned to equilibrium.
4. The static water level will be measured and recorded prior to withdrawal of the slug.
5. The slug will be removed and rising water level measurements recorded until the water level returns to the static level.

3.2.2 Drilling Procedures

This section describes the specific procedures to be used when drilling soil borings and monitoring wells at Navajo Refinery. The objectives of the soil and ground water investigation program at Navajo Refinery are to determine the areal and vertical extent and concentration of contaminants to facilitate future decision making. To meet these objectives, the drilling program will be performed by personnel following recognized protocols, with all steps, measurements, and anomalies permanently recorded in the field logbook.

The specific objectives of the soil boring program are to:

- Define vertical and areal extent of soil contamination
- Provide stratigraphic logs of each site

Provide a data base for corrective measures study

The objectives of the monitoring well installation program are to:

- Define the vertical and areal extent of ground water contamination
- Determine the hydrogeologic characteristics of each site
- Develop a data base for corrective measures study
- Supplement the existing monitoring well network

3.2.2.1 Drilling Method

Drilling will be conducted using the following procedures:

- Drilling will be done with a CME 55 truck mounted rig (or equivalent) with 8-inch diameter hollow stem augers.
- Drilling through deeper (greater than 40 feet) sand units will be done utilizing rotary wash techniques. Rotary drilling will be dry until the first indication of the water table.
- Soil samples will be collected out front of the auger flight or rotary bit with a Shelby tube or split spoon sampler, in accordance with ASTM D-1587 and D-1586, respectively.
- Soil samples will be collected at five foot intervals or changes in lithology.
- Visual observations of chemicals, discoloration, strong odors, and possibly PID or FID readings, will be noted and logged.

Prior to drilling, each site will be inspected and cleared as necessary to allow access by the drilling rig and crews. Public utilities will be advised of the drilling operations and locations beforehand so that activities do not interfere with subsurface communications or utility lines. Proposed field locations of all monitoring wells and soil boreholes will be marked during the planning/mobilization phase of the field investigation. The RFI program manager will approve all final drilling locations before drilling is commenced.

A geologist will be present at each operating drill rig to log samples, monitor drilling operations, record depth to water table and other ground water data, prepare borehole logs and well construction diagrams, and record well installation procedures.

3.2.2.2 Borehole Logs

Soil samples and lithologic descriptions acquired during the drilling of both monitoring wells and soil borings will be recorded on a standard borehole log. The following information will be entered in the log or attached to it:

- Project name and number.
- Borehole location and number.
- Name and initials of borehole logger.
- Description of drilling equipment used, driller's name and company, rig size and manufacturer, and method of drilling.
- Brief description of well construction, filter pack, and seal materials using the well construction log.
- Special problems encountered and their resolution.
- Distinct boundaries between soil types and/or lithologies and depths of occurrences.
- Depth of first-encountered ground water or hydrocarbons, along with method of hydrocarbon determination.
- Estimated depth interval for each sample taken or classified, length of sampled interval and length of sample recovery, sampler type and size.
- Description of each soil sample taken, according to the methodology in ASTM D2488-84 "Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)." Soil sample descriptions will include the following:
    - Soil type
    - Grain shape

  - Grading of the predominant fraction (poor, moderate, or well)
  - Color (according to Munsell Soil Color Charts)
  - Plasticity of fines (nonplastic, low, medium, high)
  - Odor, if organic or unusual
  - Other: presence of roots or rootholes, mica, gypsum, caliche or other secondary precipitates, or surface coatings on coarse-grained particles

- Sample depths and sample numbers.

3.2.2.3 Drilling Safety and Underground Utility Detection

All regulations and requirements pertinent to drilling safety will be observed. Prior to drilling, refinery plant engineers and all utility companies will be contacted to determine if any of their lines underlie the site. The locations of any underground lines present will be marked in the field by utility personnel.

3.2.2.4 Equipment Decontamination

All drill rigs and associated equipment will be steam cleaned between boreholes to prevent cross-contamination. Sampling equipment will be decontaminated between samples per Section 3.2.3.1.

3.2.2.5 Well Construction and Development

3.2.2.5.1 Well Construction

All monitoring wells will be set inside an eight-inch borehole. The wells will be constructed of two-inch 1.D. Schedule 40 PVC slotted casing with a 0.01-inch slot size and two-inch I.D. Schedule 40 PVC risers. The wells are designed to: (1) allow sufficient ground water flow for well sampling; (2) minimize the passage of formation materials (turbidity); and (3) provide sufficient structural integrity to prevent the collapse of the intake structure. Well casing, filter pack, bentonite seal, and grout are placed from within the borehole. The wellhead is completed with a cement seal and locking surface casing (see Figure 3.1).

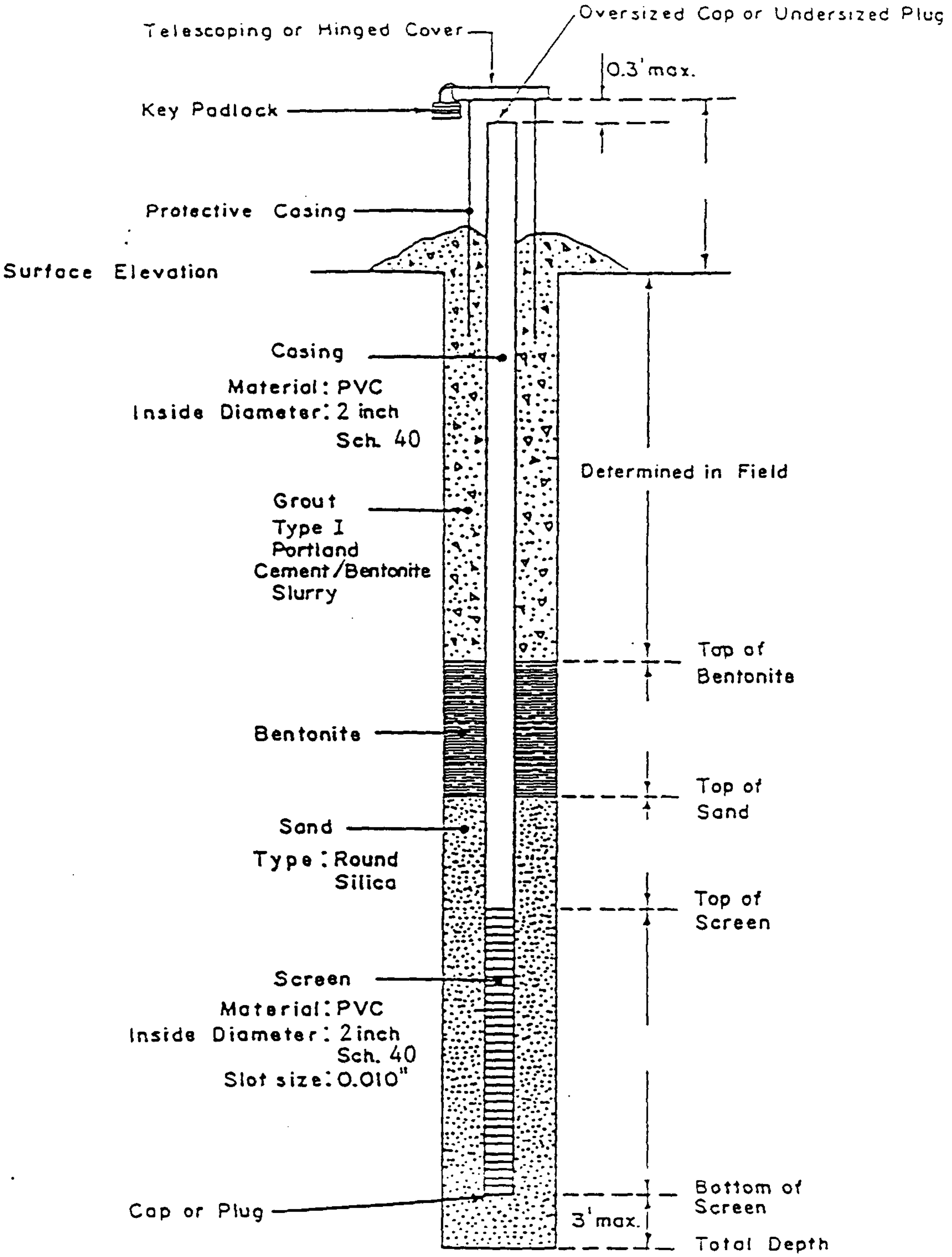
Casing/Screens

Well construction will consist of a standard procedure for placing slotted and blank casings into a borehole. A filter pack, bentonite seal, and cement grout are placed sequentially in the annulus between the borehole and casing/screen. The well casings will be constructed of two-inch inside diameter Schedule 40 PVC casing with a screw cap bottom and top plug. Casing sections will be flush threaded with screw joints.

Each well screen section will be either five or 10 feet in length (depending on the zone being investigated) and be machine-slotted with a 0.01 -inch spacing. The endings, casings, and screens will be steam cleaned prior to use in order that they are free of contaminants. The screening range will allow for seasonal fluctuation in the water table and allow for the collection of representative ground water samples. Cleaned materials will be wrapped in plastic sheeting or placed on racks during storage. The geologist on site is responsible for the supervision of all steam cleaning procedures.

Filter Packs

Once the casing is in place, the filter pack will be installed. The filter pack will consist of washed graded sand, and will be poured from the ground surface. The filter pack will be added at a rate to prevent bridging. The sand will be placed directly in the annular space between the casing and the borehole. The filter pack will extend from the bottom of the screen to a minimum of two feet above the screen.



The Earth Technology Corporation

FIGURE 3—3 1

CROSS-SECTION OF A
TYPICAL MONITORING WELL

The volume of filter material needed to fill the annular space will be calculated. Bridging of materials has occurred if less than the calculated volume is needed to fill the space. If this occurs, a tremie pipe may be used to break the bridging and correctly fill the space.

The field geologist will record the start and stop times of the sand packing, the depth intervals that sand was packed, the amount of sand used, and any problems that arise. The geologist will also record the type of materials used for packing, including: trade name, source, supplier, and typical grain size distribution.

Bentonite Seal

A bentonite seal will be placed in the annular space above the filter pack to separate the permeable zone from the pack and grout. The bentonite will be poured through a tremie pipe. The bentonite used will either be granular, or a slurry that is thick enough to prevent significant penetration of the underlying gravel pack. Seal thickness will be measured by sounding with a weighted probe on at least three sides of the well immediately after placement of the filter material, and again prior to rehydration of the bentonite. The geologist will record the start and stop times of the bentonite seal emplacement. the interval of the seal, the amount of bentonite that was used, and any problems that arose. The geologist will also record type of bentonite and the supplier.

Cement Grout and Protective Casing

The cement grout mixture placed above the bentonite will be composed of 10:1 weight ratio of Portland cement to bentonite 5-10% high grade containing enough water for a pumpable mix. The mixture will be prepared and blended on-site to produce a thick, lump-free mixture. The grout will be placed at least one-half hour after placement of the bentonite seal, and will extend from the top of the bentonite seal to three feet below the ground surface. If possible, filter pack, bentonite seal, and grout should be slowly placed to avoid bridging of material in the annular space of the borehole.

QA/QC measurements of various well dimensions will be completed for each well unless the depth of the well makes measuring the total length of the screens and casings on the ground surface impractical. QC measurements consist of the distances from the top of the well casing to the:

- Top of the bentonite seal
- Top of the filter pad
- Top of the screen
- Bottom of the well

If direct measurements to the screens and casings cannot be made, the number and length of screen and casing sections will be counted individually and summed to determine the total length of screens and casings.

Monitor wells completed above ground will have the cement/bentonite grout placed up to the surface and a 3-5' steel protective casing placed over the well. The protective casing will extend approximately one to two feet below land surface. The casing will have a locking cap to discourage tampering and prevent rainfall or other foreign objects from entering the wellhead. Monitor wells completed flush with the ground surface will be place in a water-tight vault with a protective locking lid. The vault will be placed on top of the cement/bentonite grout.

After the grout has completely set (about 24-72 hours), depressions due to settlement will be filled in by the same grout mixture as previously used. The start and stop times of the cementing, the vertical intervals that were cemented, the amount of cement used, the mix used (gallons of water per bag of cement), any additives to the cement, and any problems that arose during grouting will be recorded on the well construction log.

Well Protection and Marking

The protective casing will be placed over the exposed well casing and seated in a two-foot by two-foot by four-inch concrete surface pad. The pad will slope away from the well. For wells located in traffic areas, a water-tight "chastity" box will be set approximately one inch above grade to prevent surface water ponding. The locks on the well caps will either have identical keys, or be keyed for opening with one master key. The lock keys will be turned over to Navajo Refinery personnel after the completion of fieldwork.

Three 3-inch diameter, cement-filled steel guard posts will be installed around each well. The guard posts will be set in individual concrete footings and extend two feet below ground and three feet above ground. The number of each well will be clearly marked on the well protective casing, both in paint and by impact numbering.

Well Completion Form

Final well construction specifications will be recorded on standard boring logs. The well description will consist of construction details by depth from ground surface, and will include details on the screened interval, casing, filter pack, bentonite seal, grout, and well pad.

3.2.2.5.2 Well Development

Well development is the process by which the aquifer's hydraulic conductivity is restored by removing mobile particulates from within and adjacent to newly installed wells. Well development substantially minimizes the amount of fine materials that may accumulate in the well between sampling events, thus reducing the amount of purging needed to obtain a clear sample.

The wells will be developed using a combination of bailing, surging, and pumping. The fine-grained materials accumulated in the well casing will be bailed from the well until the bottom of the well casing can be probed. After bailing, the well will be surged using a surge block to bring in more fine-grained materials from the filter pack. The well will be bailed again to remove fine-grained material until the bottom of the casing can be probed. After the second bailing, a submersible pump will be placed in the well and pumped. During pumping, aquifer parameters consisting of pH, temperature, and electrical conductivity (EC) will be monitored. After the parameters have stabilized (i.e., less than 10% variability between readings) and the water is relatively free of sediment, the pump will be turned off and water-level recovery measurements will be recorded. After one hour, or after the water has reached its static level, recovery measurements will stop and the submersible pump will be removed from the well. Water level recovery measurements will then be recorded.

The specific procedures for surging and bailing are as follows:

- Measure the total depth of well (TD) and depth to water (DTW).
- Calculate casing volume (CV) using the formula CV = (TD - DTW)c.

where c is the conversion factor for gallons per linear foot based on well diameter

c = 0.61 for 3.8" well

c = 0.16 for 2" well

Casing volumes will be used to serve as guide for total volume of water to be bailed.

- Using a surge block, surge by lifting and dropping the bailer through the column of water in the well. Surge the entire screen interval by five-foot sections using approximately 10-20 iterations per section.
- Monitor the pH, electrical conductivity (EC), temperature, and water clarity in every casing volume removed.
- Monitor pH, EC, temperature and clarity until parameters come to equilibrium (±10% of previous casing volumes).
- The well can be considered developed when the water is clear (i.e., silt and suspended particle content is low), and the water quality parameters have reached equilibrium.

In some cases, overpumping may be used in conjunction with surge bailing to enhance well development. Overpumping is similar to surging and bailing, except that water is removed from the well through the use of a submersible pump lowered into the well. The pumping system must be able to achieve the desired yield at a given depth, and includes:

1. A check valve to prevent water from running back into the well when the pump is shut off
2. A flexible discharge hose
3. A safety cable or rope to ensure that the pump can be removed from the well
4. A flow metering system (a graduated container of a known volume and stopwatch or inline flow meter)
5. An electric generator

6. An ammeter, to measure current and monitor pump performance

3.2.2.6 Surveying of Sampling Locations

The elevations and locations of all well installations (and sampling points) will be determined by a land surveyor at the close of the fieldwork. The elevation at the top of each new well casing (taken from a notch on the well casing) will be determined to 0.01 foot and be traceable to, and previously established from a survey marker. Both the elevation of the ground surface and the elevation of the top of the well casing will be measured. All surveyed points will be recorded on both site-specific and project maps, as will the locations of benchmarks and permanent markers.

3.2.3 Sample Collection

Described below are the procedures for collecting samples of soil, surface water, ground water and air. In addition, decontamination of sampling equipment is also described below.

3.2.3.1 Equipment Decontamination

All sampling equipment, including internal components, will be thoroughly decontaminated prior to use and between sample points to prevent cross contamination. The drilling rigs and tools will also be cleaned and decontaminated thoroughly before and after each borehole. At a minimum, drill bits and casings will be steam cleaned and rinsed after each borehole. In some cases, more extensive decontamination procedures will be required if contaminated material remains after steam cleaning. All equipment for soil and water sampling will be washed with detergent and rinsed, first with drinking quality water and then distilled water. Sampling equipment that is not readily decontaminated will be discarded after each use. Discarded materials, including decontamination solutions, will be accumulated and stored in appropriate receptacles for proper disposal.

3.2.3.2 Ground water Sampling

Ground water sampling from newly-constructed monitoring wells will not commence until approximately 24-hours after well development to allow ground water in the well to reach equilibrium conditions. Ground water samples will be taken first from monitoring wells estimated to be least contaminated and proceed to other wells in the order of increased expected contamination, as estimated from available data and literature.

All equipment used to measure and sample the ground water (e.g., bailers, pumps, tapes, ropes) will be decontaminated (Section 3.2.3.1) before use in each well to prevent cross contamination between wells. Equipment that is dedicated to a well does not require decontamination after use.

At the beginning of sampling, the ground water elevation will be measured and recorded as described in Section 3.2.1.1. In addition, the distance from the top of the water surface to the water-sediment interface or well bottom will also be measured to the nearest 0.1 foot to calculate total casing water volume for well sampling.

After these measurements and prior to collection of ground water samples, each well will be purged of 1) water in the well, 2) water in the gravel pack, and 3) aquifer water which has been affected by the presence of the well. The well will be purged as described in Section 3.2.2.6.1. A minimum of three well casings/volumes removed to ensure that the sample will be representative of ground water conditions. The pH, conductivity, and temperature of the ground water will be monitored during purging at a minimum of five-gallon intervals. A sample will be collected when these parameters have stabilized. If the well is pumped dry during the evacuation of three borehole volumes of water, the well will be allowed to recover to the original water level elevation before sampling.

The ground water sample will be taken immediately after pumping is complete or the well has recovered. A stainless steel or teflon bailer will be used to collect water samples. The bailer will be lowered down the casing on a nylon line. Plastic sheeting will be placed around the well-head to ensure that the bailer line does not touch the ground wile raising or lowering the bailer in the well. The sample will be poured from the bailer directly into the sample container.

In a slow-recovering well, samples may have to be taken when less than three casing volumes have been removed. In this case, sampling will proceed when the water quality parameters have stabilized and the deviation from standard procedure will be documented fully in the field logbook.

At each wellhead, conductivity, pH, and temperature will be measured with portable meters before the sample is collected. In some cases, parameter measurement may be possible directly at the well discharge point. Water to be measured will be collected in nalgene or glass transfer bottles that will be rinsed with sample water prior to filling. Meter probes will be rinsed with distilled water before and after each measurement. Results will be recorded in the field logbook.

QC blanks will be collected according to the schedule outlined in Section 3.3.

3.2.3.3 Soil Sampling

Both surface and subsurface soil samples will be collected at Navajo Refinery to determine the areal and vertical extent and concentration of contaminants in soil. The procedures and requirements involved in collecting these samples are described below.

Boreholes (associated with the installation of monitoring wells) for soil samples will be drilled using the same hollow stem auger method as the monitoring wells. Samples will be obtained at five foot intervals from the land surface to six inches above the water table using an 18-inch long, two-inch O.D. split-spoon sampler.

The split-spoon sampling device will be used to collect soil samples as follows:

1. A split-spoon device or sampler will be attached to the sampling rods and lowered into the borehole. The sampler will not be allowed to drop onto the soil being sampled.
2. The hammer will be positioned above and the anvil attached to the top of the sampling rods.
3. The sampler will be placed on the bottom of the boring and a seating blow will be applied by the hammer.
4. The drill rods will be marked in three successive six inch increments so that the advance of the sampler under the impact of the hammer can be, easily observed.
5. The sampler will be driven with blows from the 140-pound hammer dropping 30 inches and the number of blows applied in each six-inch interval will be counted, and hammering will continue until the sampler ceases to advance or all, 3 six-inch intervals are completed.
6. The number of blows required to effect each six inches of advancement will be recorded. The first six-inch interval is considered to be a seating drive. The sum of the number of blows required for the second and third six inches of penetration is termed the "standard penetration

resistance," or the "N-value." If the sampler is driven less than 18 inches, the number of blows for each completed six-inch increment and for each partial increment will be recorded on the boring log. For partial increment, the depth of penetration will be reported to the nearest one inch, in addition to the number of blows. If the sampler advances below the bottom of the boring under the static weight of the drill rods and hammer, this information will be noted on the boring log.

