GW - 28

REPORTS

YEAR(S):

1996

VOLUME III
RCRA FACILITY INVESTIGATION
THREE-MILE DITCH & EVAPORATION PONDS
PHASE III REPORT
(Revised)
NAVAJO REFINERY
ARTESIA, NEW MEXICO

prepared for

Navajo Refining Company
501 East Main Street
Artesia, New Mexico 88210

January 1996

INSTRUCTIONS FOR UPDATING THE NAVAJO REFINERY THREE MILE DITCH & EVAPORATION PONDS RFI PHASE III REPORT

This revised report, dated January, 1996, is the second revision of the April 1995 document and responds to EPA's November 22, 1995 Report Deficiency Comments with additional text and appendices. The new Volume III notebook contains all changes to be made to the report. Only relevant sections are revised, and the updated material is arranged for easy replacement including pre-punched pages. This guide will assist in replacing and adding the new material. All new replacement pages are dated January 10, 1995 in the lower right-hand corner, except for some pages in Chapter 5 which received only reformatting.

VOLUME I

1. Replace notebook front cover and side sheets with updated sheets provided in the clear sheet protector (found in the front of Volume III).
2. Add Navajo Refining January 10, 1996, cover letter and "Certification Statement", together with January Attachment 1 which responds to the 11/22/95 EPA comments.
3. Replace inside cover sheet, and existing "Table of Contents" with updated material.
4. Remove pages **4-56** through **4-60** and insert replacement pages **4-56** through **4-61**.
5. Remove pages **5-1** through **5-5** and insert replacement pages **5-1** through **5-6**.

VOLUME II

1. Replace notebook front cover sheet and side sheets with updated sheets provided in the clear sheet protector (found in the front of Volume III).
2. Remove Appendix G and hold for insertion in Volume III.

VOLUME III

1. Insert Appendix G behind tab "G".
2. New Appendices H and I are already included in the Volume III notebook.
3. Remove and discard sheet protector in the front of this volume.

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Navajo **REFINING COMPANY**

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January 10, 1996

Mr. Rich Mayer, Environmental Engineer
RCRA Permits Branch
U.S. Environmental Protection Agency
1445 Ross Avenue, Suite 1200
Dallas, Texas 75202-2733

Re: Transmittal of Revised RFI Phase III Report, Three-Mile Ditch and Evaporation Ponds, Navajo Refinery, Artesia, New Mexico, January 1996

Dear Mr. Mayer:

Enclosed please find revisions to the "October 1995 Revised RFI Phase III Report" which are submitted in response to the EPA's November 22 deficiency comments for the cited report. The Phase III report originally was submitted to EPA in April 1995 with updated and revised sections transmitted to EPA in October 1995. The revisions in the current submittal include proposals for additional sampling of existing groundwater monitor wells in the vicinity of the evaporation ponds, and for surface water and sediment monitoring of the Pecos River during the period the evaporation ponds remain active.

In addition, in response to EPA's comments, we have prepared a groundwater risk assessment analysis for a scenario where livestock drink the groundwater. The resulting document shows no significant risk would be incurred by livestock consuming water containing organic or inorganic constituents with the possible exception of arsenic. Even in the case of arsenic, however, there is a strong reason for believing that there is no sufficient risk. This is discussed in detail in the risk analysis report included with this submittal, and is briefly summarized in the following paragraph.

Historic data indicate that samples have on occasion exceeded water quality criteria for arsenic in water consumed by livestock. However, as a result of the RFI investigations, it has been determined that arsenic concentrations in the vicinity of the evaporation ponds are directly related to the turbidity of the samples. RFI samples obtained in 1995 have been collected using techniques to greatly reduce turbidity and the resultant analyses have showed up to a ten-fold arsenic reduction compared to earlier samples. The current results show groundwater concentrations that are approximately 25 percent of the most conservative recommended livestock standard for arsenic. Therefore, we believe that earlier data indicating possible risks are artificial, and that there is in fact no significant risk.

An Independent Refinery Serving . . . NEW MEXICO • ARIZONA • WEST TEXAS

Because the report revisions are again minor in nature, the large two-volume report was not reproduced, but revised sections are provided for insertion in the document. New title pages, cover sheets, and appendix dividers are also included for insertion in the notebook binders containing the original document.

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

Sincerely,

Phillip L. Youngblood
Director of Environmental Affairs

PLY/te

encl.

CERTIFICATION STATEMENT

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Phillip L. Youngblood
Phillip L. Youngblood
Director of Environmental Affairs

1-10-96
Date

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

NOV 22 1995

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

Phillip L. Youngblood
Director of Environmental Affairs
Navajo Refining Company
501 E. Main Street
Artesia, New Mexico 88210

RE: RFI Phase III Report Deficiency Comments

Dear Mr. Youngblood:

The Environmental Protection Agency (EPA) has completed a technical review of the RFI Phase III Report received October 3, 1995, and has determined that the Report is deficient. Enclosed is a list of deficiencies for your review. Regarding the Soil Removal Workplan, EPA will issue a separate letter.

A revised RFI Report addressing the enclosed comments must be submitted to EPA by December 31, 1995. If you have any questions, please contact Mr. Rich Mayer of my staff at (214) 665-7442.

Sincerely yours,

David Neleigh, Section Chief
New Mexico-Federal Facilities

Enclosure

cc: Mr. Benito Garcia,
New Mexico Environment Department
Mr. Dave Boyer,
LATA

NOD Comments on Navajo Refining's RFI Phase III Report

General Comment: Please provide in the revised Report the name, address, and telephone numbers of all "offsite" property owners in which the three mile ditch is located. Also, please provide a map showing the location of all property owners in respect to the ditch. EPA will require that Navajo notify (by certified mail) each property owner of the contamination (soil and groundwater) on their property from the ditch and from the evaporation ponds. Also, Navajo will be required to place a notification in the property owners deed describing the contamination and a survey of the ditch locating the contamination. EPA will also require that Navajo provide a written notice to the New Mexico State Engineering office describing and locating the areas of groundwater contamination from the evaporation ponds and three mile ditch.