7. The raising and dropping of the 140-pound hammer will be accomplished using either of the following two methods:

   a. By using a trip, automatic, or semi-automatic hammer drop system.

   b. By using a cathead to pull a rope attached to the hammer. The cathead shall be essentially free of rust, oil, or grease. For each hammer blow, a 30-inch lift and drop will be employed by the operator. The operation of pulling and throwing the rope will be performed rhythmically without holding the rope at the top of the stroke.

8. After driving the sampler to the desired depth, it will be brought to the surface and opened. The percent recovery or the length of sample recovered will be recorded. The composition, color, stratification, and condition of the soil samples will be described in the boring log.

The samples will be collected in three six-inch long, removable brass liner rings contained within the sampler assembly. The first two liners contain samples for laboratory analysis and will be sealed on the ends with aluminum foil and plastic end caps. The wrapped liners will then be wrapped with aluminum foil. The third sample-filled liner will be used to determine soil lithology. Soil samples not retained for laboratory analysis and samples used for field VOC measurements will be placed with soil cuttings produced during drilling.

QC samples will be collected as described in Section 3.3.

3.2.3.4 Surface Soil Sampling

Pre-sampling set-up procedures are described in Step 1. Steps for sample collection and compositing of waste or soil are explained in Steps 2 and 3, respectively. Transfer of composite samples to the sample containers is described in Steps 4 and 5.

1. Pre-Sampling Set-Up: Prepare for sampling by placing plastic sheeting with sand bags (or cinder blocks) near the sample collection areas (not directly beside them) but away from the unloading zone. Place the sampling equipment on the sheet. Be careful not to soil the plastic sheet or sampling equipment with dirt or wastes near the sample collection areas.

2. Grab (Core) Sampling of Waste or Surface Soil: If the soil or waste is fairly dry, use a stainless steel coring device; if the mixture is very moist or sludge-like, use a stainless steel scoop. Place enough sample in the sample container or polyethylene pail and mix thoroughly with the scoop.

3. Composite Sampling of Waste or Soil Samples: Equal amounts of samples should be collected from the sampling points. Combine and mix thoroughly the samples in the pail with the scoop and transfer the composite sample to the sample containers as described in Steps 4 and 5.

4. Organic Volatiles/Semi-Volatiles: Using the scoop, carefully mix the materials in the pail and quickly pack them into sample container so as to avoid air spaces. Fill the container to overflowing and screw on lid. Apply identification labels to container and cover with clear tape.

5. Pesticides/PCBs/Herbicides/Metals/Non-Conventionals: Using the scoop, thoroughly mix soil or waste samples in sample pail and fill sample containers. Fill each sample container to within one-half inch of top. This provides room for expansion should there be any gas production between sample collection and when container is open at the laboratory. Air spaces are of no concern. Apply identification labels to container and cover with clear tape.

3.2.3.5 Surface Water/Sediment Sampling Methods

The following procedures outline steps taken to collect stream sediments located along the Three-Mile Ditch/Eagle Creek.

3.2.3.5.1 Sediment Sampling

Sediment sampling will be attempted beneath every surface water sampling location (or in the case of dry conditions in the Three-Mile Ditch/Eagle Creek area, a location designated in Section 3.1).

1. Sediment samples will be collected beneath the area used to collect a surface water sample. To avoid sediment disturbance, and introducing sediments into the surface water sample, sediments will be collected after surface water sampling.

2. If water depth permits, sediment samples will be collected by grab methods directly into the sample container. At prohibitive depths samples will be collected with a stainless steel clam shell sampler, hand auger, or shovel.

3. Samples will be packed in ice for transport to the sample staging and shipping area. Samples will be handled and shipped in accordance with USDOT regulations under 49 CFR.

4. Sampling instruments will be deconned using the method described in Section 3.2.3.1.

5. During sampling activity, the sampling team will note the following in the dedicated field book.

    - Date, time, location and weather
    - Depth of stream, seep, etc. at sample point
    - Diagram of sampling area and points
    - Visual identification of sediment using the Unified Soil Classification System
    - Sample identification number
    - Decontamination procedures for equipment

3.3 QUALITY ASSURANCE PROJECT PLAN

3.3.1 Purpose and Scope

The purpose of this Quality Assurance Project Plan (QAPP) is to document the quality assurance requirements applicable to the work conducted by Navajo Refining Company and its subcontractors during the conduct of the facility investigation. This plan describes the requirements for organizing, planning, performing, reviewing and documenting activities which affect the quality of work conducted on the Navajo Refining site by personnel, consultants and subcontractors of Navajo. This plan is intended to incorporate the requirements of EPA. The scope of this plan includes field sampling, analytical testing, equipment maintenance, data reduction and reporting.

The project QAPP as presented herein applies to all work performed by Navajo Refining and subcontractors whether performed at the site or in any office or laboratory.

All sampling and laboratory analyses will be conducted in accordance with protocols and guidelines set forth in this document. Specifically, this includes the following areas:

- Preparation of sample containers.
- Sampling procedures.
- Sample preservation.
- Sample custody.
- Sample holding time.
- Analytical procedures.
- Calibration procedures and frequency.
- Data reduction validation.
- Internal QC checks.

3.3.2 Project Organization and Responsibility

3.3.2.1 Overall Responsibility

Navajo Refining's designated program manager is responsible for the overall management of the investigation. Although subcontractors may be used for some project tasks, Navajo assumes full responsibility for ensuring that their actions comply with all aspects of the approved Work Plan (e.g., SOPs, Health and Safety Plan, and QAPP).

The program manager will be Navajo's prime point of contact with the U.S. EPA and will have responsibility for technical, financial and scheduling matters. Furthermore, the program manager will coordinate the deployment of corporate resources required to successfully complete the project. In the program manager's absence, a designated representative, will act as the point of contact.

3.3.2.2 Subcontractor Responsibility

The types of subcontractors which will be utilized in the monitoring and sampling field activities and their anticipated project task(s) are listed below:

SUBCONTRACTOR	FIELD TASK
Chemical Laboratory	Chemical Analysis
Drilling Company	SubsurFace Exploration
Consulting Engineer	Field/Sampling Coordination

Capability Statements for each contractor will be supplied to U.S EPA prior to the start of work.

Each subcontractor will be responsible for following the approved guidelines included in the RFI. The progam manager will coordinate all field activities to ensure the safe and proper performance of all activities.

3.3.2.3 Quality Assurance

3.3.2.3.1 Overall QA Responsibility

The program manager has overall responsibilty for establishing the QAPP and for its implementation in all project activities.

The Project Quality Assurance/Quality Control (QA/QC) Officer reports to the program manager, and coordinates with the program manager in the implementation of the QAPP. The project QA Officer has access to all project personnel. He has the responsibilities to monitor and verify that the project work is performed in accordance with the QAPP, and approved procedures and to assess overall QA effectiveness.

3.3.2.3.2 Field QA Responsibility

The Project QA Officer has responsiblity for the on-site field QA. The QA/QC Officer and/or an assigned representative will work closely with the field staff and subcontractors to ensure that they are in compliance with all field requirements of the QAPP.

3.3.2.3.3 Laboratory QA Responsibility

The Laboratory Director and/or Chief Quality Control Officer will be responsible to the program manager for completion of the analytical tasks and associated QAPP activities. Quality Coordinators will be assigned by the laboratories management to implement the project QAPP and to monitor project activities on a daily basis for conformance. They will report to the Project QA/QC officer on QAPP activities.

3.3.2.3.4 QA Reports to Management

Section 3.3.14 of this QAPP describes the periodic QA reporting requirements for the RFI.

After the field work has been completed and the chemical analyses and soil testing are completed and assessed, a final quality assurance report will be prepared to be included in the final RFI report. The report will summarize the QA and audit information, indicating any corrective actions taken and the overall results of the QAPP. The Project QA/QC Officer, in coordination with the laboratory Quality Coordinators, will prepare the summary.

3.3.2.4 Performance and Systems Audits

Internal audits are performed to review and evaluate the adequacy of the QAPP, and to ascertain whether it is being completely and uniformly implemented. The project QA Officer is responsible for such audits and will cause them to be performed according to a schedule planned to coincide with appropriate activities on the project schedule.

Section 3.3.10 of this QAPP describes the periodic field and laboratory assessments and performance and systems audits to be completed during the RFI.

3.3.3 Quality Assurance Objectives

The overall objective of the Navajo Refining RFI is to provide a complete, accurate, precise and representative summary of the current state of the site. The samples and the data generated from these samples and the site generated data must provide the information necessary to complete the site summary. However, all data is subject to some error such as inability to collect samples, sampling analysis errors, faulty selection of sampling sites or inappropriate data reduction. Control or recognition of these errors is important in analyzing the data and in preparing the final summary. Establishing appropriate levels of control over sources of error and quantifying these errors when possible will assist in assessing the impact of errors on the project.

3.3.3.1 Quality Assurance Objectives

Quality assurance objectives for measurement data are usually expressed in terms of accuracy, precision, completeness, representativeness, and comparability. Definitions and descriptions of how these characteristics will be obtained are as follows:

3.3.3.1.1 Accuracy

Accuracy is a measure of the system bias. Bias is defined as the difference between the mean (average) of the true sample values and mean (average) of the laboratory analyses. The exact system bias will never be known since the true sample values are not accessible, however, inferences can be drawn from an examination of field and trip blank analyses and laboratory matrix spiked sample analyses. Field blanks measure the bias introduced by contaminated equipment, sample handling and shipping and laboratory procedures. Trip blanks measure the bias introduced by field, shipping and laboratory procedures. Spiked samples measure biases in laboratory analyses.

Acceptable accuracy measures are dependent on the sample matrix and are discussed in Section 3.3.3.5. Accuracy measures are not meaningful for the screening tests conducted in the field based on the semi-qualitative/quantitative data acquired from the PID and FID and the nature of the pH and temperature conductivity meters. Accuracy of the pH and temperature/conductivity meters will be checked by calibrating prior to daily use and a calibration check at the end of the day's use.

3.3.3.1.2 Precision

Precision is the measure of the variability of individual sample measurements. Precision will be inferred through the use of duplicate samples. If duplicate samples contain identical contaminant concentrations, any variability in the laboratory analyses must be due to variability induced by sampling, handling, or laboratory procedures. Acceptable precision values are dependent on the sample matrix and are discussed in Section 3.3.3.5. Precision values for field screening are not meaningful based on the lack of reproducibility of the samples. Field screening will be in a real time mode making duplication very difficult for the PID and FID. The pH and temperature/conductivity meters are continuous readout instruments and duplicate readings of the same sample will not yield precision values. Duplicate geotechnical tests will not be nun based on the heterogeneity and expected variations of the materials.

3.3.3.1.3 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions. Completeness is usually expressed as a percentage.

Navajo's goal for this project is 100% completeness. However, site access, sampling protocol problems, analytical problems, and the data validation process can all contribute to missing or suspect data.

3.3.3.1.4 Comparability

Comparability expresses the confidence with which one set of data can be compared with another. Comparability can be related to precision and accuracy as these quantities are measures of data reliability. At this site, no attempt will be made to quantify the relative reliability of data obtained during different studies.

Qualitatively, data subjected to strict QA/QC procedures will be deemed more reliable than other data. Field data will be obtained from a given procedure and will be reported in consistent units to allow for easy comparisons.

3.3.3.1.5 Representativeness

Representativeness is the degree to which a set of data accurately reproduce the characteristics of the population. Data is usually considered representative if the sample distribution is within statistically defined bounds of the population mean and variance.

Representativeness will be controlled by the preliminary data assessment and by performing all sampling in a meticulous manner in strict compliance with the procedures described in Sections 3.1 and 3.2.

3.3.3.2 Field Data Quality Objectives (DQO's)

The field data quality objectives can be broken into two major segments; those pertaining to field observations and field instruments and those related to sample selection, collection and shipping. Monitoring well sampling field activities and observations will be coordinated with the appropriate field instruments.

These activities will provide general and detailed information regarding the site condition that will be used in the final site evaluation.

All activities will be executed per the standard operating procedures found in Section 3.2. Calibration of the field equipment adherence to operational procedures and documentation of all observations and readings will assure the accuracy, completeness and representativeness of the data. Because of the general and qualitative measurements from most of these procedures, accuracy and precision values are not applicable.

The following media will be sampled during the RFI:

1. Soil
2. Sediment
3. Ground water

The results from sampling these media will be used to develop the analytical data base to provide answers to questions regarding the site and, ultimately, to generate the overall summary of the current state of this site. The analytical data must be sufficiently accurate and precise to identify the compounds present and the respective concentrations.

Field duplicates, field blanks, and trip blanks will be collected and submitted to the analytical subcontractor laboratory to provide data for assessing the quality of these data. Duplicate samples will be collected and analyzed to check for sampling and analytical reproducibility. Blank samples will be collected and analyzed to check for systematic errors in the sampling and analytical procedures and ambient site conditions.

The following paragraphs discuss the DQO's for each sample media.

Soil Samples

Soil samples will be collected from the surface and soil borings. Analysis of these samples will provide qualitative and quantitative data on the presence of the target compounds. Qualitative soil classification data will also be generated. These data will be used to access the spread of contamination through the soils and to evaluate potential corrective actions for the site.

Soil samples will be collected according to Sections 3.1 and 3.2. Laboratory analysis will follow the procedures discussed in this section. DQO's for the laboratory are established per ASTM and EPA procedures (Section 3.3.3.3).

Accuracy and precision of measurements obtained during field observations are not applicable due to the semi-qualitative/quantitative use of the data. Representativeness will be controlled by careful documentation of the sampling location and by following approved procedures. Deviations from the sampling procedures will be described in the field log book at the time of occurrence.

Sediment Samples

Sediment samples will be collected from Three-Mile Ditch and Eagle Creek. Analysis of these samples will provide qualitative and quantitative data on the migration and extent of contamination. The data will be used to assess if remedial alternatives should include all or some of the above areas and what types of remediation will be necessary.

Sediment samples will be collected per Section 3.1.3 and 3.2.3.5. Representativeness will be controlled by proper documentation of the sampling locations and careful attention to the appropriate procedure. Sampling deviation will be noted in the field log book at the time of occurrence.

Ground Water Samples

Ground water samples will be collected from the existing monitoring wells associated with the Evaporation Ponds and the Truck Bypass Landfarm. Analysis of the ground water samples will provide qualitative and quantitative data to assess the extent of ground water contamination. The data will be used to evaluate needed remedial activities in the feasibility study.

Ground water samples will be collected as described in Sections 3.1.2.2.1 and 3.2.1. Samples will be field screened for pH, temperature and conductivity. Accuracy of the field screening will be confirmed with pre-activity and post-activity calibration of the instrument. Representativeness will be controlled by the preliminary existing well assessment and attention to appropriate sampling procedures. Sampling deviation will be noted in the field log book.

3.3.3.3 Analytical Laboratory Data Quality Objectives

All ground water, surface water, soil, and sediment samples will be analyzed using ASTM and U.S. EPA procedures. The quality assurance goals for these analyses are established in the referenced procedure.

3.3.3.4 Level of Quality Assurance

The laboratory will report and submit QA/QC data identifying the samples used for matrix spikes and matrix spike duplicates, the surrogate spikes and the percent recoveries and laboratory duplicates.

3.3.3.5 Accuracy and Precision

The quality control limits of accuracy and precision for organic analyses are shown in Tables 3.1 and 3.2. Table 3.1 lists the organic surrogate spike recovery limits for volatiles for water and soil/sediment matrices. Table 3.2 lists the matrix spike recovery limits for water and soil/sediment for volatiles. These control limits will be completely without any outliers unless the results are deemed to be altered due to matrix effects. Any outliers will be evaluated so that matrix interferences effects may be determined. All such evaluations will be noted in the narrative for the respective set of samples. Table 3.3 lists the precision, accuracy and completion objectives for the inorganics.

3.3.3.6 Method Detection Limits

The method detection limits for the volatile organic parameters monitored are listed in Table 3.4. Table 3.5 lists the detection limits for the inorganics.

3.3.4 Sampling Procedures

The QC sample collection procedures are covered by this section. Sections are included regarding the methodology for documenting sample locations, sample numbers, sample containers, and sample preservation and decontamination.

Table 3.1 Organic Surrogate Spike Recovery Limits, Navajo Refining Company.

FRACTION	SURROGATE COMPOUND**	LOW/MEDIUM WATER	LOW/MEDIUM SOIL/SEDIMENT
VOA	Toluene-d_8	88-110	81-117
VOA	4-Bromofluorobenzene	86-115	74-121
VOA	1,2-Dichloroethane-d_4	76-114	70-121
BNA	Nitrobenzene-d_5	35-114	23-120
BNA	2-Flurobiphenyl	43-116	30-115
BNA	p-Terphenyl-d_{14}	33-141	18-137
BNA	Phenol-d_5	10-94	24-113
BNA	2-Fluorophenol	21-100	25-121
BNA	2,4,6-Tribromophenol	10-123	19-122
Pest.	Dibutylchlorendate	(24-154)*	(20-150)*

* These limits are for advisory purposes only. They are not used to determine if a sample should be re-analyzed. When sufficient data becomes available, the U.S. EPA may set performance based contract required windows.

** Surrogate compounds listed are preliminary; Any proposed changes will be submitted to U.S. EPA for approval with the designated laboratories internal QA/QC Plan.

Table 3.2 Matrix Spike Recovery Limits*, Navajo Refining Company.

FRACTION	MATRIX SPIKE COMPOUND	WATER*	SOIL/SEDIMENT*
VOA	1,1-Dichloroethene	61-145	59-172
VOA	Trichlorethene	71-120	62-137
VOA	Chlorobenzene	75-130	60-133
VOA	Toluene	76-125	59-139
VOA	Benzene	76-127	66-142
BN	1,2,4-Trichlorobenzene	39-98	38-107
BN	Acenaphthene	46-118	31-137
BN	2,4-Dinitrotoluene	24-96	28-89
BN	Pyrene	26-127	35-142
BN	N-Nitroso-Di-n-Propylamine	41-116	41-126
BN	1,4-Dichlorobenzene	36-97	28-104
ACID	Pentachlorophenol	9-103	17-109
ACID	Phenol	12-89	26-90
ACID	2-Chlorophenol	27-123	25-102
ACID	4-Chloro-3-Methylphenol	23-97	26-103
ACID	4-Nitrophenol	10-80	11-114

* These limits are for advisory purposes only. They are not to be used to determine if a sample should be re-analyzed. When sufficient multi-lab data are available, standard limits will be calculated.

Table 3.3 Precision, Accuracy, and Completeness Objectives, Navajo Refining Company.

Measurement Parameters:

Aluminum
Arsenic
Barium
Cadmium
Calcium
Chromium
Copper
Iron
Lead
Magnesium
Manganese
Mercury
Nickel
Potassium
Selenium
Silver
Sodium
Zinc

Methods:

Atomic Absorption (AA) Spectroscopy
Gravimetric Determination
Colormetric Determination

Reference: "Test Methods for Evaluating Solid Waste", SW 846, U.S. EPA.

Experimental Conditions: Spiked and unspiked field samples

<u>Precision</u>

Relative Percent Difference: ± 20%

<u>Accuracy</u>

Percent Recovery: 75%

<u>Completeness</u>: 90%

Table 3.4 Hazardous Substance List (HSL) and Required Detection Limits (RDL)** for Volatile Compounds Navajo Refining Company.