Page 3-22; 1st paragraph: Navajo mentions that benzene was detected in MW-15 at 15 ppb in November and 13 ppb in January. Please include the PID well readings and any readings on the purged water in the revised Report. The log description performed from the phase II report indicated hydrocarbon contamination.

Page 3-34; Future Groundwater Monitoring: EPA will review the monitoring information after the five year period and will determine whether continued monitoring is needed.

Page 4-59; Future Groundwater Monitoring: EPA believes that semiannual monitoring should be performed as long as the ponds remain open. After closure, Navajo may go to annual monitoring, provided that the current contamination characteristics remain the same or have improved. EPA believes that all groundwater monitoring wells should be monitored for semivolatiles. Also, OCD 5 should be monitored for volatiles and semivolatiles. Since the closure monitoring requirements are being rolled into the RFI, discontinuance of groundwater monitoring after five years is unlikely. However, reviewing the data to modify future groundwater monitoring requirements is reasonable. Please modify in the revised Report.

Page 4-59; Groundwater Risk Assessment: Navajo needs to include in the revised report a risk assessment analysis on a scenario where livestock (such as cattle or horses) drink the groundwater.

Page 5-5; Results and Discussion: Navajo needs to include in the revised report a surface water and monitoring plan for the Pecos surface water and sediments.

ATTACHMENT 1

RESPONSE TO NOVEMBER 22, 1995 EPA REGION 6 DEFICIENCY COMMENTS ON THE OCTOBER 1995 REVISED RFI PHASE III REPORT FOR THREE-MILE DITCH AND EVAPORATION PONDS
NAVAJO REFINING COMPANY
ARTESIA, NEW MEXICO

GENERAL COMMENT:

Please provide in the revised Report the name, address, and telephone numbers of all "offsite" property owners in which the three mile ditch is located. Also, please provide a map showing the location of all property owners in respect to the ditch. EPA will require that Navajo notify (by certified mail) each property owner of the contamination (soil and groundwater) on their property from the ditch and from the evaporation ponds. Also, Navajo will be required to place a notification in the property owners deed describing the contamination and a survey of the ditch locating the contamination. EPA will also require that Navajo provide a written notice to the New Mexico State Engineering office describing and locating the areas of groundwater contamination from the evaporation ponds and three mile ditch.

RESPONSE:

The RFI Phase III report has been modified to include the name, address, and telephone numbers of the owners of all "offsite" property through which the Three-Mile Ditch passes. This information is presented in *Appendix I* of the revised report. This appendix also includes a figure indicating the property boundaries of all affected property owners with respect to the ditch. Navajo has noted and will comply with the requirement that each property owner along the ditch be notified by Navajo of the status of environmental conditions on their property. A sample letter will be included with the revised Soil Removal Plan which is to be submitted to EPA by January 31, 1996.

Subsequent to telephone conference discussions between representatives of Navajo and EPA Region 6, EPA agrees that Navajo is unlikely to possess the legal authority to execute the attachment of a notice or other documentation to the legal property deed of a separate private entity. Consequently, EPA has agreed that the requirement for deed notification attachment cited in the General Comment is suspended until further notice.

At the time of the aforementioned discussions, Navajo noted that, for purposes of the RCRA post-closure notification requirements set forth at 40 CFR 264.116, Eddy County regulates local land use outside the City of Artesia and the New Mexico State Engineer Office holds legal jurisdiction over groundwater appropriation and use. Therefore, Navajo will file notification with both Eddy County and the State Engineer Office no later than the time of closure of the ponds. For the purpose of this filing, closure of the pond system will be considered complete when all ponds are deactivated and de-watered, verification sampling is initiated, and an associated Certification of Closure notification is submitted by Navajo to the EPA Regional Administrator, in accordance with the requirements of 40 CFR 264.115. The required notification to the Eddy County and the State Engineer office will conform with all applicable scheduling and information requirements specified at 40 CFR 264.116.

COMMENT:

Page 3-22; 1st paragraph: Navajo mentions that benzene was detected in MW-15 at 15 ppb in November and 13 ppb in January. Please include the PID well readings and any readings on the purged water in the revised Report. The log description performed from the phase II report indicated hydrocarbon contamination.

RESPONSE:

No additional instrument readings are available for this well. The boring log completed during well installation in January 1993 does not show PID data, but a hydrocarbon odor was noted in core samples starting at nine feet. As detailed in the discussion on page 3-22 of the Phase III report, benzene was detected only in the November 1994 and January 1995 samplings by Navajo's contract laboratory and not in two subsequent samplings in February and June 1995 by Navajo, nor in the November sampling by EPA's contractor, PRC. The two detections were not accompanied by the other BTEX hydrocarbons usually associated with waste petroleum constituents leading to speculation that the result was a false positive by the laboratory. Because no additional information is available the report text at this section has not been modified.

Due to the proximity of this well to the inlet for Pond 1, it is scheduled to be sampled semi-annually during the period the remaining active evaporation ponds are in use and annually during the following five-year period. At that time, a subsequent monitoring schedule for this and the other monitor wells will be determined after review of cumulative data and trends. The report text has been modified in Section 4.6 to reflect that the well will be sampled semi-annually.

COMMENT:

Page 3-34; Future Groundwater Monitoring: EPA will review the monitoring information after the five year period and will determine whether continued monitoring is needed.

RESPONSE:

This comment concerns the groundwater monitoring program being conducted in monitor wells installed adjacent to Three-Mile Ditch. The EPA comment is noted and no further response by Navajo is necessary.

COMMENT:

Page 4-59; Future Groundwater Monitoring:* *EPA believes that semiannual monitoring should be performed as long as the ponds remain open. After closure, Navajo may go to annual monitoring, provided that the current contamination characteristics remain the same or have improved. EPA believes that all groundwater monitoring wells should be monitored for volatiles and semivolatiles. Also, OCD 5 should be monitored for volatiles and semivolatiles. Since the closure monitoring requirements are being rolled into the RFI, discontinuance of groundwater monitoring after five years is unlikely. However, reviewing the data to modify future groundwater monitoring requirements is reasonable. Please modify in the revised report.