		DETECTION LIMITS*	
VOLATILES	CAS NUMBER	LOW WATER[a] ug/L	LOW SOIL/ SEDIMENT[b] ug/Kg
1. Chloromethane	74-87-3	10	10
2. Bromomethane	74-83-9	10	10
3. Vinyl Chloride	75-01-4	10	10
4. Chlorethane	75-00-3	10	10
5. Methylene Chloride	75-09-2	5	5
6. Acetone	67-64-1	10	10
7. Carbon Disulfide	75-15-0	5	5
8. 1,1-Dichloroethene	75-35-4	5	5
9. 1,1-Dichloroethane	75-35-3	5	5
10. trans-1,2-Dichlorethene	156-60-5	5	5
11. Chloroform	67-66-3	5	5
12. 1,2-Dichloroethane	107-06-2	5	5
13. 2-Butanone	78-93-3	10	10
14. 1,1,1 -Trichloroethane	71-55-6	5	5
15. Carbon Tetrachloride	56-23-5	5	5
16. Vinyl Acetate	108-05-4	10	10
17. Bromodichloromethane	75-27-4	5	5
18. 1,1,2,2-Tetrachlorethane	79-34-5	5	5
19. 1,2-Dichloropropane	78-87-5	5	5
20. trans-1,3-Dichloropropene	10061-02-6	5	5
21. Trichloroethene	79-01-6	5	5
22. Dibromochloromethane	124-48-1	5	5
23. 1,1,2-Trichloroethane	79-00-5	5	5
24. Benzene	71-43-2	5	5
25. cis-1,3-Dichloropropene	10061-01-5	5	5
26. 2-Chloroethyl Vinyl Ether	110-75-8	10	10
27. Bromoform	75-25-2	5	5
28. 2-Hexanone	591-78-6	10	10
29. 4-Methyl-2-pentanone	108-10-1	10	10
30. Tetrachlorethene	127-18-4	5	5
31. Toluene	108-88-3	5	5
32. Chlorobenzene	108-90-7	5	5
33. Ethyl Benzene	100-41-4	5	5
34. Styrene	100-42-5	5	5
35. Total Xylenes		5	5

[a] Medium Water Required Detection Limits (RDL) for Volatile HSL Compounds are 100 times the individual Low Water RDL

[b] Medium Soil/Sediment Required Detection Limits (RDL) for Volatile HSL Compounds are 100 times the individual Low Soil/Sediment RDL

*Detection limits listed for soil/sediment are based on wet weight. The detection limits calculated by the laboratory for soil/sediment, calculated on dry weight basis, as required by the contract, will be higher.

**Specific detection limits are highly matrix dependent. The detection limits listed herein are provided for guidance and may not always be achievable.

Table 3.5 Detection Limits for Elements Determined by Inductively Coupled Plasma Emission or Atomic Absorption Spectroscopy and Cyanide, Navajo Refining Company.

PARAMETER	DETECTION LEVEL (ug/L)
Arsenic	10
Chromium	10
Lead	5

3.3.4.1 Sampling Locations and Numbers

Preliminary sample locations have been predetermined for some tasks based on available data and/or the project data objectives. (See Section 3.1). However, the exact location of all samples will be determined in the field based upon field conditions. The locations will be determined by either the program manager or the designated field coordinator. The EPA On-Site Coordinator(s) will be consulted, if present.

The exact locations of each sampling point will be described in the project log book along with a sketch that includes a minimum of two, if possible three, distance measurements.

The measurements will be referenced to marked grid stakes and/or from permanent ground features and landmarks whiCh are included on the site map.

There will be two identification numbers used for each sample. One will be the serial identification number assigned by the laboratory. The other identification will be an in-house number designed to incorporate site specific field data into an alphanumeric code. The in-house numbering will consist of the following four components:

- Project and SWMU Identification
- SWMU
- Sample Type
- Sample Location
- Sample Number

The project and SWMU identification is a three letter designation unique to the site and SWMU sampled. For this project, the identification will be designated as follows:

- NEP - Navajo Evaporation Ponds

- NMD - Navajo 3 Mile Ditch
- NEC - Navajo Eagle Creek

Each sample type collected during the sampling program will be identified by one of the following two to three digit alpha codes:

- SL - Sludge Sample.
- GW - Monitoring Well Ground water Sample.
- SS - Surface Soil Sample.
- SB - Soil Boring Sample.
- SD - Sediment Sample.
- AR - Air Sample.
- XXB - XX(Matrix Type) Blank.

A three digit number will be used to indicate the sampling location. Thus, the identification system will require that all sampling locations be given a separate number. The field ties to these sampling locations as well as other pertinent data will be kept in the field sampling notebook.

A two digit number will be used to consecutively number replicate samples taken at a sampling site. Examples of a sample number are:

NEP-SL-001-01 = Navajo evaporation ponds, sludge sample, location 001, first sample.

NEP-SLB-001-01 = Navajo evaporation ponds, sludge sample blank, location 001, first sample.

3.3.4.2 Sample Containers and Sample Preservation

The required sample containers, filling instructions, sample preservation methods, and shipping instructions are summarized in Table 3.6 for each of the sample types.

Table 3.6 Sample Containers, Preservatives, and Holding Times for Low Concentration Test Parameters, Navajo Refining Company.

Parameter	Container	Preservation	Holding Time	Procedure
WATER and LIQUIDS:				
Purgeable Organic Compounds (Volatiles)	2-40 ml glass vials with Teflon lined caps	iced to 4°C	14 days for analysis	fill completely to exclude air bubbles
Extractable Organic (BNA Semi-Volatiles)	2-one liter glass bottles (amber) with Teflon lined caps	iced to 4°C	5 days for extraction analysis within 40 of extraction	fill bottle to neck
Metals	1-one liter high density polyethylene bottle	adjust pH to less than 2.0 with nitric acid	analysis within 6 months of collection	fill bottle to neck
SOILS AND SOLIDS:				
Purgeable Organic Compounds (Volatiles)	6-8-ounce wide-mouth glass jar	iced to 4°C	14 days for analysis	fill completely
Extractable Organic Compounds (BNA Semi-Volatiles)	6-8-ounce wide-mouth glass jar	iced to 4°C	14 days for extraction	fill completely
Inorganics	6-8-ounce wide-mouth glass jar	iced to 4°C	analysis within 6 months of collection	fill completely

The collected sample containers will be kept out of direct sunlight and, after decontamination and labeling, will be placed in coolers and stored at approximately 4°C (except geophysical and high hazard samples) until they are packaged for shipping to the proper laboratory. Samples designated for chemical analysis will be packaged and shipped within two days of collection.

3.3.4.3 Decontamination of Sampling Equipment

There are several categories of equipment which will require cleaning prior to use, and between sample events. These include:

- Hand Sampling Equipment
- Field Monitoring Equipment
- Drilling Equipment

The procedures which will be utilized for each are included in Section 3.2.

3.3.5 Sample Custody

Verifiable sample custody is an integral part of field and laboratory operations. Several steps will be taken in the field and laboratory to document and ensure that samples collected in the field have been properly acquired, preserved, and identified. The following sections describe these steps in detail.

3.3.5.1 Field Sampling Documentation

3.3.5.1.1 Documentation of Sample Acquisition

A key piece of information that will be documented is the sample acquisition data All information pertinent to field observations, surveys, and sampling will be recorded in a bound logbook with consecutively numbered pages. Entries in the logbook will include at least the following:

- location of sampling activity and addresses;
- purpose of sampling (e.g., definition of contamination, waste analysis, etc.),
- type of process (if known) producing wastes;
- type of waste (e.g., sludge, liquid, etc.);
- number and approximate volume of samples taken;
- location of sampling point;
- description of sampling point;
- date and time of collection;
- collector's sample identification number(s);
- sample distribution (e.g., chemical laboratory, geotechnical laboratory etc.);
- sample presentation;
- filtering methodology;
- references such as maps or photographs of the sampling site;
- field observations;
- any field measurements made such as pH, specific conductivity or other field parameters; and
- weather conditions.

Since sampling situations can be quite diverse, the documentation in the logbook will be sufficient to reconstruct the sampling situation without relying on the collector's memory.

3.3.5.1.2 Documentation of Sample Preservation

Proper sample preservation is important in retaining the sample characteristics prior to analysis. Sample preservation will be performed by the sampling personnel as described in Section 3.3.4.2. Sampling preservation will be documented by the sampling personnel on the chain of custody form and also in the field logbook.

3.3.5.1.3 Chain of Custody

In addition to the field logbook, each sample sent off-site will be recorded on a chain of custody record. An identifying code will be assigned to each sample and this code will be used on the chain of custody and in the logbook to ensure that the sample description is identifiable. A brief description of the sampling point will also be placed on the chain of custody form.

Chain of custody forms will become permanent records of all sample handling and shipment. Samples will be collected in accordance with the sampling procedures designated in Section 3.2. If standard sampling procedures are not used, a written justification for each deviation will be placed in the project file. Upon completion of sampling, the sample will be prepared for shipment in accordance with the applicable sample instructions including preservation, labeling and logging.

The person collecting a sample will initiate document(s) at the source of the sample and start the chain of custody procedure. Chain of custody documentation will include the following applicable data:

- field sample number, site name and project;
- date sample taken;
- date sample submitted to the laboratory;
- sample taken by (signature);
- information describing source of sample and sample itself;
- sampling method used;
- expected interferences, if any;
- remarks;
- preservation technique;
- number and type of shipping containers;
- signature of persons relinquishing and obtaining custody of samples;
- indication of sample disposition.

The sample will be kept in limited access or locked storage at the proper temperature until custody is relinquished from the site and formal documentation of the transfer is completed.

The program manager or On-site Coordinator will be responsible for sample storage and shipment and for completing the sample accountability records. Upon each transfer of custody, the person involved will verify sample numbers and condition and will document the sample acquisition and transfer. The field sample custodian will properly package the samples, indicate the shipping method and describe the sample accountability record, and obtain shipment documentation such as certified mail receipt or bill of laden number.

On transfer of custody of the samples to the transport agency, the field sample custodian will sign and retain a copy of the shipment documentation, witness the transport company custody signature, and send a copy of the chain of custody with the samples. On arrival at the laboratory, the sample custodian will sign for custody and return a copy of the completed chain of custody to Navajo. Laboratory custody procedures will then be conducted per Section 3.3.5.2.

Ground water and soil samples will be shipped as environmental samples by commercial carrier following DOT regulations. Samples classified as hazardous materials will be shipped according to DOT regulations for hazardous materials.

3.3.5.1.4 Tags

Each sample will be tagged and sealed.

Sample tags are necessary to prevent misidentification of samples. Gummed paper tags will be used. The tag will include at least the following information:

- name of collector.
- date and time of collection.
- place of collection.

- collector's sample number, which uniquely identifies the sample.

Sample seals are used to preserve the integrity of the sample from the time it is collected until it is opened in the laboratory. Gummed paper seals will be used as official sample seals.

The seal will be attached in such a way that it is necessary to break it in order to open the sample container ensuring that the sample has not been tampered with.

3.3.5.1.5 Field Tracking Forms

The chain of custody form will be supplemented in the field by a field tracking form. This form is a complete listing of samples taken, the sample collector and the date and time of collection. Field tracking establishes sample custody prior to shipment and, as such, provides additional sample control.

3.3.5.2 Laboratory Operations

The minimum procedures which will be used by the laboratory for sample receipt, chain of custody, sample identification, sample extract identification, tracking of sample analyses, laboratory data assembly and documentation control are described below.

Laboratory Sample Receipt Procedures: The following laboratory receipt procedures will be used:

- The samples will be delivered directly to the laboratory receptionist on weekdays. Shortly after arrival, the samples will be transferred to the geotechnical laboratory. On weekends, holidays or outside of regular working hours, the sample custodian or his authorized personnel (only sample custodian is mentioned hereafter) will receive the samples shipped directly to the lab.

- The sample custodian will examine the shipping container and record the following information on a Log-in Sheet (called the Sheet herein), one case per form(s).
    - presence/absence of custody seal(s) on the shipping container(s)
    - condition of custody seal (i.e., intact, broken)
    - The sample custodian will open the shipping container, remove the enclosed sample documents and record on the sheet:
        - presence/absence of the chain-of-custody record(s)
        - presence/absence of airbills and/or bills of lading documenting shipment of samples
        - case and airbill numbers
    - Remove sample containers and record on the sheet:
        - condition of samples (intact, broken, leaking, etc.)
        - presence/absence of sample tags
    - If sample tags are present:
        - record sample tag numbers
        - compare with chain of custody record(s)
    - Compare the following documents to verify agreement among the information contained on them:
        - chain of custody records
        - sample tags
        - airbills or bills of lading

Document both agreement among the forms and any discrepancies found. If discrepancies are found, contact the project QA/QC Officer or Program Manager for clarification and notify appropriate laboratory personnel.

- If all samples recorded on the chain of custody record were received by the lab and there are no problems observed with the sample shipment, the custodian will sign the chain of custody record in the "received for laboratory by" box on the document. If problems are noted, sign for shipment and note problems in remarks box of the sheet detailing the problems. The project QA/QC Officer or program manager will be contacted for direction. The appropriate lab personnel will be notified. The problems and resolution will be detailed in the case narrative.

- Log-in Samples: The procedure for sample identification will be performed at this time. The information on the date and time of sample receipt, chain of custody record number, field sample numbers, lab numbers and sample tag numbers will be recorded on the Sample Log-in Sheet.

Laboratory Chain of Custody Procedures: The National Enforcement Investigations Center (NEIC) of EPA defines custody of evidence in the following ways:

- It is in your actual possession, or
- It is in your view, after being in your physical possession, or
- It was in your possession and then you locked or sealed it up to prevent tampering, or
- It is in a secure area

In order to satisfy these custody provisions, the following standard operating procedures will be implemented:

- Samples will be stored in a secure area
- Access to the laboratory will be through a monitored reception area.
- Visitors will sign-in the reception area and be escorted while in the laboratory.
- All transfers of samples into and out of storage will be documented on an internal chain of custody record.
- After a sample has been removed from storage by the analyst, the analyst is responsible for the custody of the sample. Each analyst must return the samples to the storage area before the end of the working day.

Laboratory Sample Identification: The following procedures will be used to determine laboratory sample identification:

- During the sample receiving process, the laboratory sample custodian or other designated personnel will assure that each sample container is identified with a unique field sample ID number and that this number is recorded in the Sample Log-in Sheet.

- The sample custodian will remove the sample tag and place it in the appropriate case file. If stick-on labels are used instead of tie-on sample tags, this fact will be noted in the comment section of the log-in sheet.

Laboratory Tracking of Sampling Analysis: A system for tracking the sample through preparation and analysis is needed because of the evidentiary nature of the sample analysis results. The laboratory records may be used in court as evidence in enforcement proceedings. Consequently, the following procedure will be used to track sample analyses.

- Both the preparation and the analysis of samples will be documented.
- All notebook pages, computer printouts, and other laboratory documents will show the case/sample number, date, signature (initials) of the analyst and other pertinent information.
- Upon completion of analysis, data will be filed in the appropriate case or sample files.
- All sample preparation information will be documented in the laboratory notebook. All sample analysis data will be documented using log-books. When sample preparation or analysis is finished by an individual, the completed documents will be placed in the appropriate sample and/or case files.

Laboratory Data Assembly: The following procedures will be adhered to for assembly of the project data:

- A procedure for organization and assembly of all documents relating to each case will be implemented by the sample custodian or designated person.

- This procedure will ensure that all documents are compiled in one location for submission to Navajo in single case files, arranged by field sample number. Case file folders will be prepared as follows:

    - Using appropriate file folders, preferably assign one folder to each case according to field number.
    - Place all documents, sample tags, forms, and laboratory generated data pertaining to one case in the folder.

- Documents should be arranged by document type within the case folders, i.e., all sample tags together, all traffic reports together, all deliverables, etc.
- These document case files will be filed in one location and stored in a secure area

The internal QA/QC Procedures for the designated laboratory will be submitted to U.S. EPA prior to the start of work.

3.3.5.3 Evidence Files

All controlled documents, log books, reports and data packages will be submitted to Navajo Refining, located in Artesia, New Mexico after the RFI completion. At this location the files will be stored in a secure area All transfers of data into and out of the storage area will be documented on an internal chain of custody record.

The files will be kept for a minimum of six years after the termination of the RFI. After the 6 year period, the EPA will be notified within thirty (30) days prior to the destruction of any documents.

3.3.6 Calibration Procedures and Frequency

3.3.6.1 Field Calibration Procedures

The field environmental monitoring equipment was previously described in Section 3.2. Each instrument will be calibrated and maintained in accordance with the manufacturer's procedures.

3.3.6.2 Chemistry Laboratory Calibration Procedures

The calibration procedures and frequency of calibration will follow the specifications of the appropriate U.S. EPA and ASTM procedures. The use and frequency of these procedures will be verified by internal audit. Additionally, a project specific quality assurance audit will be conducted by the Quality Assurance Officer.

3.3.7 Analytical Procedures

Analytical methods which will be utilized for the water, soil, waste matrix samples during the RFI are described in:

- SW 846: Test Methods for Evaluating Solid Waste (Physical/Chemical Methods) Third Edition, September 1986.
- Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, March 1983.
- Annual Book of ASTM Standards.

3.3.8 Data Reduction, Validation and Reporting

The three types of data that will be generated by this project include: chemical data, geotechnical data, and geophysical data. The following guidelines will apply to each type of data.

3.3.8.1 Data Reduction

Data reduction will be carried out using prescribed documented techniques. Any statistical summaries of the data will be presented in such a manner that the reviewer can easily judge the validity of the procedure and any conclusions drawn. Assumptions made in performing any statistical analyses will be clearly stated, as will confidence/significance levels used for any test hypotheses. Data summaries will be checked against the raw data for consistency and summary statistics recalculated in the event of doubt.

Chemical data reduction will be done in conformance with the prescribed methods referenced in the appropriate analytical procedures.

3.3.8.2 Data Validation

Chemical, geotechnical, and geophysical data will be validated by the designated Quality Assurance Coordinator. The Analysis Coordinator will perform a review of select data for each analytical task. This review will consist of the following elements; review of analytical program, examination of results, verification of results.

3.3.8.2.1 Review of Analytical Program

The responsible individual will review a select set of results to ensure that the required program elements, such as method blanks, surrogate spikes, and QC samples, have been accomplished according to the program design. The supporting data will be reviewed to ensure that analyses were performed under the correct conditions and that all required procedural steps were performed.

3.3.8.2.2 Examination of Results

The Analytical Coordinator will examine the results obtained along with the pertinent chromatogram, spectra absorption traces, and geophysical logs to ensure that the results are reasonable and that the analyst has interpreted the results correctly. Any unusual or unexpected results will be reviewed and a resolution will be made as to whether the analysis should be repeated or the results recalculated.

3.3.8.2.3 Recalculation of Results

The Analytical Coordinator will selectively recalculate results to ensure that the calculation was performed properly. Emphasis will be placed on the those results showing a significant concentration of one or more of the analytes of interest. At a minimum, one set of calculations will be checked for each batch of samples analyzed.

3.3.8.3 Data Reporting

Following data validation, the verified data will be transferred from the analytical data sheets to reporting forms. The Analytical Coordinator will be responsible for ensuring that all required information is recorded for reviewing the completed form for the accuracy of the transferred information. All data will be verified against the analytical data sheets, and the completed forms will be reviewed by the individual responsible for the analysis prior to submission of the results to the sponsor.

3.3.9 Internal QC Checks and Frequency

Internal quality control checks will be made in the laboratory and the field. These checks are discussed in this section.

3.3.9.1 Internal QC Checks and Frequency - Laboratory

QC sample frequency will follow the standard requirements cited earlier in this document. Internal quality control procedures for ground water, surface water, soil and sediment samples will follow the appropriate U.S. EPA and ASTM guidelines. These procedures specify the number of laboratory blanks to be used, the number of calibration standards, the frequency that the calibration standards must be run, the frequency at which laboratory duplicate samples must be run, and the frequency at which spiked and referenced samples must be run. Field blanks (where applicable) will be collected to check for sample contamination due to field sampling equipment.

3.3.9.2 Internal QC Checks and Frequency - Field

The combustible gas analyzer, PID and FID are analytical instruments, that will be used in the field, which are scanning type instruments to approximate real time concentrations. Calibration and standardization are done by span gases. Electronic field instruments are zeroed electronically as an internal electronic adjustment, which compensates for the aging of batteries and changes in instrumentation characteristics. Duplicates, spikes and splits are not feasible due to the nature of the instruments.

The pH and temperature/conductivity meters will also be used on-site. Calibration and checks of the pH meter are done by standard solutions. Several duplicate readings are generally used to improve data quality when using this instrument. The temperature/conductivity meter is factory calibrated for conductivity, while the thermometer is "air" calibrated prior to each use.

3.3.10 Performance and Systems Audits

Internal audits are performed to review and evaluate the adequacy of the QAPP, and to ascertain whether it is being completely and uniformly implemented. The Quality Assurance Officer is responsible for such audits and will ensure that they are performed according to a schedule planned to coincide with appropriate activities on the project schedule. Such audits may be supplemented by additional audits for one or more of the following reasons:

a. When significant changes are made in the QAPP.

b. When it is necessary to verify that corrective action has been taken on a nonconformance reported in a previous audit.

c. When requested by the program manager.