RESPONSE:

Navajo is currently performing semi-annual sampling of groundwater in the vicinity of the evaporation ponds under a schedule approved in 1991 by the New Mexico Oil Conservation Division (NMOCD) as a condition of Ground Water Discharge Plan approval. The current schedule requires sampling of adjacent monitoring wells surrounding the ponds either in the spring or fall of each year. Additionally, existing monitor wells downgradient from inactive evaporation Ponds 1 and 2 that historically have detected releases of organic constituents from these ponds have been sampled semi-annually. The result of this sampling regimen is that groundwater is effectively monitored twice yearly immediately adjacent to the active and inactive ponds.

Following discussion with Rich Mayer of EPA Region VI on December 7, 1995, Navajo is proposing to modify the current schedule to increase monitoring beyond what was proposed in the October, 1995 RFI document. As shown in the attached table (reproduced as Table 4-11 in the revised text), beginning in 1986 the sampling frequency will continue to generally follow the NMOCD-approved discharge plan schedule, but sampling of RFI-installed wells adjacent to and downgradient from ponds 1 and 2 will be performed twice yearly during the period the remaining ponds are active. For a five-year period following the end of active pond use, monitor well sampling will be performed annually.

Specific monitoring requirements (including wells to be sampled, sampling frequency, and constituents to be analyzed) subsequent to the five-year period are to be determined after review of cumulative data and trends, and consultation between Navajo and U.S. EPA and/or state RCRA staff. However, since groundwater conditions are expected to improve following cessation of active pond use, Navajo intends to propose decreasing sample frequencies and/or constituents during the remainder of post-closure monitoring. For example, Navajo may propose to sample wells every two years during the following five-year period, and further decrease sample frequencies during subsequent five-year intervals.

The report text at Section 4.6 has been revised to incorporate the monitoring plan discussion presented above.

COMMENT:

Page 4-59; Groundwater Risk Assessment: Navajo needs to include in the revised report a risk assessment analysis on a scenario where livestock (such as cattle or horses) drink the groundwater.

RESPONSE:

The RFI Phase III report has been revised to incorporate the required groundwater risk assessment analysis for livestock, which is presented as *Appendix H* of the revised report.

COMMENT:

Page 5-5; Results and Discussion: Navajo needs to include in the revised report a surface water and monitoring plan for the Pecos surface water and sediments.

RESPONSE:

During the active status of the evaporation ponds, Navajo proposes to perform river surface water and sediment sampling once yearly at one upgradient and one downgradient location adjacent to the ponds. The upgradient location will be at the same location (NPR-RW-1 and NPR-SD-1, Figure 5-1, RFI Phase III report) as the upgradient samples collected for the Phase III study. An upgradient sample will provide a control in the event river water or sediment has been impacted by non-Navajo sources. The downgradient water and sediment samples will be collected in the vicinity of NPR-SD-4, but slightly upstream from that location to avoid any inadvertent impact from sediment disturbance due to cattle crossing the river or from the nearby buried pipeline. The report text at Section 5.3 has been revised to incorporate the proposed monitoring.

RCRA FACILITY INVESTIGATION
THREE-MILE DITCH & EVAPORATION PONDS
PHASE III REPORT
(Revised)

prepared for

Navajo Refining Company
Artesia, New Mexico

by

Los Alamos Technical Associates

January 1996

David G. Boyer
David G. Boyer
Project Manager

Brian P. Sullivan
Brian P. Sullivan
Assistant Project Manager

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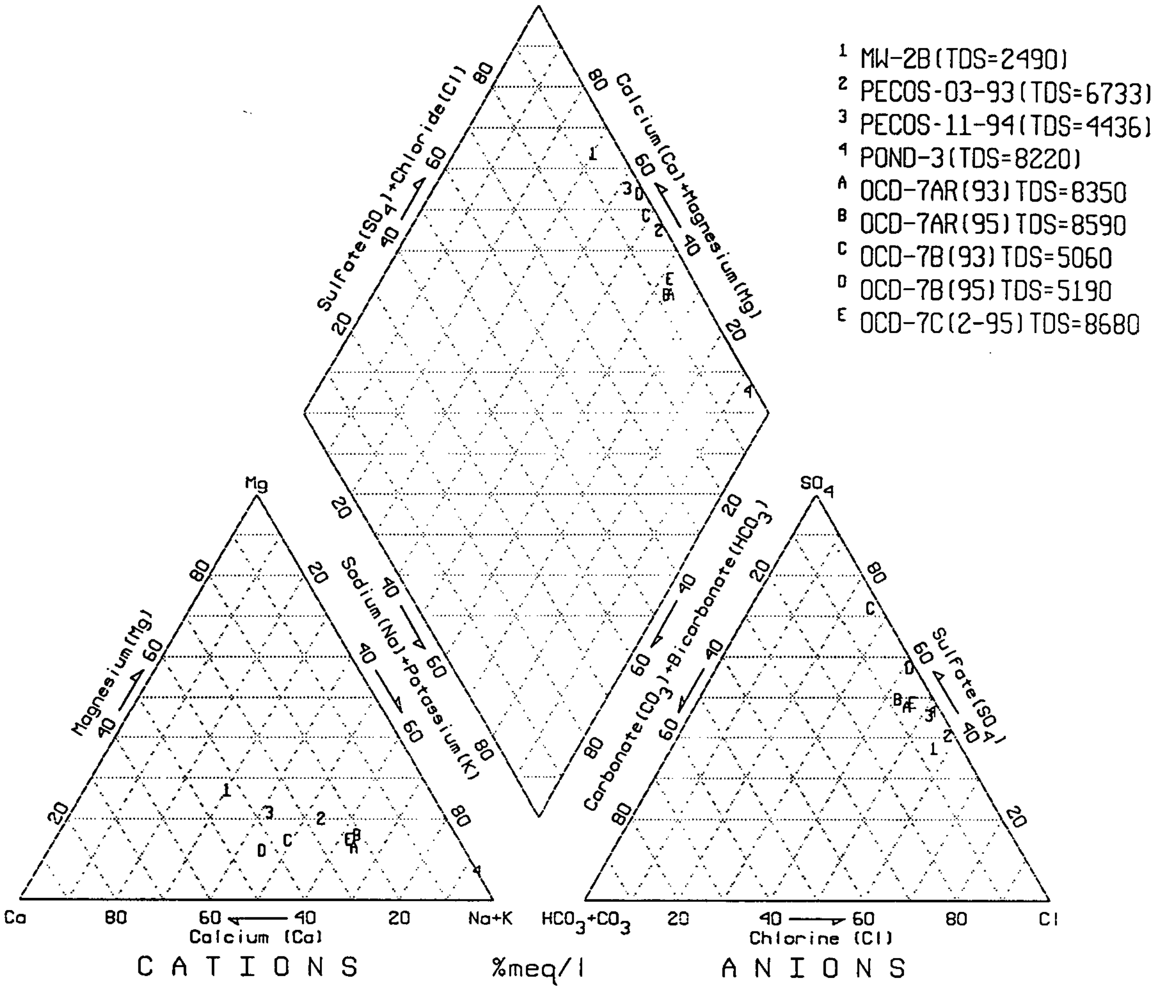
- OCD-7AR and OCD-7B are located within 50 feet of Pond 3 with OCD-7AR showing continued impact by pond salts during the 1993-1995 period (Figure 4-15). Water in OCD-7B has remained approximately the same composition although the chloride composition has increased. Water in new well OCD-7C is almost identical in composition to water in OCD-7AR, even though arsenic levels differ significantly. Because of the chemistry similarities, water from the OCD-7AR zone likely was transported downwards during drilling and associated well development. Based on the lack of arsenic seen in intermediate well OCD-7B, it can be predicted that OCD-7C will stabilize unless artificially created vertical pathways remain available for direct fluid transport.