The objectives of performance and systems audits are to ensure that the quality assurance program developed for this project is being implemented according to the specified requirements, to assess the effectiveness of the quality assurance program, to identify nonconformances and to verify that identified deficiencies are corrected. Upon discovery of any significant deviation from the quality assurance program, the program manager shall be informed of the nature, extent, and the corrective action taken/needed to remedy the deviation.

3.3.10.1 Performance Audits

A performance audit can be defined as a review of the existing sample and quality assurance data to determine the accuracy of the total measurement system(s) or a component part of the system. The analysis of project specific performance evaluation samples and the participation in scheduled inter-laboratory studies may be included as part of the performance audit.

3.3.10.1.1 Laboratory Performance Audit

The laboratory director will monitor and audit the performance of the QA procedures to ensure that the project is performed in accordance with the data quality objectives. The results of any U.S. EPA or State audits will be made available upon request to Navajo for subsequent review. Additional audits may be scheduled by Navajo at various times to evaluate the execution of sample identification, sample control and chain of custody procedures.

Results from the analysis of any performance evaluation samples will be made available to Navajo for review. Any problems will be identified and corrective actions will be taken if necessary.

3.3.10.1.2 Field Performance Audit

At least one field performance audit will be conducted by the QA Officer or his designee. The field auditor will observe and review the procedures being used to ensure that they conform with the approved operating procedures. Specific attention will be given to sampling procedures and preservation to demonstrate that required methods are being used. Field instrumentation quality assurance procedures will also be verified to ensure that all proper procedures are being followed. Analytical results and quality assurance samples and analyses will be reviewed and recommendations on the adequacy and necessity for repetition of analysis will be made. The QA Officer will review the data for questionable results and will determine if repeat analyses are required. Significant analytical problems will be discussed with the QA Officer and Laboratory Manager.

The field auditor will report to the Navajo QA Officer orally within 5 days on the results of each audit to transmit any significant problems with the held quality assurance program. A written report will be made by the held auditor of each field audit within 10 days after each audit.

3.3.10.2 Systems Audit

A systems audit consists of an evaluation to determine if the components of the measurement system(s) were properly selected and are being used correctly. A systems audit includes a careful evaluation of field and laboratory quality control procedures.

3.3.10.2.1 Laboratory Systems Audit

A laboratory systems audit will be conducted on a regular basis by the Laboratory Manager. The Laboratory Manager will conduct an initial systems audit to ensure that all instruments proposed for use were properly selected for the given methods and are performing properly. This will include a review of the analytical methods proposed for use and the laboratory procedures prepared from these methods. Necessary changes will be confirmed in writing to the Navajo QA Officer, to ensure that the laboratory meets all of the measurement systems requirements of the quality assurance plan. After this initial systems audit is complete, the Laboratory Manager will:

- implement the analytical plan and ensure that all quality control measures are executed as written;
- ensure that all analysts and technicians are properly trained;
- verify on a routine basis that all instruments are performing properly and that conditions, etc., are as required; and
- conduct periodic evaluations of personnel and instruments during the course of the analyses to ensure that initial conditions persist.

The Laboratory Manager will report orally to the Navajo QA Officer if the systems audit shows a significant discrepancy from the QAPP. Each major systems change will require a written summary to Navajo QA Officer to document the change made. All system changes will be documented in the project Quality Assurance notebook.

The Laboratory Manager, or his designee, will conduct the following as part of the routine analytical system to ensure compliance with the work plan and quality assurance requirements:

- verify that incoming samples correspond to the chain of custody form or packing list that accompanies them;
- inspect the samples and document the condition of each sample, especially any circumstances which might have adverse effect on the analytical results;
- note the analyses required on each sample and transmit this information to the Analysis Coordinators;
- review all data generated to ensure that all analyses were run as specified, including quality controls; and
- prepare the data for submission to the sponsor or for entry into a computerized data bank, as appropriate.

The Laboratory Manager will periodically review the data records to ensure that the requirements are being met.

The Laboratory Manager, or his designee, will perform the following functions to ensure the sample collection systems meet the requirements. He will:

- ensure that proper container cleanup procedures are followed prior to use and that containers are protected from contamination once prepared for use;
- provide a sample of containers to the analytical coordinator, who will determine if the containers are free of contamination;
- prepare field spikes, duplicates, and blanks, as called for in the work plan, and provide these for analysis along with held samples, ensuring that the analyst is unable to distinguish between actual and quality control samples; and
- maintain all records necessary including chain of custody information on the samples.

The Navajo QA Officer will conduct at least one detailed laboratory systems audit during the project. This audit will be described in Section 3.3.10.3.

3.3.10.2.2 Field Systems Audit

At least one field system audit will be conducted by the Navajo QA Officer, or his designee. The field auditor will review the field equipment selection and use to ensure that the equipment is capable of safety and accurately performing the desired functions. Equipment selection review will be based on the capabilities and limitations of the instrument/sampling device. Use will be reviewed based on observations and comparison of actual versus expected results. The first field systems audit is expected to be conducted soon after field start up.

The field auditor will meet with key field staff members to evaluate the field program and determine if changes are necessary to improve the results. A written record of these meetings will be placed into the project file within 10 days after the meeting and program revisions will be incorporated as necessary.

The field auditor will submit a written report within 10 days after each audit and will discuss significant changes with the project management prior to any major changes.

3.3.10.3 Detailed Laboratory Performance and Systems Audit

As part of the quality assurance program, the Navajo QA Officer will conduct a detailed laboratory performance and system audit during the project.

The objectives of the detailed audit are:

- To determine that a quality assurance program has been put into use and documented in accordance with specified requirements;
- To verify by examination and evaluation of objective evidence that the documented program has been implemented;

- To assess the effectiveness of the quality assurance program;
- To identify nonconformances; and
- To verify correction of identified deficiencies.

The Laboratory Manager will be notified of the audit at a reasonable time before the audit is performed. This notification may be in writing and include such information as the general scope and schedule of the audit and the name of the audit team leader.

A brief pre-audit conference will be conducted at the audit site with laboratory management. The purpose of the conference will be to confirm the audit scope, present the audit plan, discuss audit sequence and plan for the post-audit conference.

Audits are performed on the basis of written checklists or list of questions prepared prior to the audit to ensure the depth and continuity of the audits. During the conduct of the audit, each item on the list is marked with one of the following entries;

S	Item is satisfactory
U	Item is unsatisfactory
X	Item is not applicable
N	Item was not audited

The audit checklist is intended for use as a guide and will not restrict the audit investigation when findings raise further questions that are not specifically included in the checklist. The checklist will include, as a minimum, review of QA data, laboratory procedures, chain of custody records, calibration records, and problem resolutions.

Selected elements of the quality assurance program shall be audited to determine whether they are being implemented effectively.

Conditions requiring immediate corrective action shall be reported immediately to the program manager and resolutions will be recommended to replace the faulty procedures.

At the conclusion of the audit, a post-audit conference will be held with laboratory management to present audit findings and clarify misunderstandings. Audit findings shall be concisely stated by the Navajo QA Officer on the List of Findings for Post-Audit Conference (Figure 3.2). The findings of the audit will be acknowledged by the Laboratory Manager signing the post-audit conference record.

An audit report will be prepared within 15 working days by the Navajo QA Officer and signed by the Laboratory Manager. The report will include the following:

- Description of audit scope.
- Identification of the auditors.
- Persons contacted during pre-audit, audit and post-audit activities.
- A summary of audit results, including an evaluation statement regarding the effectiveness of the QA Program elements which were audited.
- Details of findings and program deficiencies will be reported on a Standard Audit Report Format similar to Figure 3.3. Each finding and program deficiency shall be identified and described in sufficient detail to assure that corrective action can be effectively carried out by the project organization.
- Recommendations for correcting the findings or improving the QA Program.

Figure 3.2

QUALITY ASSURANCE AUDIT FINDING REPORT

Navajo Refining Company

Project ______________________

Audit No. ________ Audit Date ______________________

Audit Finding No. ______________________

QUALITY ASSURANCE AUDIT FINDING REPORT

Audited Organization ______________________

Audited Area ______________________

10 CFR 50 Appendix B Requirement ______________________

NQA-A ______________________

QAM ______________________

OBSERVATION/FINDING

RECOMMENDATION

Corrective Action Required Yes Prepared By ______________________

No ______________________

____

CORRECTIVE ACTION REPLY Response Date Due ______________________

Prepared By ______________ Title ______________ Date ______________

____

____

CORRECTIVE ACTION VERIFIED

By ______________________

Title ______________ Date ______________

Figure 3.3

STANDARD AUDIT REPORT FORMAT

Navajo Refining Company

Project No.________________________________

To: ____, Project Director

Subject: Report of Audit of (project unit), on (date)

PURPOSE:

Give the name and title of the person conducting the audit, and list any individuals who may have assisted in conducting the audit.

PERSONNEL CONTACTED:

Present the checklist from which the audit was conducted, with the appropriate S, U, X or N marking for each item op the list.

DISCUSSION:

Indicate nonconformance noted. A nonconformance is defined as a deficiency in characteristic, procedure or documentation which renders the quality of an item unacceptable or indeterminate. Examples of nonconformance include incorrect or inadequate documentation or deviations from prescribed office, field, or laboratory procedures.

CORRECTIVE ACTION:

Indicate action to correct and to prevent recurrence of nonconformances, and dates by which reply to audit must be received and corrective action completed.

RECOMMENDATIONS:

Present suggestions regarding items or procedures which are not considered nonconformances, but which may result in nonconformances if allowed to continue, or for which relatively minor changes may result in improved quality.

- The audit report will be addressed to the Navajo program manager.

The Laboratory Manager or his designated representative will respond to the audit deficiencies by completing a Corrective Action plan in written form within 20 working days. The response will clearly state the corrective action for each finding, including action to prevent recurrence and the date the corrective action will be completed. If corrective action has been completed, supporting documentation will be attached to the reply.

Follow-up action will be performed by the Laboratory Manager or his designated representatives to:

- Evaluate the adequacy of the response.
- Assure the corrective action is identified and scheduled for each nonconformance.
- Confirm that corrective action is accomplished as scheduled. Re-audits will be conducted and reported in the same manner as the original audit.
- Follow-up action may be accomplished through written communication, re-audit, or other appropriate means.

Records will be generated and retained for all audits. Records will include audit reports, written replies, the record of completion of corrective actions, and documents associated with the conduct of audits which support audit findings and corrective actions as appropriate.

3.3.10.4 Nonconforming Items and Disposition

The supervisory and staff personnel will, during the execution of their normal activities, make certain that the work is performed in accordance with the requirements of the QAPP, establish procedures or accepted professional practices. Rework or revision of work due to nonconformance is described in the applicable work procedure. Any irregularities and/or deviations will be reported in writing to the QA Officer and the Navajo program manager. Any person may originate a report on irregularities and/or deviations.

The originator of a Nonconformance and Disposition Action Report (NCR) will describe his findings on the form provided for this purpose (Figure 3.4). A nonconformance is defined as a deficiency which renders the quality of an item unacceptable or indeterminate. Depending on the nature of the nonconformance, the quality of the item in question may be accepted following an investigation of the nonconformance.

The work which has the irregularities and/or deviations may be temporarily stopped while the nonconformance is being investigated. Section 3.3.14 presents a summary of the written quality assurance reports that will be submitted to management.

Disposition

The Navajo program manager will be responsible for initiating disposition action on all nonconforming items. The procedure will be as follows:

- The Navajo program manager will review the nonconformance and disposition action reports and take the necessary action; he will complete the disposition section of the report.
- The Navajo Quality Assurance Officer or his designee will review, verify and countersign the Program Manger's disposition.
- The completed report will be filed in the appropriate file.

Figure 3.4

NONCONFORMANCE AND DISPOSITION ACTION REPORT (NCR)

Navajo Refining Company

Date: ____________________

SUBMITTAL

NCR NO: ____________________

TO: ____________________

Description of Nonconformance and Cause:____________________

Proposed Disposition____________________

Submitted by____________________Location____________________

Approved by____________________Date____________________

DISPOSITION (by Project Manager or designee)

Implementation of Disposition Assigned to: ____________________

Actual Disposition: ____________________

____________________Disposition completed on ____________________
(Date)

____
(Signature)

VERIFICATION

Disposition reviewed and work inspected by____________________on____________________Disposition verified by____________________on____________________

(Use additional sheet or memo if needed.)

3.3.10.5 Schedule of Audits

A summary of the performance and systems audits to be performed is shown in Table 3.7.

3.3.11 Preventative Maintenance

3.3.11.1 Laboratory Maintenance

All instruments will be maintained in accordance with manufacturer's recommendations and/or normal laboratory practice. All maintenance will be documented and maintained in permanent records by the individual responsible for each instrument. This will include both routine, scheduled maintenance and unscheduled maintenance required by operational failures.

All nonroutine or scheduled maintenance will be reported to the Analysis Coordinator responsible for that instrument and will enter the communication scheme reported in Section 3.3.10. The Analysis Coordinators will review the maintenance records on a regular basis to ensure required maintenance is occurring.

3.3.11.2 Field Maintenance

All field instruments, sampling equipment and machinery will be maintained in accordance with manufacturers recommendations and normal field practice. All maintenance will be documented in permanent records by the individual responsible for each item. This will include routine scheduled maintenance and unscheduled maintenance. Unscheduled maintenance will be reported to the Project QA/QC Officer and the program manager. The Project QA/QC Officer will review the maintenance records on a regular basis to ensure required maintenance is occurring.

Table 3.7

SCHEDULE OF AUDITS TO BE PERFORMED NAVAJO REFINING COMPANY

AUDIT TYPE	CONDUCTED BY	AREA	SCHEDULE	(WORKING DAYS AFTER AUDIT) REPORT SCHEDULE	REPORT TYPE
SYSTEM STARTUP	LABORATORY MANAGER	LABORATORY	PRIOR TO PROJECT START OR IMMEDIATELY FOLLOWING	5 10	ORAL WRITTEN
SYSTEM STARTUP	NAVAJO PROGRAM MANAGER OR DESIGNEE	FIELD	FOLLOWING STARTUP	5 10	ORAL WRITTEN
PERFORMANCE	LABORATORY MANAGER	LABORATORY	WEEKLY	5 MONTHLY	ORAL WRITTEN
PERFORMANCE	NAVAJO QA OFFICER OR DESIGNEE	FIELD	SEMIMONTHLY	5 MONTHLY	ORAL WRITTEN
IN-DEPTH SYSTEMS AND PERFORMANCE	NAVAJO QA OFFICER OR DESIGNEE	FIELD AND LABORATORY	MID PROJECT	15	WRITTEN
AUDIT FOLLOWUP	NAVAJO QA OFFICER OR DESIGNEE	FIELD AND LABORATORY	AS NEEDED	20	WRITTEN
SYSTEMS	LABORATORY MANAGER	LABORATORY	SEMIMONTHLY	MONTHLY	WRITTEN
SYSTEMS	NAVAJO PROGRAM MANAGER OR DESIGNEE	FIELD	SEMIMONTHLY	MONTHLY	WRITTEN

3.3.12 Data Assessment

All data generated will contain a statement on the accuracy and precision of the methodology used to obtain them. The procedures and equations for determining the accuracy and precision are discussed in Section 3.3.7, Analytical Procedures, and Section 3.3.9, Internal QC Checks and Frequency. These procedures will be reviewed during the performance audits described in Section 3.3.10, Performance and Systems Audits, to ensure that the procedures are being implemented and accurately followed. Field data will be assessed by the procedures referenced in this document and those respective operating procedures found in Section 3.2. These procedures will also be reviewed during the performance audits.

3.3.13 Corrective Action

The ultimate responsibility for maintaining quality in the analyses lies with the Navajo program manager. The routine operation of the quality assurance program, however, falls upon the QA/QC officer, and the Laboratory Manager.

The Laboratory Manager will have the responsibility for ensuring that his personnel are adequately trained to perform analyses, that equipment and instrumentation under his control are calibrated and functioning properly, and that systems audits are performed on a regular basis.

The Laboratory Manager will have the responsibility for preparation and implementation of quality assurance plans. The Laboratory Manager or his designee will review the data generated to ensure that quality control samples are run as specified in the protocol.

The Navajo Quality Assurance Officer will have the responsibility for the preparation of SOPs and quality assurance guidelines for the project, and for conducting/evaluating the results from systems audits. The Quality Assurance Officer will review program plans for consistency with organizational and contractual requirements and advise the Laboratory Manager.

The Navajo QA OfFicer or his designee also have responsibility for conducting and evaluating the QA procedures for the field testing and ensuring that all necessary corrective action items will be completed.

3.3.14 Quality Assurance Reports to Management

Section 3.3.10 describes the periodic assessments and performance and systems audits to be completed during the Navajo RFI Site Project. Table 3.8 is a summary of the written quality assurance reports that will be submitted to management.

As reported in Section 3.3.10, weekly assessment of the sample and quality assurance for accuracy, precision and completeness will be conducted and reported orally to the QA Officer. All audits and quality assessments will be reported in oral and written form to the QA Officer to provide rapid response to quality assurance problems and documentation of the audit and response in the project files.

After the field work has been completed and the final analyses are completed and checked, a final quality assurance report will be prepared to be included in the final RFI report. The report will summarize the quality assurance and audit information, indicating any corrective actions taken and the overall results of the QAPP.

Table 3.8 QA Report to Management, Navajo Refining Company.

Report	Responsibility	Schedule
Laboratory Start Up Systems Audit Results	Laboratory Manager	10 days after audit
Field Start Up Systems Audit Results	QA Officer	10 days after audit
Laboratory Performance Audit Results	Laboratory Manager	Monthly
Field Performance Audit Results	QA Officer	10 days after audit
Laboratory Systems Audit Results	Laboratory Manager	Monthly
Field Systems Audit Results	QA Officer	10 days after audit
In-depth Performance and Systems Audit Results	QA Officer	Mid Project
Audit Deficiency Resolution	Field or Laboratory Personnel	As needed, 20 days after notice
Quality Assurance Summary	QA Officer	At Project Conclusion

4.0 DATA MANAGEMENT PLAN

4.1 DATA MANAGEMENT

The RFI will result in significant amounts of data, including results of chemical, physical, geotechnical, and/or biological analyses. This may involve analyses of many constituents, in different media, at various sampling locations, and at different times. Data management procedures have been established to effectively process these data such that relevant data descriptions (e.g., sample numbers, locations, procedures, methods, and analysts) are readily accessible and accurately maintained.

In order to ensure effective data management, a data management plan will be implemented to document and track investigation data and results. This plan addresses data and report processing procedures, project file requirements and all project-related progress reporting procedures and documents. This plan provides the format(s) to be used to present the data, including data reduction.

4.2 DATA PRESENTATION

RFI data will be arranged and presented in a clear and logical format. Tabular, graphical, and other visual displays (e.g., contaminant isopleth maps) will be incorporated for organizing and evaluating such data. Particular methods most applicable to the RFI will vary with the type of unit, the type of data, the medium under consideration, and other factors.

Table 4.1 summarizes the methods and information to be incorporated into the data presentation of this RFI.

Sample identification numbers as well as laboratory data management (i.e., designation of blanks, duplicates, spikes,

Table 4.1 Uses of Tables and Graphics, Navajo Refining Company.

Tabular Displays

1. DISPLAY SITE INFORMATION AND MEASUREMENTS TO BE PROVIDED:
    - A. Water Table Elevations
        1. Field parameters.
        2. Date/time.
        3. Well coordinates used in determination.
    - B. Sampling Location Coordinates
        1. Field parameters/lab parameters (gross).
        2. Date/time.
        3. Person collecting samples.
2. DISPLAY ANALYTICAL DATA
    - A. List of constituents of concern and other monitoring parameters with associated analytical measurements.
    - B. Display sorted results (e.g., by medium, sampling date, soil type).
    - C. Compare study and background area data (Statistical Procedures).
        1. Statistical calculations
        2. Statistical reference charts
    - D. Report input data, boundary conditions, and output values from mathematical modeling.

Graphic Displays

1. DISPLAY SITE FEATURES TO BE PROVIDED:
    - A. Site layout and topographic map.
    - B. Sampling locations map(s).
    - C. Stratigraphy and water table elevations (profile, transect, and/or fence diagram).
    - D. Potentiometric contour map of groundwater.
2. ILLUSTRATE THE EXTENT OF CONTAMINATION
    - A. Areal extent of contamination for each SWMU and media.