- OCD-8A appears slightly impacted by the pond, but OCD-8B does not (Figure 4-16). Although downgradient from the pond, no sign of any arsenic or other metal impact is seen in OCD-8B. The deep water has the characteristics seen in MW-2B and MW-18B. No significant changes in water quality were observed between 1993 and 1995.

The preceding information on water characteristics was derived from examination of the trilinear diagrams and used to verify the reasonableness of the groundwater flow model and examine changes in the water quality composition of the groundwater. Because the mathematical flow model is used to duplicate existing flow conditions, interpretation of the geochemical characteristics of the groundwater provides information that supports the predictions made by the model. Together they provide strong evidence that the impacts of past and continued use of the ponds will be limited to the area of the ponds and to the area of poor-quality groundwater that exists near the surface and downgradient of the site.

4.6 Future Groundwater Monitoring

Wells in the immediate proximity of the evaporation ponds are currently being sampled by Navajo on a schedule required by the NM Oil Conservation Division as a condition of approval of the Groundwater Discharge Plan in 1991. Wells are being sampled on a staggered schedule with adjacent wells alternately sampled in either the spring or fall months for selected water quality constituents regulated by the NM Water Quality Control Commission. Some wells downgradient from Ponds 1 and 2 that historically have detected releases of organic constituents from the ponds are sampled semi-annually. The result of this sampling regimen is that groundwater is effectively monitored twice yearly immediately adjacent to the active and inactive ponds.



RE/SPEC

Trilinear mixing diagram, OCD-7A, -7B, -7C Pecos River, evaporation pond, RFI Phase III, April 1995

prepared for:

PROJECT: 318/3

LOCATION: ARTESIA, NEW MEXICO

APPR:

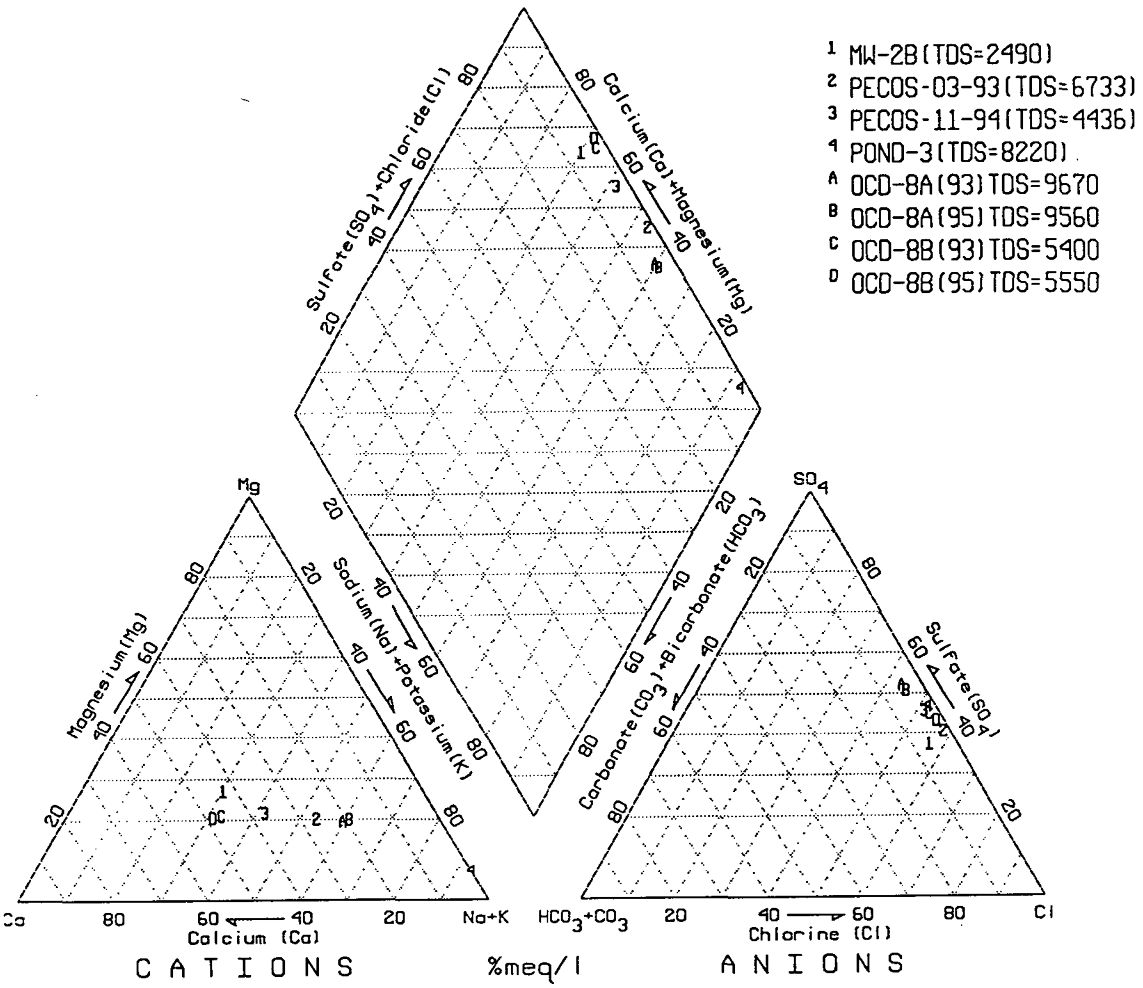
DATE: 4-28-95

DRAWN BY: DB

SCALE:

DATE:

FIGURE: 4-15



RE/SPEC

Trilinear mixing diagram, OCD-8A, -8B, Pecos River, evaporation pond, RFI Phase III, April 1995

prepared for:

Navajo

PROJECT: 318/3	
LOCATION: ARTESIA, NEW MEXICO	
APPR:	DATE: 4-28-95
DRAWN BY: DB	SCALE:
DATE:	FIGURE: 4-16

Beginning in the Spring of 1996, Navajo proposes modification of the current sampling schedule to increase monitoring of wells and constituents in the vicinity of the ponds. The following wells in the vicinity of the evaporation ponds are proposed for sampling; OCD 4 is not included because it was designed to monitor water quality of future pond expansion which no longer is scheduled to occur:

MW Series: 1, 2A, 2B, 3, 4A, 4C, 5AR* ,5B, 5C, 6A, 6B, 7A, 7B, 14, 15, 22A and 22B.
OCD Series: 1, 2A, 2B, 3, 5, 6, 7AR, 7B, 7C, 8A and 8B.

During the time the pond is in continued use, sampling for some wells will be staggered, with some wells sampled in Spring and others in Fall to allow coordination with the current Oil Conservation Division sampling program. As shown in Table 4-11, the sampling frequency will continue to generally follow the NMOCD-approved discharge plan schedule, but sampling of RFI-installed wells adjacent to and downgradient from Ponds 1 and 2 will be performed twice yearly during the period the remaining ponds retain active permit status.

Prior to purging, water level and total depth in each well will be measured, and electrical conductivity, temperature and pH will be measured during the purging operation. To avoid obtaining turbid samples, purging will be conducted at discharge rates that will not exceed two liters per minute. Samples will be analyzed for the same constituent listing of BTEX volatiles (including carbon disulfide and methyl ethyl ketone), semi-volatiles, metals, and water chemistry parameters (plus fluoride) as was performed during this Phase III investigation. A summary report will be submitted to EPA by April 1 of each year. The summary report will include the sampling analytical results plus the quarterly water level measurements of the nested pond monitor wells which are completed at different depth intervals.

At the cessation of active pond status (as defined by the initiation of soil verification sampling within the inactivated and dewatered ponds), monitor well sampling will be performed annually for at least the following five-years. Subsequent to this five-year period, specific monitoring requirements (including wells to be sampled, sampling frequency, and constituents to be analyzed) will be determined after review of the cumulative data and trends, and consultation between Navajo and U.S. EPA and/or state RCRA staff. However, since groundwater conditions are expected to improve following cessation of active pond use, Navajo intends to propose decreasing sample frequencies and/or constituents during the remainder of post-closure monitoring. For example, Navajo may be propose to sample wells every two years during the following five-year period, and further decrease sample frequencies during subsequent five-year intervals.

---

* Monitor Well 5AR replaced well 5A at the same location in August 1995.

Table 4-11. Proposed Groundwater Monitoring Sampling Matrix Navajo Evaporation Ponds

Monitor Well ID	Active Permit Status[1,2] Semi-annual Spring[3]	Semi-annual Fall[3]	Closure Monitoring 5-years following active use[2]	Subsequent monitoring[4]
MW-1		X	Annual	TBD
MW-2A		X	Annual	TBD
MW-2B		X	Annual	TBD
MW-3	X	X	Annual	TBD
MW-4A	X	X	Annual	TBD
MW-4C	X	X	Annual	TBD
MW-5AR	X	X	Annual	TBD
MW-5B	X	X	Annual	TBD
MW-5C	X	X	Annual	TBD
MW-6A	X	X	Annual	TBD
MW-6B	X	X	Annual	TBD
MW-7A	X		Annual	TBD
MW-7B	X		Annual	TBD
MW-14	X		Annual	TBD
MW-15	X	X	Annual	TBD
MW-22A	X	X	Annual	TBD
MW-22B	X	X	Annual	TBD
OCD-1	X		Annual	TBD
OCD-2A		X	Annual	TBD
OCD-2B		X	Annual	TBD
OCD-3	X		Annual	TBD
OCD-5	X		Annual	TBD
OCD-6		X	Annual	TBD
OCD-7AR	X		Annual	TBD
OCD-7B	X		Annual	TBD
OCD-7C	X		Annual	TBD
OCD-8A		X	Annual	TBD
OCD-8B		X	Annual	TBD

Notes:

1. APS ceases upon initiation of soil verification sampling within the inactivated and dewatered ponds.
2. Sampling for BTEX volatiles plus carbon disulfide and MEK; PAH semi-volatiles; total As, Cr, Pb and Ni metals; and water chemistry parameters plus fluoride.
3. Sampling frequency generally follows NMOCD-approved discharge plan schedule; wells sampled twice per year are located downgradient from the vicinity of Pond 1 and the Pond 2 inlet, areas which received significant volatile and semi-volatile constituents prior to 1987.
4. Subsequent monitoring requirements (including wells to be sampled, sampling frequency, and constituents to be analyzed) are to be determined after review of the cumulative data and trends, and consultation between Navajo and U.S. EPA and/or state RCRA staff.

4.7 Groundwater Risk Assessment

Risk assessments have been recently conducted at the evaporation ponds by RE/SPEC (1995) for inclusion in the Pond 1 Corrective Measures Study (CMS), and by ENSR (1995) as part of the closure plan for the other active evaporation ponds. A groundwater risk assessment was prepared for the CMS submitted in December, 1994 and included in the August 1995 revised CMS. The pertinent sections of the CMS are reproduced as Appendix G of this report.