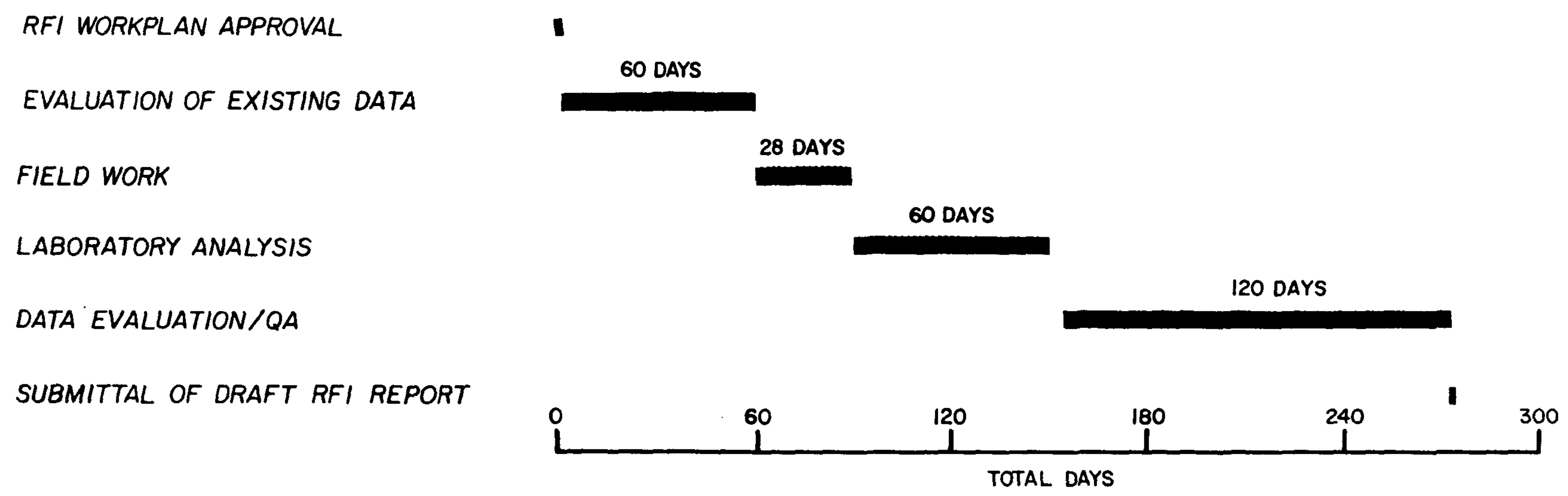
replicates, and data flagging) and data reduction techniques are presented in Section 3.3.

4.3 STATISTICAL PROCEDURES

Due to the presence of background or anthropogenic levels of organics and inorganics in various media or matrices, statistical tools can be utilized to evaluate data sets or populations. For instance, the data resulting from the RFI may be evaluated utilizing a T-test which indicates mathematical dissimilarity between populations. The rationale behind the selection of a specific statistical method, along with the appropriate documentation, will be included with the evaluation of the RFI data

4.4 SCHEDULE

The estimated schedule for the RFI is included as Figure 4.1.



MARIAH ASSOCIATES, INC.

FIGURE 4-1 SCHEDULE OF RFI ACTIVITIES

TELEPHONE
(505) 748-3311

TELETYPE
(910) 986-0990

Navajo REFINING COMPANY
501 EAST MAIN STREET • P. O. DRAWER 159
ARTESIA, NEW MEXICO 88210

December 1, 1993

VIA HAND DELIVERY

Mr. William K. Honker, P.E., Chief
RCRA Permits Branch (6H-F)
Hazardous Waste Management Division
U.S. Environmental Protection Agency, Region VI
1445 Ross Ave., Suite 1200
Dallas, Texas 75202-2733

Re: Transmittal of Revised RFI Phase II Report,
Three-Mile Ditch and Evaporation Ponds,
Navajo Refinery, Artesia, New Mexico, November, 1993

Dear Mr. Honker:

Enclosed please find the Revised Phase II RFI Report for the above facility. The April 1993 original report was reviewed and modified as necessary to respond to your letter of October 6, 1993, which transmitted EPA review comments on the April submittal. Navajo Refining Company's response to EPA's comments is also enclosed as a separate document, and page numbers of both the original and revised text material are included to assist in locating the text changes. At the November 19 meeting with EPA in Dallas, Navajo received an extension until December 1, 1993, to submit the revised RFI report.

Notwithstanding EPA's comments presented in the October 6 letter, Navajo continues to believe that the RFI investigation showed little or no risk to groundwater or the environment from waste material buried in the Three-Mile Ditch. Although releases were documented to have occurred to groundwater from the evaporation ponds, investigation shows that these releases occurred principally downgradient of inactive Pond 1 and proposed-to-be-closed Pond 2. The magnitude of the concentrations of released constituents are at or several times above MCL's only in the immediate vicinity of the ponds, which is extraordinary given that the original ponds were in use for over 50 years prior to establishment of major wastewater treatment.

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Of more import is the fact that the shallow groundwater at the ponds is naturally salty (approaching or in excess of 10,000 mg/L) and is unusable for drinking or agriculture. In addition, the nearby Pecos River also is severely salt-impacted from other sources and unusable for domestic use. Further, as has been demonstrated by this study and others, the area of the ponds serves as a regional hydrologic discharge zone precluding the movement of constituents downward beyond the immediate zone of hydraulic influence at the ponds.

The revised report and our response to comments discusses these issues and presents our position that additional investigation or further action beyond continued improvement of wastewater quality is unwarranted.

If you have any questions, please do not hesitate to contact me at (505)748-3311.

Sincerely,

Matthew P. Clifton

Matthew P. Clifton

MPC/
Enclosures

cc: David G. Boyer

Response to EPA Region 6 Deficiency Comments on Navajo Refining Company's Phase II RFI Report

EPA: Below are the comments regarding Navajo's Phase II RFI Report. The comments include general and page specific comments regarding the Report. Some comments may overlap.
Navajo: *Responses are shown in italics. For ease of comparison, text references are shown with 4/93 and 11/93 page numbers.*

General Comments on Three-Mile Ditch:
The Region recommends that Navajo remove the waste/contaminated soils from the Three-Mile Ditch, as was originally planned by Navajo. The Region's understanding of Navajo's logic for removing the materials out of the ditch were:

1. It would reduce the amount of sampling needed to sufficiently characterize the unit (the ditch is approximately 3 miles in length), which would reduce costs.
2. Removing the waste/soil would eliminate the source for potential contamination to groundwater and human/ecological exposures to the waste/soil. Also, the waste material would be treated more effectively by being aerated and tilled.
3. By removing the waste/soil, Navajo could determine areas of the ditch that were contaminated to the groundwater and could install monitoring wells in appropriate locations in a cost effective manner.

From reading the recommendations in the report, Navajo has reversed its original intentions for waste/soil removal from the ditch. The Region believes, for the above stated reasons, that Navajo should perform corrective measures on the ditch, instead of leaving it in place.

Navajo believes that the characterization of ditch materials performed during the RFI Phase I and II studies demonstrates that there is no significant risk to human health and the environment from the materials remaining in the subsurface. This discussion is presented later in the response to comments, specifically EPA RFI comments regarding report pages 111-114, and pages 147-149. However, if EPA continues to have concerns, Navajo is willing to discuss this issue further with the agency.

General Comment on Evaporation Ponds:
The Region agrees with Navajo's recommendation that groundwater monitoring and water measurement levels be continued periodically. However, the Region also believes that the lagoons should stop receiving effluent and that treatment or removal of contaminated

sludges/soils be initiated. Furthermore, the Region also believes that a more structured/rigid bioremediation program be initiated on closed pond no. 1.

Navajo believes that the information provided in this report shows minimal risk to usable water supplies from continued use of the Ponds 3, 5 and 6, especially with an upgraded effluent quality. The groundwater quality problems resulted mainly from past discharges to now-inactive Pond 1 with some contribution from original Pond 2 (as located on report Figure 6). The discharge of a much cleaner effluent to the ponds will combine with the upward flow of fresher water to assist in natural remediation of the impacted groundwater. However, as discussed in prior meetings with EPA and reaffirmed in our meeting of November 19, 1993, Navajo continues to assess alternatives to future use of the evaporation ponds.

In response to EPA's expressed desire to see the development of a more structured bioremediation program, Navajo is in the process of drafting a plan which will encompass the details of operation and management being employed, including schedules for routine tilling, soil fertility testing and maintenance, soils monitoring and final unit closure. A proposed closure plan for Pond 2 has already been submitted to EPA for review.

General Comment (on blueprint maps):

The blueprint maps showing sample locations along the Three-Mile Ditch are too dark to read. Please include maps in a revised Report which are legible.

Better copies of the blueprint maps were obtained from the City of Artesia and have been modified to show RFI Phase I and II sample locations.

Page 1; Executive Summary:

Navajo needs to include in the revised Report the signatory requirement required by the permit and by 40 CFR 270.11.

The RFI Report has been revised to include the certification statement specified at 40 CFR 270.11. The certification statement has been inserted in the document immediately preceding the Executive Summary.

Page 1; Section 1.0, 1st bullet (11/93 page 1, 1st and 2nd bullets):

Please clarify in a revised RFI Report the statement pertaining to localized presence of residual volatile and semivolatile compounds.

Is Navajo saying that contamination along the 20,000 ft length of the ditch is contaminated localized in a linear sense; or, that contamination within the ditch is vertically localized along most parts of the ditch?

The combined results of the Phase I and Phase II investigation of Three-Mile Ditch reveal that volatile organic constituents were detected only infrequently and at concentrations significantly below applicable health-based numbers. Bullet 1 of the executive summary has been revised to include a statement to that effect.

Semivolatiles results are now highlighted in a separate paragraph (new Bullet 2). Navajo acknowledges that the Phase I investigation results and data for split samples obtained by PRC during the Phase II investigation indicate semivolatiles at a higher rate of frequency than was observed for Navajo's Phase II ditch sample analytical data. This discrepancy appears to have been caused by analytical problems resulting in higher than desired laboratory detection levels for KWBES samples. Lower detection levels were achieved during the Phase I effort and by PRC for some Phase II soil samples during the Phase II investigation. Therefore, in reference to the presence of semivolatile constituents in the ditch the paragraph has been revised and the use of the word "localized" eliminated.

Page 1; Section 1.0, 2nd bullet (11/93 page 1, 3rd bullet):
EPA feels that biodegradation of organic constituents in the ditch will be considerably slower than the biodegradation rate occurring in closed pond no. 1, since most of the waste in the ditch is covered by 2-3 ft of surface soils/fill and the wastes in the ditch are not aerated and turned over, like the materials in the pond. Furthermore, Three-Mile Ditch sample TMD-TR-002-03, taken at 11 ft contained ethylbenzene 1.34 ppm and xylene at 3.35 ppm.

Navajo agrees with EPA that the rate of biodegradation of organic constituents in the ditch would likely be slower than the rate which could be obtained for those materials if they were transferred to Pond 1. However, as stated in the RFI report, the available facts and evidence argue against the need to excavate the ditch at this time. Levels of contaminants, the apparent high sorption characteristics of the soil (as assessed by TCLP testing), and, most significantly, the absence of any credible human or ecological receptors for the subsurface contaminants, are all factors which indicate that the effort and expense which would be required to excavate and remediate the ditch soils are not warranted at this time.

The significance attached by EPA to the reported ethylbenzene and xylene detections in ditch sample TMD-TR-002-003 is unclear. No ditch samples yielded TCLP concentrations for volatile organic constituents above maximum TCLP-allowable levels or otherwise above *applicable health-based numbers for groundwater (even in the absence of the 100-fold attenuation factor used for TCLP evaluation for target constituents), with the exception of a single TCLP detection for trichloroethylene at a concentration less than 5% of the maximum TCLP-allowable level. TCLP analyses of the ditch sample in question (TMD-TR-002-003) yielded* ***no*** *detectable concentrations of any hazardous substance list organic constituents. It is also notable that a split sample collected by the EPA representative (PRC) yielded concentration data for ethylbenzene and xylene which were approximately two orders of magnitude less than the values obtained by Navajo for this sample. Finally, the sample in question was collected at a depth approximately 7 ft above the water table.*

Page 1; Section 1.0, 3rd bullet (11/93 page 1, 4th bullet):

Please clarify in a revised RFI Report the statement suggesting that areas within the unit with metal concentrations above health-based levels are not widespread but exist as localized occurrences. Is Navajo saying that the localized metal occurrences are not widespread in a horizontal (linear sense) or vertical plane within the ditch? EPA disagrees if Navajo is stating that horizontal contamination of metals above health-based criteria. The Phase II investigation had 0 out of 4. Therefore, a total of 11 out of 16, or 69%, which indicates more towards the widespread interpretation vs. the localized.

It would appear that EPA has misconstrued the intent of the statement referring to the localized nature of elevated levels of various metal constituents. The combined results of the Phase I and Phase II investigations indicate that, when the volume of hydrocarbon-contaminated soils contained within the unit is considered in its totality, areas where an ***individual metal species*** *is found above applicable health-based numbers are indeed not typically widespread, either in a vertical or horizontal sense.*

For instance, in scoring the rate at which trenches excavated during the Phase I and Phase II investigations exhibit soils with potentially serious metals contamination, EPA tallied the presence of any of the three metals of concern at any sample interval. However, if the incidence of arsenic, chromium, and lead in ditch samples that were detected above health-based limits are considered on a per sample interval basis, their individual rates of occurrence are 14/51 (27%); 11/51 (22%); and 6/51 (12%), respectively. Navajo considers this distinction to be critical, since it has implications for the total volume of waste-contaminated soils which may contain potentially hazardous concentrations for those three metal constituents. Bullet 3 on Page 1 has been revised in order to clarify this point.

Page 1; Section 1.0, 4th bullet (11/93 page 2, 5th bullet):

Is Navajo stating that portions of the Three-Mile Ditch which are within the water table part or all of the time will not leach metals into the groundwater? Please clarify in the revised RFI Report.

Of the 12 trenches excavated in Three-Mile Ditch during the course of the RFI Phase I investigation, soil samples were obtained immediately above the water table (NMD-TR-004 and 005) or slightly below the water table (NMD-TR-009). At these locations, the most significantly elevated metal concentration was observed at NMD-TR-004, which exhibited a lead concentration of 123 mg/kg. Of the four confirmatory trenches excavated in Three-Mile Ditch over the course of the RFI Phase II Investigation, two samples were obtained in visually clean soils below the zone of contamination but well above the shallow water table (TMD-TR-001 and 002), within 2 ft of the shallow water table (TMD-TR-003), or in saturated soils immediately below the water table (TMD-TR-004). None of the samples collected from those trenches exhibited metal concentrations which could be construed as posing a potential threat of metal constituent releases to shallow groundwater. Thus, even if supporting data provided by TCLP testing is excluded from consideration, no evidence has been obtained to indicate that unit soils in proximity or contact with shallow groundwater may potentially act as an ongoing source for the release of metal constituents to the groundwater.

Based on the considerations described above, the bullet 4, Page 1 has been revised to state that, in addition to the findings and conclusions resulting from TCLP testing, no soil data has been obtained to indicate that unit soils in immediate proximity to, or potentially in contact with, the water table exhibit metal concentrations that could potentially serve as a source for an ongoing release of metal constituents to the water table.

Page 18; Section 3.5.3, 2nd paragraph (11/93 page 18):

Is this water under artisan pressure in every well installed in this aquifer, or is it location specific? Please clarify in the revised RFI Report.

Most wells in the zone identified as the near-surface saturated zone were found to be under artesian pressure, some as much as several feet above the depth water was first encountered. However, often fine-grained sediments will not show water when first drilled because of the time necessary for water near the top of the saturated zone to enter the borehole. Reviewing the combined lithologic information and drillers observations on the depth when saturation occurs for a particular well is the best way to determine the occurrence of artesian conditions at a well. Wells and piezometers drilled closest to Eagle Creek during this RFI showed the least *amount of artesian behavior, while several away from Eagle Creek showed rises in water from 7 - 9 ft (MW-17, NP-4).*

Page 19; Section 3.6 (11/93 page 18):

Please include in the revised RFI Report a discussion on the potential ecological receptors. Also, include a discussion on endangered species on the Pecos River.

The RFI report has been revised to include a discussion on potential environmental receptors, which is presented in a revised Section 3.6, and a discussion in new Section 3.7 on endangered species in the Pecos River in the vicinity of the facility. Information on endangered species was requested from Federal and New Mexico agencies, but had not been received in time for inclusion in the revised RFI.

Page 23; Section 4.2.2.2, Table 3 (11/93 page 26):

Please include in the revised RFI Report all wastewater effluent samples taken by Navajo in the past, using the same format as Table 3.

The information requested has been compiled and is now included in new Appendix C subdivided into several tables by constituent type. The tables include effluent and pond samples collected by Navajo and by state agencies during permitting and compliance inspections. Although an attempt was made to provide a comprehensive inventory of wastewater effluent samples, a subsequent review of documents provided to the Department of Justice indicates that information on some sampling events was not included in Table C1. Navajo is working to amend the Table and will submit a revised document to EPA as soon as possible.

Page 33; Section 6.1.2.1, Table 5 (11/93 page 41):

The result of phenanthrene at TMD-TR-002-01 should be 234 mg/kg instead of <234 mg/kg.
The table has been corrected to show the correct value of phenanthrene.

Page 33; Section 6.1.2.1, Table [4] 5 (11/93 page 41):

Please explain in the revised RFI Report why the detection limits were excessively high for semivolatile compounds in the following soil samples:

- TMD-TR-001-01, the lowest detection limit for any semivolatile compound was 17 parts per million
- TMD-TR-002-01, the lowest detection limit for any semivolatile compound was 140 parts per million

- TMD-TR-002-02, the lowest detection limit for any semivolatile compound was 45 parts per million
- TMD-TR-003-03, the lowest detection limit for any semivolatile compound was 240 parts per million

The RFI report has been revised to include a discussion on the relatively high detection limits achieved for Three-Mile Ditch samples TMD-TR-001-01, 002-01, 002-02, and 003-03 (Section 6.1.2.1, page 40).

Page 36; Section 6.1.2.1, Table 7 (11/93 page 43):
Please include in a revised table, the depth at which groundwater was encountered, if applicable.

Table 7 has been revised to show depths to groundwater where the information was available.

Page 37; Section 6.1.2.2, 2nd paragraph (11/93 page 44):
It would appear that the background sample results for Eagle Creek are elevated ten-fold. The background sample taken in 1990 at approximately the same location had chromium at 8 ppm and lead at 15 ppm.

During both the RFI Phase I and Phase II investigations, a background sediment sample was collected from Eagle Creek within the city limits of the town of Artesia. Although observed concentrations for chromium and lead were observed to vary significantly for background sediment samples collected during the two investigations, the level of variation is not considered to be either extraordinary or cause for concern. While the sediment samples under consideration were collected from the same general area, there is no evidence to indicate that they were obtained at the exact same spot. It is well known that baseline values for various analytical parameters may vary significantly over short spatial distances. Further, Eagle Creek is an ephemeral stream subject to periodic stormwater runoff events in which the channel bed can be expected to be scoured by relatively high-velocity flow rates. In such a non-static system, transient alterations in creek bed depositional patterns and characteristics over time are not only possible, but probable. Any such spatial and temporal variation is potentially compounded further by the fact that the general background area is located in an urban area potentially subject to heterogeneous impacts caused by surface runoff from streets, local homes and businesses, possible illegal waste disposal, etc.

Presumably, EPA has cited the observed variation in background sediment sample parameters due to concerns for potential sample collection or laboratory error. However, in the absence of *any direct evidence to indicate that such errors have occurred, the potential sources of variation and contamination discussed above are considered to be more than sufficient to account for the level of variability in sediment concentration data for chromium and lead observed between the Phase I and Phase II studies.*

Page 47; Section 6.2.2.1, 3rd paragraph (11/93 page 54):
The data obtained from these piezometers does not give EPA confidence on the direction of the groundwater flow along the total length of the Three-Mile Ditch. Groundwater appears to be flowing Northeast at the location of the four piezometers. It appears that more groundwater elevation data on the north side of the Three-Mile Ditch is needed to determine the local groundwater flow in the vicinity of the ditch.

The general direction of groundwater flow is to the east as shown by Figure 5B. Although contours in the vicinity of the Bolton Road piezometers are slightly northeast, this is likely due to the nearby presence of Eagle Creek, a major ephemeral drainageway from the mountain foothills to the west. West of the refinery, the channel is unlined and resides in a depressed, artificially irrigated urban park as a flood control measure. Subsurface recharge in this area causes monitor well water levels immediately east of the refinery to be mounded relative to those further north or south (Figure 5A) which causes groundwater to move northeast or southeast away from the center of the mound. Therefore, although groundwater movement near the Bolton Road piezometers is locally northeast, general movement is easterly towards the marshes and shallow alluvial water along the west side of the Pecos River.

Page 47; Section 6.2.2.1, last paragraph (11/93 page 54):
Please further explain why this well cannot be replaced. MW-47 appears to be located the same distance from the ditch as MW-45 and MW-46. Why are conditions different today versus when MW-47 was originally installed? Please clarify in the revised RFI Report.

Monitor wells 45, 46, and 47 were installed in 1984 as part of an early RCRA investigation. MW-47 was subsequently damaged, probably by farm equipment, and is now unusable because of bent casing. Since 1984, the refinery effluent pipeline has been constructed adjacent to Three-Mile Ditch in this area. Of more importance, the presence of high voltage electric power lines immediately above the wells and the ditch precludes the use of conventional drilling equipment. The hazards of locating a replacement well were recognized during planning for the Phase II RFI and MW-20 (located east-southeast of MW-47) was installed adjacent to the ditch as a substitute for MW-47.

Page 61; Section 7.2, 3rd paragraph (11/93 page 69):
EPA noticed only one metal elevated in background monitoring well EPA-1, barium at .25 ppm.

Arsenic, barium and nickel were elevated above minimum detection levels in well EPA-1 for the RFI Phase I sampling. Navajo agrees with EPA that only Barium seems anomalously high for this sample (the others were only slightly above detection levels), but was following EPA's convention of calling any value above the detection level as elevated. The paragraph in question has been rewritten to better summarize the results of the Phase I metals sampling.

Page 61; Section 7.2, bottom of 3rd paragraph (11/93 page 69):
Although degradation of the steel casing might be the cause for high chromium and nickel values in MW-1, Navajo has not proved otherwise by installing a new well to replace MW-1 to determine the groundwater quality.

Navajo continues to believe that the chromium and nickel contamination of MW-1 is the result of corrosion similar to MW-8 and MW-9 based on the observation that both chromium and nickel in the steel wells are one to two or greater orders of magnitude above levels found in the PVC wells.

Page 61; Section 7.2, 4th paragraph (11/93 page 69):
Fluoride has been present in Navajo's pond effluent in the past and was present at 151 ppm in a sample taken February 11, 1993. Table 28 shows fluoride above 4 ppm in wells MW-2A, OCD-7A, and OCD-1. OCD-4 is below 1 ppm in this table. Is this table correct?

The value of fluoride shown in Table 28 is correct. Numerous samples taken by the NM Oil Conservation Division have not shown highly elevated levels of fluoride, or levels elevated above the current MCL except in shallow monitor wells closest to the current pond. In groundwaters having excess concentrations of calcium, an equilibrium is established with respect to fluoride and fluoride precipitates as Fluorite (CaF_2). Because calcium-rich gypsum, limestone and caliche exist in the area, dissolved fluoride is less likely to exist compared to water low in calcium (Hem, 1989).

Page 62; Section 8.0, 1st paragraph (11/93 page 70):
Please include a narrative on the "churning process" of pond No. 1 (include the frequency, depth of churning, and any sampling results on the effectiveness of churning) and estimate the % of the pond that has been "churned".

The reference to "churning" is not located on the cited page. However a short narrative on initial pond remediation efforts is given in Section 4.2.2.1, page 24, and available sampling information is presented in Appendix K.

Page 64; Section 8.1.1.2, 1st paragraph (11/93 page 72):
Please include in the Revised Report a Trench cross-section diagram similar to those produced in the Phase I Report. Also include the trench soil/sludge log visual and olfactory descriptions, depth to groundwater, and OVA/PID readings (field logbook information).

Since the hydrocarbon contamination profile of soils within Pond 1 are highly uniform in the horizontal plane, trench cross-section diagrams similar to those produced in the Phase I report were not considered to be appropriate. Characterization of the vertical soil profiles and observations associated with the trench excavations in Pond 1 is included as Appendix E-2.

However, in response to this comment, the soil logs for the Pond 1 trenches (which already include visual and olfactory observations) have been revised to include PID monitoring information. Cross-section diagrams for the trench excavations in Three-Mile Ditch have also been prepared and are presented in Appendix E-1 of the revised RFI Phase II report.

Page 69; Section 8.2.3, 2nd paragraph (11/93 page 77):
Although there is a possibility that the gas well could be leaking, the Region does not agree with Navajo's assumption that the increased PID/FID readings are most likely from the gas well. Regional personnel observed the sampling of MW-10, characteristics of the water purged from this well were similar to the characteristics of the well water from contaminated wells close to the lagoons. The Region believes that it is more likely that the contamination in MW-10 originated from wastewaters placed into the lagoons. In addition, please explain why MW-10 has never been identified on previous RFI or groundwater reports? Furthermore, please include in the RFI Report the construction details/diagram of MW-10.

Downgradient from the ponds in the immediate vicinity of the gas well, FID and PID levels were elevated relative to levels immediately upgradient. Older gas wells have been observed to leak gas due to corroded casings and deteriorated cement. Such a leak could cause the elevated readings in question or add to existing contamination that may migrate downgradient from the ponds. This paragraph has been reworded to indicate that a gas well leak is one of several reasons that may have contributed to the elevated levels downgradient from the well.

Current refinery staff have no direct knowledge of the date of installation, or construction details on well MW-10. The well was not installed or identified during the RFI Phase I study, but *was completed subsequent to the 1986 study that included installation of the MW series monitoring wells at the pond and at MW-8 and 9. However, the well is likely Navajo's since it has "10" etched on the concrete, is only 20 ft deep, and has a lock that opened using a Navajo key. A well log was prepared for this well using available information and inserted in Appendix B.*

Page 69; Section 8.2.3, 3rd paragraph (11/93 page 77):
Please indicate in the RFI Report the lower detection limit of the analytical equipment. Also, is the xylene concentration of 98.7 ppm correct?

The lower limit of detection for EPA Method SW-8020 for volatile organics was 0.0005 mg/L for this set of samples and this information was inserted in the text. Also, the correct xylene concentration is 0.098.7 mg/L and the correct value has been inserted in the text.

Page 74; Section 8.3.1.1, Monitor Well Installation (11/93 page 82):
EPA was told in January by K. W. Brown Environmental Services that Navajo was having problems with the landowner pertaining to installation of deep well MW-4B. EPA still wants this well installed. Please explain in the revised RFI Report why this well has not been installed. EPA is willing to assist Navajo on this issue, if needed.

Navajo could not obtain an easement to this property to drill the wells proposed in the work plan. This necessitated a shallow/deep well pair (MW-22A, MW-22B) further south than planned and lack of a deep well adjacent to MW-4. In light of discussions between EPA and Navajo on November 19, Navajo questions whether further groundwater assessment is justified. If, however, EPA continues to insist on additional wells on this property, Navajo will require and welcome EPA assistance in resolving this issue.

Page 81; Section 8.3.2.1, 2nd paragraph (11/93 page 86):
Please include the location of MW-17 on a map in the revised RFI Report.

The location of this well is shown on Figure 1 and new Figure 5B.

Page 84; Section 8.3.2.2, (11/93 page 92):
The Region believes that there is no significant difference between the potentiometric levels of the upper screened and deeper screened monitoring wells. Half of the deeper wells with higher potentiometric levels had levels only .14 ft or less. Those levels are within the range of error. Furthermore, water elevations should be taken at different periods of the year to properly evaluate the potentiometric surface of the deep wells.

Navajo continues to believe that the differences between the groundwater elevation levels in the upper and deeper screened wells are significant. Wells located next to or very close to the ponds such that they may be directly influenced by pond water levels have the smallest positive elevation differences or negative values. These include MW-2A/B, OCD-2A/B, OCD-7AR/B. Wells that have significant amounts of clay nearer the surface as shown in the drilling logs also appear to have less positive elevation difference. These include MW-6A/B and OCD-8A/B where the clay zones may cause localized perched groundwater zones. As water levels fluctuate these zones inhibit the establishment of a true equilibrium and mask the effects of the upward regional gradient. Wells located away the pond berms and where sands and gravels predominate over the length of the hole show strong positive upward gradients. These include MW-5A/B, MW-7A/B, MW-11A/B, MW-18A/B, and MW-22A/B. For comparison purposes, the regional horizontal groundwater gradient in the vicinity of the ponds is 0.001 ft./ft. The strong upward vertical gradients away from the direct influence of the ponds is an order of magnitude or more greater than the horizontal gradient.

Measurements of well elevations and water levels are required to be made to the nearest hundredth of a foot. All elevations were surveyed and certified by a registered professional surveyor and water levels were measured using a calibrated electric probe. However, we would agree that values below 0.08 ft. (about 1 inch) could be within the range of measurement error especially since the PVC casing tops may not be completely level. However, we strongly disagree that values exceeding that number are within the range of expected error for these types of measurements.

We agree that values should be taken at different times during the year to evaluate impact of river elevation changes, area wide pumping, etc. on the magnitude of the upward gradient, and the need to make seasonal measurements was acknowledged in the text of the report. A second set of elevations was obtained on November 13 that supported the first set of results. The relative difference between water levels in the paired wells remained generally the same even though water levels decreased by one foot or more in several of the wells. A new table, Table 20B has been revised to reflect the results of the recent measurements.

Finally, numerous studies conducted over the past 60 years by the U.S. Geological Survey and New Mexico State Engineer have documented the existence of a groundwater discharge area at the Pecos river for both the deep artesian aquifer and the shallower valley fill aquifer. The scientifically validated results of these wide ranging hydrologic studies cannot be disregarded by EPA in its evaluation of the impacts of Navajo evaporation ponds. Although the precise extent (e.g. 40 vs. 50 ft.) of the downward migration of fluids beneath the ponds and the *seasonal fluctuations affecting the magnitude of the upward gradient can be disputed, the fact that groundwater migration in the area surrounding the pond is upwards toward the surface can not be disputed. Contaminants that may be carried downward directly under the pond are returned to the surface as a result of this documented effect.*

Page 89; Section 8.3.2.3.2, last paragraph (11/93 page 99):
Please clarify the discussion in this paragraph pertaining to the aquifer being partially confined.

Directly along the river flood plain channel and in the vicinity of the ponds no area-wide confining zone (such as a thick clay or consolidated sedimentary material) exists and water found at depths of 7 - 15 ft is generally considered to exist under water table conditions. However, because the area is a flood plain, localized zones of fine grained materials may produce hydrologic effects during testing that could be interpreted as being a result of a partially confined aquifer, especially for a low discharge aquifer test conducted for a limited period of time (i.e. not longer than 24 hours). However, closer examination of the drilling logs at MW-18 shows that a 1 ft thick clay zone is present at a depth of about 27 ft. Though other logs show the zone as localized, its presence can cause the hydrologic effects observed during a short period aquifer test. The text in this section has been revised to explain the apparent discrepancy.

Page 93; Section 8.3.2.4, Groundwater Quality (11/93 page 109):
Please include in the revised RFI Report a discussion pertaining to the groundwater contamination found across the river. In addition, please include a discussion explaining why groundwater directly south of the windmill is contaminated with organics, but the windmill does not show organic contamination. EPA personnel observed some of the contaminated groundwater samples taken south of the windmill.

No elevated levels of volatile and semivolatile organic constituents listed on EPA's target compound list were found across the river. Several unidentified hydrocarbons were found in the wells. However, the maximum total concentration of all hydrocarbons present in any single well was under 0.4 mg/L. Arsenic, chromium and nickel were found above the minimum detection levels in three of the five wells, however, no MCLs were exceeded. A discussion of the characteristics of the contamination across the river is included in Section 8.3.2.4. A discussion of the hydrologic conditions allowing movement upgradient and across a hydrologic boundary are presented in Section 8.3.3.2.

Although south of the ponds, the windmill is not downgradient from the ponds as shown by the shallow groundwater potentiometric map (Figure 14). It is, however, downgradient from the lower end of the ditch and water quality produced by the windmill does not appear to have experienced any lasting impact from 50 plus years of use of the ditch even though the ditch crossed a thick zone of saturated alluvium prior to entering Pond 1. A discussion of the results of water quality sampling of the windmill is presented in Section 8.3.2.4.

Page 101; Section 8.3.2.4, (11/93 page 111):
From reading the geologic description (indicating hydrocarbon contamination at 50 ft) and reviewing the analytical results (Arsenic at .131 ppm), the vertical extent of groundwater contamination at MW-5B has not been delineated.

Monitor well MW-5B is located directly downgradient from the Pond 2, the oldest active pond, and had the second highest arsenic value of any of the monitoring wells. As can be seen by reference to Figure 17, based on its location and the fact that the geologic log of well 5B shows sand with gravel lenses from 15 to 51 ft., an elevated arsenic value is not unexpected given that the arsenic level in the pond is also elevated. Such contamination would not be expected to extend much deeper because, as has been demonstrated by this study and others, the area of the ponds serves as a regional hydrologic discharge zone precluding the movement of constituents downward beyond the immediate zone of hydraulic influence at the ponds. Again, considering the discussions between EPA and Navajo on November 19, Navajo questions whether further groundwater assessment is justified and is prepared to continue only routine monitoring unless EPA requires the placement of an additional deep well at this location.

Page 103; Section 8.3.3, Groundwater Modeling (11/93 page 118):
Please include in the revised report a section explaining the reason for groundwater contamination in wells installed across the river.

As discussed earlier, the groundwater contamination across the river is limited to the detection of several unidentified volatile and semivolatile hydrocarbons with the estimated total hydrocarbon concentration in any well less than 0.4 mg/L. Hydrologically, apparent movement upgradient and across a hydrologic barrier can be explained by reference to Figure 19 which shows groundwater flow lines in a two dimensional setting. Because the pond creates a groundwater mound as shown on the figure, water movement is radially outward until equilibrium conditions are met and water flow resumes its normal downgradient path. Movement of water contaminants along the flow path results in water crossing under the river and being detected in the monitor wells. The action of the strong upward gradient combined *with the radial effects due to mounding create unanticipated flow paths that appear inconsistent until examined mathematically as was done with the model. Without the upward gradient, the water would move downwards and contaminants likely would not be detected in wells north of, and upriver from, the ponds.*

Page 103; Section 8.3.3, Groundwater Modeling (11/93 page 113):
The Region disagrees with some of the assumptions used in this model. Using Navajo's measurements on well MW-5B, the potentiometric surface is .49 ft higher than the corresponding shallow well potentiometric surface. However, the well indicates arsenic contamination above the MCLs. Likewise, well MW-6B potentiometric surface is .03 ft higher than the potentiometric surface of well MW-6A. This well indicates benzene above the MCL and also contains toluene and carbon disulfide. Also, there are other deeper wells that show no hazardous constituents at detectable levels but have significant concentrations of tentatively identified compounds. Therefore, Region believes that downward contamination has occurred.

As stated in the answer above, the horizontal and vertical flow components combine to create flow paths that are not immediately obvious unless looked at using the computer-generated diagram shown in Figure 19. The model used the measured and calculated field data to determine vertical and horizontal vector paths and velocities. The direction and magnitude of a velocity vector is the vector product of the hydraulic conductivity in the vertical and horizontal directions times the vector gradient in the vertical and horizontal directions. Therefore, even with a strong positive upwards gradient, particle flow will not be directly upward if the resultant vector velocities have horizontal components. As shown in Figure 19, flow at the lower zones of MW-5B is mostly horizontal and flow particles passing through this zone originate directly from the pond which explains why arsenic concentrations are similar to those measured in the evaporation pond.

The lack of a significant potentiometric difference between Well MW-6A and 6B was troublesome until the well log for MW-6B was examined. Because the monitor well is some distance from the active evaporation pond, the hydraulic head should show a strong upward component as do the other wells away from the direct influence of the pond. However, the boring log shows a 14 ft. clay zone extending from 4 to 16 ft. beneath the surface. Total measured depth of MW-6A is 18 feet of which 3 ft. is above ground surface casing. Therefore the well is completed in the clay/sandy clay zone, and permeability likely has been further lowered by hydrocarbons due to its proximity to the inlet of Pond 1 where much of the suspended particulate matter was deposited. This may have served to isolate MW-6A from effective communication with other zones so that the lack of a meaningful gradient difference *is not significant. The preponderance of information from this study, and earlier federal and state aquifer studies, supports upward movement of groundwater from depth and the inconsistency shown by this well should not and can not be used to dismiss the weight of the other evidence.*

Compared to the types and concentrations of constituents found in the other shallow and deep wells adjacent to the pond (including MW-2A), the lack of any hazardous constituents, and no unknown volatile hydrocarbons in well MW-2B is significant. The four unknown hydrocarbons detected by the semivolatile analysis totaled less than 0.5 mg/L. Therefore, the first paragraph of this section has been modified to indicate that a lack of <u>*notable*</u> *contamination was found in well MW-2B. Also, as evidenced by the reporting of analytical results from the testing of groundwater from the deep monitor wells, Navajo recognizes that downward contamination has occurred in some locations. The purpose of the groundwater modeling segment of the RFI report is to present a scientifically based explanation of the physical and chemical results of the study that will enable, as a secondary purpose, the identification of the destination of the groundwater flow particles. This was accomplished to the satisfaction of the professionals evaluating the results of the model.*

The term "tentatively identified hydrocarbons" used on the laboratory sheet and in EPA's comment is a misnomer in the sense that although hydrocarbons were detected, they were in no way identified as to composition, could not be compared to EPA's listed priority pollutants or target compounds, and therefore can not now be classified as "hazardous constituents".

Page 108; Section 8.3.3.2, last paragraph (11/93 page 118, 2nd from last paragraph):
This explanation does not coincide with the deeper monitoring wells MW-7B, MW-5B, MW-6B, and MW-22B showing contamination. The Region disagrees that downward contamination of the aquifer is not possible, since deeper wells already show contamination.

This paragraph was intended to describe how the model explains the detection of only minimal contamination in MW-2B and not to imply that all deep monitor wells are protected because of the vertical upward gradient. Navajo recognizes that hydrocarbon and/or metals contamination of varying magnitude has occurred in the deep monitor wells listed here. Navajo has changed the introductory sentence in this paragraph to reflect that the paragraph refers specifically to MW-2B, and has modified the paragraph to indicate that only minimal contamination was detected in MW-2B whereas, it would very likely be highly contaminated in the absence of the upward vertical gradient.

Page 109; Section 9.0, Discussion (11/93 page 119):

The proposed regulations published in 57 FR 21450 have been withdrawn.

The withdrawal of the proposed regulations published in 57 FR 21450 has little bearing on the intent and purpose of Navajo in their inclusion in the RFI report. The formerly proposed media contamination action levels were developed on the basis of general risk assessment principles and methodologies which are utilized by EPA in various programs, either directly (CERCLA and RCRA Subtitle D, Part 503) or in the form of general guidance (RCRA RFI Guidance, Chapter 8). The presentation of the formerly proposed regulations was not intended to serve as fixed standards for the determination of existing levels of risk or corrective action requirements, but rather to serve as a general reference point for purposes of data interpretation and discussion.

Page 111; Section 9.1.1, 3rd paragraph (11/93 page 121):

Also, well MW-45 just so happens to be next to the Three-Mile Ditch, within a few feet. The Region believes that the contamination observed in MW-45 is most likely coming/or has come from the ditch. Is Navajo implying that there might be a leak from the Three-Mile Underground Pipe or the Trickling Filter that is contributing to the groundwater contamination observed in MW-45? Please clarify in the revised report.

As discussed in Section 6.2.2.3, Groundwater Quality, there have been documented product releases to the subsurface from tanks and underground lines upgradient of well MW-45. Although several product recovery trenches are in operation in the area of the past leaks, they were installed ahead of the free phase product plume and some dissolved phase hydrocarbons likely moved past those locations prior to trench installation. There is no evidence that the effluent pipe or trickling filter are leaking. The NM Oil Conservation Division requires the effluent pipe to be periodically hydrostatically tested as a groundwater protection permit condition) and the trickling filter was inspected and water sealed prior to being placed back in service.

Page 111; Section 9.1.1, last paragraph (11/93 page 121):

The Region disagrees with part of the conclusions of this paragraph. There is already groundwater contamination in at least three wells along the ditch from volatile (identified and unidentified compounds) organic compounds (MW-45, MW-46, MW-16, and MW-15). Therefore, there is potential for current or future risk to human health or the environment.