The CMS presented the results of a groundwater risk assessment for a human residential scenario that utilized maximum concentration data from selected Pond 1 monitor wells collected during the Phase I and II RFI investigations. A review of RFI Phase III data for all monitor wells in the vicinity of the ponds does not show concentration levels exceeding data in the earlier reports, so the CMS risk assessment represents the worst-case analysis.

Of overwhelming significance, however, is the discussion in the CMS which demonstrates that, because of flood risks, residential use of property in the vicinity of the evaporation ponds will not occur. The CMS also documents that the naturally occurring groundwater in the vicinity of the ponds is unfit for human consumption without extensive treatment to remove salts which also would eliminate any hazardous constituents.

In EPA Region 6 comments of April 1995 in response to earlier CMS submittals, EPA has acknowledged that the human residential scenario is inappropriate for the evaporation pond area and is allowing an agricultural-based land use as the default risk scenario. Discussions of the latter scenario and various ingestion pathways are presented in the referenced RE/SPEC and ENSR documents.

In addition, EPA Region 6 review comments on the revised October 1995 RFI Phase III report required the inclusion of a groundwater risk assessment evaluating potential environmental risks posed to livestock utilizing groundwater as a drinking water source. Further discussions with EPA Region 6 personnel clarified the location of the hypothetical point of groundwater exposure and the potential health risks to be assessed. The groundwater risk assessment evaluating potential environmental risks to exposed livestock is presented in Appendix H of this report.

5.0 RFI PHASE III INVESTIGATION - PECOS RIVER

The following sections describe RFI Phase III investigation activities conducted on the Pecos River in the vicinity of the evaporation ponds. Investigative activities along the river included sampling and characterization of river bed sediments and surface waters. Phase III activities associated with the sediments investigation are described in Section 5.1, and the surface water investigation is presented in Section 5.2.

5.1 Pecos River Sediment Investigation

The following sections describe activities and results associated with the investigation of river bed sediments in the Pecos River in the vicinity of the evaporation ponds.

5.1.1 Sediment Sampling Procedures

The four sample locations at which river sediments were obtained at the Pecos River are presented in Figure 5-1. The sample locations included: an upstream (background) location approximately 1,000 feet downstream from the confluence of the Pecos River and Eagle Creek (NPR-SD-1); two locations situated at points where the river is in close proximity to the unit (NPR-SD-2 and 3); and a downstream location (NPR-SD-4) located approximately 4,800 feet downstream from the most downgradient point where the east side of the unit is directly adjacent to the river (Figure 5-1). Locations NPR-SD-2 and 3 are located near monitoring well series OCD-2 and OCD-7, respectively. NPR-SD-4 is situated at a point close to where a petroleum/natural gas pipeline crosses the river.

Samples were obtained using an approximately five-foot section of four-inch PVC casing pushed into the river bed. One end of the casing was threaded so that a PVC cap could be secured to seal that end. In order to minimize the amount of river water collected above the sediment sample, the casing was forced through the water column into the upper sediment layer with the cap attached. The cap was then unscrewed and the casing driven into the sediment layer to a depth approximately eight to 12 inches below sediment surface. The PVC cap was then replaced atop the casing and the casing withdrawn from the base of the river bed. To extract the sediment sample, the casing was inclined at an angle slightly above horizontal, the cap removed, and excess water permitted to drain out the casing bottom. Finally, recovered sediment material was transferred directly from the casing into appropriate sample containers.

5.1.2 Sediment Sample Analyses

The Phase III Pecos River sediment samples were analyzed for the following parameters/constituents:

- pH;
- volatile organics (EPA Method 8240 - BTEX, methyl ethyl ketone and carbon disulfide);
- semivolatile organics (EPA Method 8270 - polycyclic aromatics); and
- total arsenic, chromium, lead and nickel.

5.1.3 Analytical Results

Results of the Phase III sediment sample laboratory analyses are presented in Table 5-1 and Appendix D. Sediment pH values (approximately 8.2 standard units) were consistent among all. None of the targeted volatile or semivolatile organic constituents were detected in the river sediment samples. Reported total metal concentrations for chromium, lead, and nickel in sediment samples obtained adjacent and downgradient to the unit were consistent with the sediment concentrations for those constituents reported for the upgradient sample. For three of the four sediment samples, reported arsenic concentrations in sediment were below the 0.5 mg/Kg detection limit (Appendix D). However, for the sample furthermost downgradient (NPR-SD-4), arsenic was reported above the detection limit at a concentration of 5.6 mg/Kg.

Table 5-1. Summary of Pecos River RFI Phase III Sediment Sample Analytical Results

	Sample Location				**Background BG-TR-001**	
Parameter	NPR-SD-1	NPR-SD-2	NPR-SD-3	NPR-SD-4	5 ft.	8 ft.
pH	8.2	8.3	8.3	8.2	- -	- -
Volatiles mg/Kg[1]	< 0.006	< 0.006	< 0.006	< 0.006	- -	- -
Semi-volatiles (mg/Kg)[1]	< 0.4	< 0.4	< 0.4	< 0.4	- -	- -
Metals (mg/Kg)						
As	< 0.5	< 0.5	< 0.5	5.6	1.3	2.1
Cr	6	7	6	6	10	13
Pb	4	4	2	4	6	7
Ni	6	7	5	5	1	12

Notes: 1. All organic constituents that were evaluated were less than the reported detection limits presented in Table 5-1.

5.1.4 Phase III Sediment Investigation Discussion

For the most part, the results of the Phase III sediment investigation yielded no indication that sediments in the Pecos River have been impacted by the Navajo pond system. The significance, if any, of the reported arsenic detection event at NPR-SD-4 and its absence elsewhere is unknown. Since the sample location was downgradient of the unit, an anthropogenic source for the reported arsenic detection event is possible, although it is noted that elevated arsenic levels were not observed either in sample NPR-SD-2 or 3, which were collected at close proximity to the ponds.