Observations regarding constituents found in groundwater samples from monitoring wells adjacent to Three-Mile Ditch are not relevant to the conclusions stated in this paragraph. The cited discussion concerns the presence of residual volatile organic contaminants ***contained in subsurface soils*** *of the unit. Total concentration data for various volatile organic constituents and TCLP testing both demonstrate the low potential for hydrocarbon-contaminated soils within the unit to function as either a current or future source for the release of such constituents to the shallow groundwater.*

Navajo disagrees with the implicit assumption that evidence of volatile hydrocarbon contamination in the shallow groundwater is evidence that soils of Three-Mile Ditch currently are releasing such constituents to groundwater or possess the potential for future releases of such contaminants to groundwater. Evidence of hydrocarbon contamination of shallow groundwater adjacent to the unit may readily be anticipated after approximately 50 years of continuous unit operations. In summary, the cited discussion pertains to the potential risks, present and future, resulting from the trace levels of highly sorbed volatile organic constituents associated with subsurface soils of the unit. Based on the available soils data obtained from the unit to date, Navajo stands by the conclusions stated in the last paragraph of Page 111.

Page 113; Section 9.1.1, 1st paragraph (11/93 page 123):
It is hard to follow the logic in this first paragraph. The first sentence states that there are significant differences between the data sets of the RFI Phase I and II, for semivolatile constituents. However, later in the paragraph, the report states that the results for semivolatile constituents in Phase I are generally indicative of the status of the semivolatile contamination found in the unit. Please clarify in the revised RFI Report.

As stated in the cited paragraph, Navajo acknowledges that detection limits achieved for semivolatile organic constituents in the course of the RFI Phase II soils investigation were generally higher than those achieved during the preceding RFI Phase I investigation. The paragraph goes on to note that lower detection limits were achieved for the split samples obtained by the EPA representative, PRC, and those split samples yielded results similar to those obtained during the Phase I effort. The last sentence of this paragraph has been revised to more clearly indicate that the Phase I soils data for semivolatile constituents in Three-Mile Ditch, in conjunction with the subsequent Phase II split-sample data generated by PRC, appear to be indicative of the status of semivolatile constituents contained in unit soils in terms of the type and concentrations of those constituents.

Page 113; Section 9.1.1, 2nd paragraph (11/93 page 123):
The health-based criteria presented in Table 29 under the proposed column have been revised by EPA. There are additional semivolatile constituents that exceed health-based levels.

It is the understanding of Navajo that the revised health-based criteria cited by the reviewer consists of the health-based criteria for soils and water included in the 11/23/92 EPA Region 3 guidance memorandum from Mary Back, General States Permits Section to Carolyn Loomis, Corrective Action Programs Branch. Table 29 has been revised to include information from the Region 3 memorandum for all constituents identified during RFI Phase I and Phase II sampling events.

With the exception of phenanthrene, the inclusion of the Region 3 guidance criteria to Table 29 has not resulted in any additional instances in which observed soil concentrations of semivolatile constituents are in exceedance of the applicable health-based concentrations for soil. The 8th paragraph of section 9.1.1 has been revised to include phenanthrene as one of seven semivolatile constituents for which one or more soil samples yielded concentrations exceeding health based numbers.

Page 113; Section 9.1.1, 3rd paragraph (11/93 page 123):
Although there may have been an absence of listed RCRA semivolatile compounds, there are tentatively identified semivolatile compounds in at least three of the wells along the Three-Mile Ditch. The toxicological effects of these compounds are unknown. In addition, certain parts of the ditch are contaminated within the groundwater or within a few feet of the groundwater fluctuating zone.

Navajo disagrees with the implicit assumption that evidence of semivolatile hydrocarbon contamination in the shallow groundwater is evidence that soils of Three-Mile Ditch currently are releasing such constituents to groundwater or possess the potential for future releases of such contaminants to groundwater (please refer to the Navajo response to the EPA review comment for Page 111; last paragraph).

Page 114; Section 9.1.1, 1st paragraph (11/93 page 124):
The Region disagrees that leachate levels do not constitute a cause for concern. The leachate concentration level for phenanthrene is above the present health base level of .002 ppm for groundwater.

This comment is apparently in reference to Three-Mile Ditch trench soil samples TMD-TR-001-01, 001-02, and 002-01, which yielded TCLP leachate extraction concentrations for *phenanthrene of 0.029, 0.023, and 0.020 mg/L respectively. The reviewer cites a health-based level for phenanthrene in groundwater of 0.002 mg/l and concludes that the TCLP leachate data for phenanthrene extracted from those samples constitutes cause for concern. However, based on the rationale and development of the TCLP, it is abundantly clear that a direct comparison of TCLP extract concentrations with health-based values for groundwater is grossly inappropriate. EPA has established a 100-fold dilution attenuation factor (DAF) in the establishment of maximum allowable concentrations of target constituents in TCLP leachate extracts. The DAF was established by EPA to represent the expected reduction in the concentrations of a constituent during transport through soil and groundwater from the leachate release point to a probabilistic exposure point.*

Phenanthrene is not a target TC constituent and, as EPA acknowledged in the issuance of the final Toxicity Characteristic rule (FR. 55, March 29, 1990), the 100-fold DAF is not necessarily appropriate for other non-TC target constituents. For phenanthrene it is highly probable that the standard 100-fold DAF would represent a highly conservative value, since phenanthrene is a relatively immobile compound exhibiting very low water solubility. However, employing the standard DAF as a conservative default factor for the above-referenced data sets, the observed leachate extract concentrations for phenanthrene are comparable to a worst case groundwater concentration of approximately 0.0002 mg/l - a full order of magnitude less than the health-based limit cited by the reviewer. Therefore, Navajo stands by its general conclusion that the observed TCLP leachate concentrations for semivolatile constituents do not constitute cause for concern. However, in recognition of the fact that the TCLP leachate concentration of phenanthrene in some samples exceeds health-based limits, the last paragraph of page 113 of the report has been modified to indicate that, along with two ditch soil samples which yielded TCLP leachate extracts exhibiting naphthalene above applicable health-based limits for groundwater, three samples also yielded leachate concentrations of phenanthrene in excess of applicable health-based limits for groundwater.

Page 114; Section 9.1.1, 2nd paragraph (11/93 page 124):
Navajo is stating that horizontal contamination of metals above health-based criteria is localized. EPA disagrees. 11 of the 12 trench samples in the 1990 RFI had at least one interval containing a metal above health-based criteria. The Phase II investigation had 0 out of 4. Therefore, a total of 11 out of the 16 trenches, or 69%, which indicates more towards the widespread interpretation vs. the localized.

This comment is identical to that raised in regards to the Executive Summary, 3rd bullet. To reiterate: it would appear that EPA has misconstrued the intent of the statement referring to *the localized nature of elevated levels of various metal constituents. The combined results of the Phase I and Phase II investigations indicate that, when the volume of hydrocarbon-contaminated soils contained within the unit is considered in its totality, areas where an* ***individual metal species*** *is found above applicable health-based numbers are indeed not typically widespread, either in a vertical or horizontal sense.*

For instance, in scoring the rate at which trenches excavated during the Phase I and Phase II investigations exhibit soils with potentially serious metals contamination, EPA tallied the presence of any of the three metals of concern at any sample interval. However, if the incidence of arsenic, chromium and lead in ditch samples that were detected above health-based limits are considered on a per sample interval basis, their individual rates of occurrence are 14/51 (27%); 11/51 (22%); and 6/51 (12%), respectively. Navajo considers this distinction to be critical, since it has implications for the total volume of waste-contaminated soils which may contain potentially hazardous concentrations of those three metal constituents.

Page 114; Section 9.1.1, 3rd paragraph (11/93 page 124):
MW-1 is in the vicinity of the ditch and it also came up with metal contamination (nickel and chromium), as did MW-45 (lead and nickel) and MW-46 (nickel). Furthermore, MW-16 also has chromium below the MCL but elevated levels above background well, MW-17. In addition, the analytical results from MW-21 only gives you the present groundwater chemistry at that location, it does not provide you with the groundwater chemistry at other locations along the ditch.

Navajo continues to believe that evidence of past contamination of groundwater by metals from Three-Mile Ditch is minimal, at best. As stated earlier (Navajo response to EPA review comment for Page 61; bottom of 3rd paragraph), we believe that the levels of nickel and chromium in MW-1 are due to casing corrosion. Results of verification analyses (discussed at Section 8.3.2.4, Groundwater Quality; and Section 9.2.3.2, Groundwater Quality (discussion)) performed for several metals lowered total nickel results for MW-45 to under 0.05 mg/L. No verification analyses was performed for MW-46. More recently, both wells were resampled for the four metals sampled during the Phase II RFI. The results, presented earlier in Table 11, show all levels less than applicable MCLs except for lead which exceeds EPA's action level of 0.015 mg/l for domestic use. MW-16 did not have any detections of chromium at or above the minimum detection level in either Navajo or PRC (EPA contractor) sample results. We agree that the groundwater chemistry has not been evaluated at every point along the 3-mile length of the ditch, but the results of the groundwater sampling plus the soil sampling conducted as *part of the trench investigation makes us confident that metals present in the sediment material as a result of past trench use, do not pose a future threat to the groundwater.*

Page 114; Section 9.1.1, 4th paragraph (11/93 page 124):
Since the Three-Mile Ditch contained nickel and zinc, the Region believes that nickel and zinc could still pose a potential threat, especially for the groundwater. EPA's contractor analyzed wells along the ditch for zinc and detected zinc at .03 to .06 ppm. MW-45 contained .11 ppm zinc in the 1990 sampling results. However, EPA did not require Navajo to sample the groundwater wells for zinc. EPA will require Navajo to monitor the wells along the ditch for nickel.

As discussed in the comment above, nickel is not a problem metal along the ditch except where steel casing corrosion has caused it to enter the environment. Zinc at the levels found by EPA's contractor are approximately 100 - 200 times lower than EPA's health advisories and New Mexico's groundwater standard.

Page 115; Section 9.1.1, top of page (11/93 page 125):
EPA disagrees with the statement, that no evidence exists to indicate nickel contamination. MW-11, MW-46, and 45 had exceedances at the MCL (two were actually above the MCL).

The discussion at the top of this page relates to Three-Mile Ditch and not to the evaporation pond complex; the text referenced in this comment has been modified for clarity. Although MW-11A northeast of the ponds did have high levels of nickel, laboratory problems with nickel and arsenic analyses were experienced during the period of sampling of this and several other wells (documented in Section 8.3.2.4, Groundwater Quality). Although the sample result for this well was above the federal MCL, it was lower than the NM groundwater quality standard and the water sample was not selected for re-analysis. Samples resubmitted for analysis were prioritized based on arsenic values and this sample was not selected because of the low arsenic value and high total dissolved solids content. Navajo will resample the well for metals during the next scheduled sampling event for the evaporation pond monitor wells.

Page 115, Section 9.1.2, 1st paragraph (11/93 page 125):
EPA disagrees that all metal constituents were within normal limits from sediment samples taken from Eagle Creek during Phase I. Sample NEC-SS-004-01 contained lead at 69 ppm, which is about 3 times the background average. Although the Three-Mile Ditch may not be impacting Eagle Creek currently, it is highly likely that over the 50-year history of the ditch, some contaminants from the ditch were released occasionally to Eagle Creek by various mechanisms.

EPA cites data from the Phase I investigation to indicate that Eagle Creek has been impacted by historical operations of Three-Mile Ditch. However, as the Phase II report notes repeatedly, the local watershed for the creek immediately upgradient of Three-Mile Ditch is dominated by the homes, businesses, and streets of the city of Artesia. EPA cites a lead value of 69 mg/kg in creek sediments, adjacent to the unit as indicative of historic releases from the unit. However, a background sediment sample obtained from the creek upgradient of the unit but within the city of Artesia yielded a lead concentration of 92 mg/kg. Based on the available data, it is just as probable that the creek has been impacted by long-term nonpoint source releases from the upgradient urban area. In order to clarify this point, the sentence in question has been revised to state that metal constituent concentrations in a creek sediment sample obtained in the vicinity of the unit were less than those obtained at a representative background location upgradient of the unit, and that there is no evidence to indicate that waste constituents from the unit have exerted an environmental impact on the adjacent Eagle Creek.

Page 116; Section 9.1.3.2 (11/93 page 126):

The Region questions how Navajo can tell that the contamination from MW-45 is most likely coming from a product plume originating from the facility? The Region feels that the ditch has contributed to the contamination in MW-45, since the well is within a few feet of the ditch and the well contained nickel at the MCL. Does Navajo's gasoline or diesel contain nickel? Please clarify in the report.

The issue raised in this comment was previously discussed in Navajo's response to EPA's comments (Page 111, 3rd paragraph; Page 114, 3rd and 4th paragraphs). The level of nickel found in MW-45 during the initial sampling in November 1992 was not replicated by either re-analysis of the sample by Navajo's contractor, or in the analysis of the split sample obtained by EPA's contractor at the time of the initial sampling. Resampling in November 1993 showed nickel at 0.04 mg/L, less than one-half the current MCL. Please refer to RFI Tables 11 and 33 for the analytical data.

Page 118; Section 9.1.3.2.2, 1st paragraph (11/93 page 128):

The analytical results for MW-1 also indicate unidentified hydrocarbon compounds and KWBES & PRC representatives indicated that the well had a hydrocarbon odor. Please explain why Navajo feels that corrosion is occurring in this well versus corrosion not occurring in the wells around the lagoons, which also contain unidentified hydrocarbon compounds.

There are several possible reasons for the apparent lack of corrosion in the stainless steel monitor wells. As stated in the text, the presence of oily materials coating the casing can *prevent the electrochemical reaction from occurring. The groundwater in the vicinity of these wells ponds contained higher concentrations of unidentified hydrocarbons than did the ditch wells. A lack of subsurface oxygen in the vicinity of the plume at the pond may also contribute to the observed reduction in corrosion. Finally, water chemistry differences between the shallow ditch water and the alluvial water at the ponds may be a contributing factor. The exact cause(s) was not determined, but the observed data and comparison between the water constituents and steel composition makes a compelling argument for corrosion.*

The text at this section was modified to include additional possible causes of the corrosion.

Page 118; Section 9.1.3.2.3, Water Chemistry (11/93 page 121):
EPA disagrees with Navajo's interpretations and hypothesis from this section concluding that the Three-Mile Ditch has never contaminated the groundwater. EPA believes that the Three-Mile Ditch has contaminated groundwater along certain portions/parts of the ditch.

EPA has misinterpreted the results and statements presented in this section. The water chemistry section was inserted in an attempt to compare the chemistry of current and past effluent samples with chemistry of groundwater in the vicinity of the Three-Mile Ditch to determine if there was an obvious and/or gross impact on the general water quality from years of discharging to the unlined ditch. The section does not conclude that the ditch has never contaminated groundwater. The thrust of the section is that the water chemistry of the groundwater does not show impacts, and this, combined with the mostly favorable results of organics and metals analyses leads to the conclusion that any current groundwater impacts of past ditch use are minimal. Further, these results together with the results from the soil study and TCLP testing of the waste sediments, do not provide evidence that existing sediments are contributing or will contribute to groundwater degradation in the ditch area.

Notwithstanding the above, one sentence has been modified to make clearer that there are not obvious impacts on the water chemistry of the groundwater from the past use of the ditch.

Page 129; Section 9.2.3.2.3, 3rd paragraph (11/93 page 139):
EPA disagrees with the statement that the Phase II study did not find elevated arsenic levels north and east of pond 2. MW-2, OCD-1, OCD-6, and OCD-7A contained elevated levels of arsenic and have been impacted by pond 2. MW-2A and OCD-1 are north of pond 2; OCD-6 and OCD-7A are east of pond 2.

The paragraph has been modified to clarify that the wells north and east of the pond referred to in the text are OCD-4 and 5, and newly installed wells MW-11A and B. The results of the Phase

II arsenic analysis for these wells are 0.022 mg/L or less. This is compared to the Phase I results of 0.21 and 0.23 mg/l for OCD 4 and 5, respectively. As discussed in the second paragraph on Page 129, arsenic is difficult to analyze in the presence of elevated salts and a Phase I duplicate sample from OCD-4 reported arsenic at 0.005 mg/L.

Page 129; Section 9.2.3.2.3, last paragraph (11/93 page 141):
However, MW-15 did show elevated levels of chromium.

Navajo does not consider a level of 0.03 mg/L of total chromium in monitor well MW-15 to be a problem or even significantly elevated relative to the laboratory detection limit of 0.02 mg/L. Further, the federal MCL is 0.1 mg/L, no chromium was detected in the filtered sample, and EPA's contractor did not detect chromium in a total sample at 0.01 mg/L. Navajo is not denying past use of chromium in refinery processes, nor is it denying the fact that groundwater along the ditch was impacted by past use for over 50 years. What we are asserting is that those practices have not caused major groundwater-related problems in the vicinity of the ditch and that the sediments remaining there have minimal potential to cause future problems. The finding in groundwater along the ditch of only slightly elevated levels of constituents used and discharged in the past is not indicative of a problem, but the absence of one.

Page 131; Section 9.2.3.2.3, 1st paragraph (11/93 page 141):
EPA disagrees with the Navajo statement that elevated chromium is probably a result from the concentration of naturally occurring salts. Effluent data indicate that arsenic, chromium, and nickel are present today and most likely at greater concentration eight years ago. Not only was chromium above the MCL in OCD-3, so was nickel and lead.

The statement in this paragraph related to naturally occurring salts has been removed and the paragraph rewritten. Further review of available data reveals that arsenic, lead and nickel were reported at or below detection levels in the Phase I report (Table 6.15). The value for chromium is missing from the table, but it is not listed in the text as exceeding the then MCL of 0.05 mg/L. TDS in this well is less than that of several other monitor wells sampled for the RFI that did not show such elevated levels. Several samples taken by the OCD over the past several years since well installation in 1988 are not of assistance since all samples analyzed were filtered as required by regulation. Because the RFI results are anomalous compared to earlier analyses, Navajo will agree to resample the well during the next regularly scheduled sampling of monitor wells in the vicinity of the ponds.

Page 131; Section 9.2.3.2.3, 2nd paragraph (11/93 page 141):
Nickel was elevated in seven wells around the lagoons in the 1990 Phase I sampling round, so EPA cannot conclude that nickel is not coming from the lagoons. Furthermore, effluent data in the report indicate that nickel was present in at least one of the sample results. In addition, on page 118, Navajo concludes that corrosion of the stainless steel wells around the pond is reduced, since there is hydrocarbon contamination in most of those wells which "coat" the wells from the groundwater.

Eight monitor wells reported elevated concentrations of nickel above 0.05 mg/L in the Phase I investigation. Concentrations ranged up to 0.13 mg/L in MW-1, but otherwise occurred equally in the steel and PVC wells. An original and duplicate sample for OCD-4 reported nickel values of 0.05 and 0.11 mg/L respectively. It is likely that analytical problems for nickel also occurred during the Phase I study, because wells subject to a verification analysis for the current study were at or below detection levels except for the three stainless steel ditch wells. Not coincidentally, PRC values for resampled wells were undetected at 0.040 except for the three ditch wells. Finally, an unfiltered pond sample taken in November 1992 reported a nickel value of 0.06 mg/L, but it was not subject to a verification analysis. The effluent data reported to be in the Phase 1 report was not found in the copy provided to KWBES. Although sample results are at times contradictory, verification analyses and split sampling with EPA's contractor point towards low nickel values except in the three stainless steel wells previously observed to have problems.

Page 132; Section 9.2.3.2.4, 4th bullet (11/93 page 142):
EPA disagrees with the statement that the deeper well MW-2B does not have organic contamination. The lab analysis indicates that unknown semivolatile hydrocarbon compounds were detected and that the geologic description reported hydrocarbon contamination to 48 ft, therefore, indicating downward contamination.

Navajo agrees that the semivolatile analysis showed evidence of unknown hydrocarbon constituents and has rewritten the paragraph. However, the geologic description did not report that there was hydrocarbon contamination to 48 ft, but that there was an absence of such contamination from 48 - 50 ft. Because of the heaving sands, split spoon samples could not be obtained continuously because the hole would not remain open at depth for retrieval and reinsertion of the sampling tool. With the alternative being the use of a heavy mud to keep the hole open which would make well development and sampling difficult and could have *impacted analytical results, KWBES opted to log the hole from cuttings except for the final 2 ft to determine the presence of any contamination.*

Notwithstanding the presence of unidentified semivolatile constituents, the well was notable by the absence of an obvious hydrocarbon problem that was found in the other deep wells adjacent to the ponds. This led to the examination of vertical gradients and one of the key findings of the investigation.