However, alternative explanations to account for the data point must also be considered. Sediment sample NPR-SD-4 was obtained close to the location where several buried petroleum pipelines cross the river and there may be residual disturbance impacts. Further, at the time of sampling, this location also exhibited significant impact resulting from the movement of livestock passing to, from, and within the river. The river bank was severely eroded, the river bed significantly wider, and water depth significantly less than that encountered at the other Phase III sediment sample locations. Thus, it is possible that sample NPR-SD-4 was not representative of typical sediment conditions along that reach of the river. Alternately, since only a single sample was obtained in this general area, the possibility that the reported concentration may be within the natural range of river sediments must also be considered. The reported arsenic data could also result from laboratory error. Finally, it is possible that the arsenic data for this sample may represent the combined influence of several, or all, of the above-listed alternative effects.

5.2 Pecos River Surface Investigation

The following sections describe activities and results associated with the characterization of surface waters of the Pecos River in the vicinity of the evaporation ponds.

5.2.1 Surface Water Sampling Procedures

Surface water samples were obtained at two locations on the river (Figure 5-1). The sample locations included: an upstream (background) location approximately 1,000 feet downstream from the confluence of the Pecos River and Eagle Creek and a second location situated due east of the unit where the river is in closest proximity to it.

Surface water samples were obtained as grab samples obtained directly from the river at midstream.

Figure 5-1. Sediment and Surface Water Sample Locations, Evaporation Ponds, RFI Phase III, 1995

5.2.2 Surface Water Sample Analyses

The Phase III Pecos River surface water samples were analyzed for the following parameters/constituents:

- volatile organics (EPA Method 8240 - BTEX, methyl ethyl ketone and carbon disulfide);
- semivolatile organics (EPA Method 8270 - polycyclic aromatics);
- total arsenic, chromium, lead, and nickel; and
- general water chemistry parameters (pH, TDS, dissolved cations and anions, etc.).

5.2.3 Analytical Results and Discussion

The results of the Phase III Pecos River surface water sample laboratory analyses are presented in Appendix D and Table 5-2. General water chemistry results are included with Table 4-8. In brief, none of the target inorganic constituents or volatile and semivolatile organic constituents were observed at the reported detection limits for either sample. General water chemistry parameters were also highly similar for the two Phase III surface water samples. Consequently, no evidence was obtained from the Phase III investigation to indicate that surface waters of the river are being impacted by the evaporation ponds.

Table 5-2. Summary of Pecos River RFI Phase III Surface Water Sample Analytical Results.

	Sample Location	
Parameter	NPR-RW-1	NPR-RW-2
pH	8.2	7.8
Total Dissolved Solids (mg/L)[1]	4,580	4,610
Volatiles mg/Kg [2]	< 0.005	< 0.005
Semivolatiles (mg/Kg) [2]	< 0.010	< 0.010
Metals (mg/Kg)		
As	< 0.005	< 0.005
Cr	< 0.02	< 0.02
Pb	< 0.01	< 0.01
Ni	< 0.01	< 0.01

Notes: 1. Other inorganic constituents are shown in Table 4-8.
2. All organic constituents that were evaluated were less than the reported detection limits presented in Table 5-2.

5.3 Future Surface Water and Sediment Monitoring

Based upon the results of sampling and analysis of sediments and surface water obtained from the Pecos River in the proximity of the evaporation ponds, no significant environmental impact to the river is indicated. However, in order to provide further confirmation of those findings, Navajo proposes that a surface water and sediment sampling and analysis program for the river be conducted on an annual basis until the evaporation pond system ceases to maintain active permit status (as defined by the initiation of soil verification sampling within the inactivated and dewatered ponds).

The annual river monitoring will include the collection of two surface water and two sediment samples (one each upgradient and downgradient). The upgradient sample collection station will be located approximately 1000 feet downstream from the confluence of the Pecos River and Eagle Creek at the same location as the upgradient samples collected for the Phase III study (shown as NPR-RW-1/NPR-SD-1 in Figure 5-1, Page 5-4). An upgradient sample will provide a control specimen in the event river water or sediment has been impacted by non-Navajo sources. The downgradient water and sediment sample will be collected in the vicinity of NPR-SD-4, but slightly upstream from that location to avoid any inadvertent impact from sediment disturbance due to cattle crossing the river or from the nearby buried pipeline.

The annual program for environmental sampling of the Pecos River will be scheduled to occur in conjunction with the fall semi-annual groundwater monitoring event for the ponds (described in Section 4.6). Sample collection and preservation procedures, and constituent analytical testing will be as described in Sections 5.1 and 5.2 of this report. A summary report will be prepared and a combined groundwater, surface water, and sediment monitoring report will be submitted to EPA by April 1 of each year.

APPENDIX G

Appendix G

APPENDIX H

Appendix H

APPENDIX H

Groundwater Risk Assessment, Livestock Exposure Scenario

H-1. Introduction

The following sections present methods, results and conclusions of a groundwater risk assessment involving the shallow groundwater zone located downgradient of the Navajo evaporation pond system. This assessment was developed in response to EPA Region 6 review comments on the October 1995 (revised) submittal of the Navajo Refining Company Three-Mile Ditch and Evaporation Ponds RFI Phase III report. Region 6 has required Navajo to prepare a groundwater risk assessment under an agricultural land use scenario in which livestock (e.g. cattle or horses) utilize contaminated groundwater as a drinking source. Assessments of risk through other various human and ecological pathways were submitted previously to EPA as Appendix G of the October, 1995, document.

Subsequent to further discussions between representatives of Navajo and EPA Region 6, several issues related to the development of the required risk assessment were resolved. The hypothetical point of livestock exposure to contaminated groundwater in relation to downgradient location from the ponds and aquifer interval was identified, and it was also determined that evaluation of potential environmental risk to exposed livestock would be limited to potential direct health effects that could result in direct mortality or loss in agricultural productivity.

The hypothetical point of environmental exposure to contaminated groundwater, associated environmental monitoring data and identification of potential constituents of concern are discussed in section H-2. Exposure pathway concentrations and intake rates for the modeled livestock receptors are described in section H-3, toxicity assessment and risk characterization are presented in section H-4, and discussion and conclusions are presented in section H-5.

H-2. Point Of Exposure And Environmental Data Evaluation

H-2.1 Point of Exposure

Downgradient monitoring well MW-4A was selected to represent the modeled point of livestock exposure to environmental contaminants. Well MW-4A is located approximately 425 feet due south of Pond 1. The location of MW-4A in relation to the evaporation ponds is shown in Figure 4-1 of the revised RFI Phase III report (page 4-22) to which this risk assessment document is appended.