The words "water chemistry" have been added to the paragraph preceding the bullet sections highlighting our comparisons. Water chemistry was used to attempt comparisons between the various classifications of water found in the area of the evaporation pond in an attempt to understand the physical and chemical actions which will either mitigate or exacerbate the hydrocarbon and inorganic chemical releases from the ponds that have occurred during the past 50 to 60 years.

Page 132; Section 9.2.3.2.4, 6th bullet (11/93 page 155):
EPA questions how Navajo can state that deep well MW-6B appears unaffected when it contains benzene above the MCL and also contains toluene, carbon disulfide, and methyl ethyl ketone. Furthermore, if deeper zoned better quality is supposed to be moving upward, why does the deeper zoned well have higher concentration of contaminants? Please clarify in the revised RFI Report.

Again, the discussion on impacts relates to salt and that word has been added to the paragraph where appropriate to make the interpretation clear. Where evidence of hydrocarbon migration, or lack thereof, is available to support or rebut the hypothesis, it is included in the discussion.

During the time Pond 1 was active, sediments transported down the ditch were deposited in the pond opposite the well and hydrocarbon constituents were moving downward due to the fluid pressure head in the pond. When closed, the downward head was eliminated and the gradient should once again re-establish its upward prominence. However, residual hydrocarbons transported downward when the pond was active remain and are detected during sampling. The zone is apparently undergoing replacement with fresher water and left to itself should undergo natural bioremediation. Figures 18 and 19 show the conceptual model of particle transport including movement of particles from the area of MW-6 when the pond was active. Please note that wells shown on Figure 17 have been projected to a common vertical cross-section for the purpose of 2-dimensional groundwater modeling.

Page 145; Section 9.2.3.2.4, 1st bullet (11/93 page 155, 3rd bullet):
However, well pairs MW-7A and B are contaminated with unidentified hydrocarbon compounds.

Navajo agrees that unidentified hydrocarbons were found in the well. The intent of the paragraph is to explain why the wells have salt impacts (and unidentified hydrocarbons) but show no target compounds. Reference to Figure 19 also will assist in the interpretation.

Page 145; Section 9.2.3.2.4, 3rd bullet (11/93 page 155, 6th bullet):
MW-22B (the deeper zoned well) is contaminated with unidentified hydrocarbon compounds.

The paragraph has been modified to include these impacts. In the absence of other information, these impacts can be postulated from the particle flow map shown in Figure 19.

Page 146; Section 9.2.3.2.4 (11/93 page 156):
Navajo has not included a section in the RFI Report describing the hydrocarbon contamination in wells across the Pecos River. Please include a section on this.

A section describing the hydrocarbon contamination in wells across the river was presented in Section 8.3.2.4 and a discussion of the hydrologic mechanisms that allow it to occur are given in Section 8.3.3.2.

Page 147; Section 10.1, Conclusions, Three-Mile Ditch (11/93 page 157):
Navajo makes the statement that organic constituents found in the ditch do not pose a likelihood for significant contamination to the groundwater. Please clarify what Navajo means by significant levels (below MCL, 2 times the MCL, 100 times the MCL, etc.)

The sentence has been revised to indicate that in the context of the sentence under consideration, the term "significant" refers to the release of waste constituents in quantities which would result in groundwater concentrations in excess of conservatively estimated and applicable health-based levels.

Page 147; Section 10.1, 1st bullet (11/93 page 157):
EPA believes this assumption may be true when:

1. Wastes are not in contact with the groundwater or within the fluctuating zone of the groundwater;
2. Water is not ponded, drained, or flooded upon the unit;
3. Aeration of the waste in the unit can occur.

However, EPA does not see these factors occurring along all points of the ditch.

A total of five trenches have been excavated along the ditch where it has been determined that the waste-impacted soil profile is either in contact or in close proximity to the shallow groundwater. These trenches include: Phase I investigation trenches NMD-TR-004, 005 and 009; and Phase II investigation trenches TMD-TR-001 and TMD-TR-004. The attached Table 1 summarizes environmental conditions at or near the water table at those locations, as assessed by soil sample analyses.

As the table shows, at those locations where unit soils were sampled at or near the groundwater, levels of hydrocarbon contaminants were either below detection limits or so low as to pose little possibility that those soils could function as a source for the release of desorbed hydrocarbon constituents to groundwater at concentrations which would not quickly be attenuated and/or degraded. Similarly, metal concentrations were either highly similar to background values at these locations or only slightly elevated relative to background. There is no evidence to indicate that unit soils in proximity or contact with groundwater contain hazardous metal constituents at concentrations which could potentially impact adjacent shallow groundwater.

The reviewer appears to imply that TCLP evaluation is inappropriate to assess the potential risk to groundwater posed by some of the samples from wastes which may be transient or continuously in contact with groundwater. However, an evaluation of the history of development and applicability of the Toxicity Characteristic rule indicates that this assumption is inaccurate. TCLP maximum allowable concentrations were developed on the basis of a massive fate and transport modeling effort which incorporated both unsaturated zone and saturated zone phases. Model inputs utilized real-world distributions for parameter values (subsurface hydraulic properties, soil types, climate regimes, etc.), and a Monte Carlo simulation allowed the results to be presented as a cumulative frequency distribution for many thousands of model runs. In the establishment of TCLP concentration-based limits, major conservative assumptions of the modeling effort included:

- *steady state source conditions (e.g., infinite contaminant source for constituents of concern);*
- *chemical transport is steady in the vertical direction in the unsaturated zone, and lateral and transverse movement of the chemical is negligible; and,*
- *no occurrence of biodegradation.*

As a condition of the RFI Phase II investigation, EPA required that TCLP analyses be conducted on all soil samples collected from the unit, and Navajo has been given no reason to doubt EPA's confidence in the utility of the test.

In summary, EPA has explicitly adopted the position that contaminated soils within the unit that are proximal to, or in contact with, groundwater will act as a source for the release of contaminants to the groundwater. Navajo respectfully notes that EPA has produced no relevant environmental data to support this position. Instead, a preponderance of the investigative evidence obtained to date points to the opposite conclusion, which is stated in the 1st and 3rd bullet of page 147 (new page 157) of the RFI Phase II report.

The current status of unit soils within the ditch must be judged on the basis of current observations and data obtained from the trench investigations. The environmental quality of shallow groundwater adjacent to the ditch results from decades of prior operations which have now ceased. The existing groundwater conditions in the vicinity of the unit have no bearing on the potential for soils within the unit to act as a source for ongoing or future releases of waste constituents.

Page 147; Section 10.1, 2nd bullet (11/93 page 157):
EPA believes that biodegradation will be much slower when 2-3 ft of surface soil is overlaying the original waste in the unit.

Navajo concurs with the reviewer's observation, but it in no way diminishes the validity of the statement in question.

Page 147; Section 10.1, 3rd bullet (11/93 page 157):
EPA disagrees if Navajo is stating that horizontal contamination (lengthwise along the ditch) of metals is localized. 11 of the 12 trench samples in the 1990 RFI had at least one interval containing a metal above health-based criteria. The Phase II investigation had 0 out of 4. Therefore, a total of 11 out of 16, or 69%, which indicates more towards the widespread interpretation vs. the localized.

This comment has been previously discussed twice in the response to comments referring to Page 114; 2nd paragraph, and the Executive Summary, 3rd bullet.

Page 147; Section 10.1, 5th bullet (11/93 page 157):

EPA disagrees that there is a lack of credible evidence for nickel in some of the groundwaters along the Three-Mile Ditch. MW-45 and MW-46 are at or above the MCL for nickel and were near MCL levels in the 1990 sampling event.

This comment was previously discussed in Navajo's response to EPA's review comments for Page 114; 3rd paragraph. The verification analyses performed at the time of the RFI and the recently completed resampling of wells MW-45 and MW-46 show that nickel is not a constituent of concern in the groundwater.

Page 147; Section 10.1, 6th bullet (11/93 page 157):

Although there may have been an absence of listed RCRA volatile and semivolatile compounds, there are tentatively identified volatile and semivolatile compounds, in at least three of the wells along the Three-Mile Ditch.

The 6th bullet of Page 147 has been revised to indicate that no Appendix VIII hazardous volatile or semivolatile constituents were detected in groundwater samples collected in the vicinity of the ditch.

Page 147; Section 10.1, 7th bullet (11/93 page 157):

The Phase II sampling event proved that the excessive levels of nickel and chromium found in MW-8 and MW-9 were due to corrosion of the stainless steel. It did not prove that other wells along the ditch with elevated metals were corroding. However, newly installed well MW-16 did contain chromium elevated above background levels at .03 ppm.

This was previously discussed in Navajo's response to the EPA review comment found at page 114, 3rd paragraph. Except in the steel casings, when found in groundwater, chromium was measured at levels barely above the detection level of 0.02 mg/L and 3 - 4 times lower than the MCL of 0.1 mg/L. After review of this information, and the verification and resampling analyses for nickel, Navajo believes the statement remains valid.

Page 147; Section 10.1, 8th bullet (11/93 page 157):

From reviewing the four piezometer data points, the localized flow around the ditch appears to be in a northeast direction. EPA cannot reach a conclusive decision on the flow locally near the ditch on the results of this data. Please clarify in the revised RFI Report.

Revised groundwater maps presented in Figures 5A and 5B clarify the movement of groundwater eastward from the refinery to the vicinity of the river. The word "generally" is *added to the first line of this paragraph since the gradient turns southward approaching the river and is subject to small fluctuations due to localized changes in lithology, and surface topography. In the vicinity of Bolton Road, Eagle Creek appears, and was observed, to receive groundwater flow while nearer the river, it appears to recharge the alluvium during times when water is present.*

Page 148; Section 10.1, 1st bullet (11/93 page 158):
EPA disagrees that all metal constituents were within normal limits from sediment samples taken from Eagle Creek during Phase I. Sample NEC-SD-003-01, contained lead at 69 ppm, which would be about 5 times higher than background. Another sediment sample, NED-SD-003-01, contained lead at 38 ppm, which is about 3 times the background average. Although the Three-Mile Ditch may not be impacting Eagle Creek currently, it is highly likely that over the 50-year history of the ditch, some contaminants from the ditch were released occasionally to Eagle Creek.

This comment has been previously discussed in the response to the comments referring to Page 115; 1st paragraph.

Page 148; Section 10.1, 4th bullet (11/93 page 158):
The graphical technique may not have indicated a mixture of effluent waters with groundwaters of the Three-Mile Ditch; however, well logs, trenches, and sampling results indicate waste from the ditch has contacted the groundwater at certain locations along the ditch.

This paragraph has been modified to reflect the comments made in response to the EPA review comment found at Page 118, Water Chemistry.

The reviewers comment would appear to be valid. However, it is not relevant to the statement in question. The intent of the statement is to indicate that the available evidence demonstrates that shallow groundwater in the vicinity of the ditch is not hydrologically connected with groundwater obtained from several wells located closest to the ditch which are currently being utilized for domestic purposes.

Page 148; Section 10.1, 1st paragraph (11/93 page 158):
EPA disagrees that waste materials within the Three-Mile Ditch have no potential to migrate from the unit.

This issue has been addressed repeatedly throughout this response to EPA's comments on the RFI Phase II document. Navajo's position on this issue may be summarized as follows:

- *Volatile organic constituents, which comprise the most mobile hazardous constituents in soils of the unit, are generally present only at trace levels. Volatile constituents in unit soils represent an extremely limited source of contaminants which will be released to groundwater in such small quantities that attenuation and degradation will effectively eliminate any deleterious impact on the groundwater.*
- *Some semivolatile organic constituents are present at concentrations which could be construed to pose an environmental risk, based on direct, long-term exposure. However, as was the case for volatile constituents, the semivolatiles should not pose a threat to groundwater contamination. Semivolatiles exhibit very low water solubility and typically remain highly sorbed to soil/organic matter matrices. No evidence has been obtained to indicate that semivolatile contaminants within or below the phreatic zone are present at concentrations which could result in the release of detectable quantities of those constituents (see the attached Table 1).*
- *The unit soils data compiled to-date do not indicate the presence of excessively high concentrations of metal constituents adjacent to the shallow groundwater. Further, a large body of literature and experience dealing with the fate and transport of metal constituents present in high clay content, high pH soils such as those found within the unit, suggest that the migration and release of metal constituents to groundwater is highly unlikely, particularly under the prevailing semi-arid conditions in the vicinity of Artesia, New Mexico.*
- *Existing monitoring data indicating low level metals and hydrocarbon contamination of the shallow groundwater adjacent to the unit does not constitute evidence of either an ongoing or future release of such contaminants from unit soils. Rather the observed groundwater conditions are readily accounted for as the long-term effects of many decades of prior unit operations.*

Page 148; Section 10.1, last paragraph (11/93 page 159):

EPA disagrees with Navajo's logic that if you remove wastes from the Three-Mile Ditch and spread the out in closed lagoon no. 1 that a greater potential for exposure to environmental receptors will be increased. The potential should be the same as present.

Navajo is confident that EPA is in agreement that some portions of the Three-Mile Ditch unit soils exhibit concentrations of various organic and inorganic constituents which exceed reliable health-based numbers for an acceptable level of risk, based on direct exposure to the *soil via consumption, inhalation, and dermal exposure. Currently, unit soils are inaccessible to direct contact by human or ecological receptors, and there is no reason to believe that:*

- *Contaminants will be released in detectable quantities to adjacent groundwater; or*
- *The groundwater would serve as a contaminant exposure pathway for either human or environmental receptors even in the event that the groundwater in question was to be impacted by large contaminant releases from the unit.*

Navajo is unable to discern how unit soils can be excavated, transported for distances as far as several miles, and spread over a 15-acre surface area without any potential for exposure to human and other environmental receptors, as is the case under current conditions at the undisturbed unit.

Page 149; Section 10.1, 1st paragraph (11/93 page 159):
EPA believes that it will be more cost effective and will reduce groundwater contamination by removing areas along the ditch where the unit is within or near the groundwater. The costs of more wells and long-term monitoring will be more expensive and still not guarantee that contamination will not occur.

Navajo submits that the potential impact of unit soils on current and future quality of the underlying shallow groundwater conditions has been sufficiently addressed at numerous points throughout this document, and that neither long term monitoring nor excavation are warranted based on the results of this study.

Page 150; Section 10.2.2, 1st paragraph (11/93 page 160):
Please clarify in the revised RFI Report which well around the evaporation ponds had corrosion of the stainless steel casing. Although Navajo interprets contamination of groundwater as minor when the concentration only exceed the MCL by 4 times, EPA considers this concentration level sufficient to require a CMS.

Although all evidence points to corrosion of MW-1 as a cause for the elevated level of chromium and nickel in that well, the word "probable" was added to that sentence because a replacement well has not been installed. The latter portion of the paragraph has been rewritten to compare the length of time of pond operation, waste types, and concentrations to the magnitude of contamination found at the site.

Page 150; Section 10.2.2, Groundwater (11/93 page 160):
There is no explanation in this section for the groundwater wells across the Pecos River being contaminated. Please include this discussion in this section.

A section describing the hydrocarbon contamination in wells across the river was presented in Section 8.3.2.4 and a discussion of the hydrologic mechanisms that allow it to occur are given in Section 8.3.3.2. An additional "bullet" is included in this section summarizing the occurrence.

Page 151; Section 10.2.2, 7th bullet (11/93 page 161, bullet 9):
EPA disagrees that there was a significant upward vertical gradient and that there has been no downward contamination.

The statement in this paragraph does not state that there has been no downward migration, but that such migration is limited by naturally occurring hydrologic conditions that are identifiable and measurable, and sufficiently significant so that estimates of movement and travel distance in the subsurface can be established that fit the data and observations collected at the site.

Page 152; Section 10.2.2, 1st bullet (11/93 page 162, bullet 5):
EPA does not consider contaminating an aquifer 40 ft in depth to be limited downward migration.

The paragraph referenced here presents a summary of the total effect of the system hydrologic characteristics on groundwater movement in the vicinity of the ponds. A minor change to the paragraph has eliminated the word "only".

Page 152; Section 10.2.2, 3rd bullet (11/93 page 162, bullet 8):
Well logs and groundwater results indicate hydrocarbon contamination in deep well MW-2B.

Navajo agrees that the semivolatile analysis for MW-2B shows unidentifiable hydrocarbons and the text of this paragraph has been changed to reflect this. However, the north side deep wells have water and contaminant characteristics different from wells on the south side which support the groundwater modeling results.

Page 152; Section 10.2.2, last paragraph (11/93 page 162):
EPA agrees with the recommendation of Navajo pertaining to monitoring and measuring, but disagrees with continued effluent disposal in operating pond no. 2. EPA also recommends that a CMS be performed on pond no. 2.

Navajo will defer a decision on performing a Corrective Measures Study (CMS) until further discussions are held between Navajo and EPA. However, based on the information provided in the RFI report, Navajo believes such a study is unnecessary.

Response to RFI Phase II comment regarding page 147; 1st bullet.

Table 1. Observation and data summary for trenches in proximity to groundwater.

Location	NMD-TR-004
Sample No.	NMD-TR-004-03
Sample Depth	approx. 4.5 ft.
Sample Interval Description	base of visually contaminated soils approx. 1.5 ft. above water table
Analytical Summary (a)	
Total VOAs	ND
Total SemiVOAs	2 phthalate detections
Metals	at or near background levels
Location	NMD-TR-004
Sample No.	NMD-TR-004-04
Sample Depth	approx. 6.0 ft.
Sample Interval Description	visually clean soils at the water table
Analytical Summary (a)	
Total VOAs	ND
Total SemiVOAs	ND
Metals	at or near background levels
Location	NMD-TR-005
Sample No.	NMD-TR-005-03
Sample Depth	approx. 6.5 ft.
Sample Interval Description	visually contaminated soils slightly below water table
Analytical Summary (a)	
Total VOAs	toluene, ethylbenzene, xylene: max = xylene at 2.5 mg/kg
Total SemiVOAs	6 detections: max = phenanthrene at 6.7 mg/kg
Metals	background levels
Location	NMD-TR-009
Sample No.	NMD-TR-009-03
Sample Depth	approx. 5.5 ft.
Sample Interval Description	visually contaminated soils approx. 1.5 ft. above water table
Analytical Summary (a)	
Total VOAs	ND
Total SemiVOAs	1 phthalate
Metals	background levels
Location	NMD-TR-009
Sample No.	NMD-TR-009-04
Sample Depth	approx. 6.5 ft.
Sample Interval Description	visually contaminated soils at the water table
Analytical Summary (a)	
Total VOAs	ND
Total SemiVOAs	ND
Metals	background levels

a — no TCLP analyses conducted on RFI Phase I soil samples
ND — Not detected
NA — Not analyzed

Table 1. Continued.

Location	TMD-TR-001
Sample No.	TMD-TR-001-03
Sample Depth	approx. 15 ft. below level surface
Sample Interval Description	clean soils at the water table
Analytical Summary (Navajo // PRC)	
Total VOAs	ND // NA
Total SemiVOAs	ND // NA
Metals	at or near background levels // NA
TCLP VOAs	ND // NA
TCLP SemiVOAs	ND // NA
TCLP Metals	Ba at 0.6 mg/L // NA
Location	TMD-TR-004
Sample No.	TMD-TR-004-02
Sample Depth	approx. 6.5 ft.
Sample Interval Description	visually contaminated soils at the water table
Analytical Summary (Navajo // PRC)	
Total VOAs	acetone at 0.035 mg/kg // 2-butanone at 0.015 mg/kg
Total SemiVOAs	1 phthalate // ND
Metals	background levels // background levels
TCLP VOAs	ND // ND
TCLP SemiVOAs	ND // ND
TCLP Metals	As at 0.006 mg/L, Ba at 0.7 mg/L // ND
Location	TMD-TR-004
Sample No.	TMD-TR-004-03
Sample Depth	approx. 8.5 ft.
Sample Interval Description	visually clean soils 2 ft. below water table
Analytical Summary (Navajo // PRC)	
Total VOAs	methylene chloride at 0.245 mg / kg // toluene at 0.002 mg/kg (est.)
Total SemiVOAs	1 phthalate at 1.9 mg/kg // ND
Metals	background levels // background levels
TCLP VOAs	ND // NA
TCLP Semi VOAs	ND // NA
TCLP Metals	As at 0.021 mg/L, Ba at 0.6 mg/L, Se at 0.027 mg/L // NA

a — no TCLP analyses conducted on RFI Phase I soil samples
ND — Not detected
NA — Not analyzed