Monitoring well MW-4A possesses a 10-foot screened interval extending from the piezometric surface of the uppermost water-bearing zone, where it is first encountered at a depth of about 8 feet, to a final depth of 18 feet (as measured from surface grade).

The selection of monitoring well MW-4A as the designated point of livestock exposure to groundwater was driven by the fact that it met the following interdependent criteria:

- Groundwater at that location is documented to have been impacted by wastewater constituents migrating from the ponds; and
- The concentration of total dissolved solids does not exceed 10,000 mg/kg, such that it could feasibly be utilized as a livestock watering source.

H-2.2 Data Evaluation

Groundwater monitoring well MW-4A was installed on June 17, 1986 (Geoscience, 1987). Groundwater monitoring data for MW-4A has been compiled from a series of site investigations and routine monitoring events conducted at the evaporation ponds since its installation. Routine environmental monitoring of groundwater at MW-4A is conducted as part of an ongoing New Mexico Oil Conservation Division (NMOCD) monitoring program required under the state-approved groundwater discharge plan for the facility. In addition, groundwater samples obtained from MW-4A also have been evaluated during the course of a series of RCRA Facility Investigations (of which this current document is a part).

Tables H-1 through H-3 summarize all groundwater sample laboratory analyses for MW-4A which were identified in preparation for this risk assessment. It is also noted that additional environmental data for groundwater samples collected at MW-4A may exist besides those presented herein. However, the data presented in Tables H-1 through H-3 includes only those sampling events for which a fundamental level of data verification could be obtained in the form of identified laboratory analytical reports. The laboratory analytical data reports containing environmental data for MW-4A groundwater samples are presented in Attachment H-1 to this Appendix. In addition, it is also noted that most of the laboratory analytical reports presented in Attachment H-1 refer to MW-4A as MW-4, since the well has only recently been re-designated as MW-4A following the installation of a new, deeper monitoring well (MW-4C) at that location during the RFI Phase III field investigation.

As presented in Table H-1 through H-3, environmental contaminants of concern reported in groundwater samples from MW-4 have been divided into three contaminant categories: volatiles, semivolatiles and metals. MW-4A groundwater monitoring data for the contaminant categories of concern are discussed in the following sections.

H-2.2.1 BTEX Constituents - Reported Groundwater Concentrations

Although groundwater samples collected from MW-4A were analyzed for a variety of volatile organic constituents (VOCs) during at least some of the sample events identified during the course of this evaluation, reported VOC detection events were associated only with the presence of BTEX constituents (Table H-1, Attachment H-1). Average and maximum concentration values for BTEX constituents are presented in Table H-1. However, for the purposes of this assessment, only the maximum concentration values were utilized in the estimation of potential environmental risk.

Table H-1. Summary of BTEX Data for Monitor Well MW-4A Used in the Groundwater Risk Assessment.

	BTEX Constituents			
Sample Date	Benzene	Toluene	Ethylbenzene	Xylenes (total)
8/7/86	< 0.005	0.140	0.039	NA
4/30/87	NA	NA	NA	NA
5/5/87	< 0.1	< 0.1	< 0.1	< 0.1
8/14/87	0.045	0.280	0.130	0.992
11/16/87	0.051	0.025	0.156	0.059
6/3/88	< 0.050	< 0.050	< 0.050	< 0.050
7/26/1992 [1]	< 0.0002	0.036	< 0.0002	< 0.0002
7/26/1992 [2]	< 0.005	< 0.005	< 0.005	< 0.010
6/90	BDL[3]	BDL[3]	0.032	0.023
6/10/92	0.018	0.006	0.014	0.035
11/12/92	0.021	0.009	0.019	0.032
4/28/93	0.020	0.012	0.019	0.043
12/20/93	< 0.010	< 0.010	< 0.010	< 0.010
6/21/94	< 0.002	< 0.002	< 0.002	< 0.002
11/10/94	0.013	0.006	0.015	0.028
6/28/95	0.012	0.008	0.019	0.036
Maximum / Average Concentration [4]	**0.051 / 0.025**	**0.280 / 0.049**	**0.156 / 0.041**	**0.992 / 0.101**

Notes:

1. Split sample analyzed at Inter Mountain Laboratories.
2. Split sample analyzed at Ana-Labs, Inc.
3. Below Detection Limit, detection limit not identified.
4. Averages calculated using full detection limit values for constituents reported below detection limit.

Table H-2. Summary of Semivolatile Organic Constituent Data for Monitor Well MW-4A Used in the Groundwater Risk Assessment.

	SVOA Constituents (mg/l)	
Sample Date	Analytical Method	Results Summary
8/14/87	Method 764 - 6 constituents reported [1]	4 non-detects < 0.01 mg/l, and 2 detections [2]
7/26/1992 [3]	Method 8100 - 26 constituents analyzed	all non-detects < 0.001 to 0.002
7/26/1992 [4]	Method 8270 - 26 constituents analyzed	all non-detects < 0.01 to 0.05
6/10/92	Method 8270 - 61 constituents analyzed	all non-detects < 0.1 to 0.2
11/12/92	Method 8270 - 66 constituents analyzed	all non-detects < 0.05 to 0.125
6/21/94	Method 8270 - 2 constituents analyzed	2-methyl napthalene and naphthalene < 0.001
11/10/94	Method 8270 - 16 constituents analyzed	all non-detects < 0.10
Average Detection Limit [5]		< 0.07 mg/l

Notes:

1. Total number of identified constituents not specified in laboratory report.
2. 1-methyl naphthalene and acenaphthalene detected at 0.098 and 0.031 mg/l, respectively.
3. Split sample analyzed at Inter Mountain Laboratories.
4. Split sample analyzed at Ana-Labs, Inc.
5. Where a range of detection limits is reported, the higher value was used in the average calculation.

Table H-3. Summary of Metals Analytical Data for Monitor Well MW-4A Used in the Groundwater Risk |Assessment.

	Metal Constituents (mg/l)[1]			
Sample Date	**Arsenic**	**Chromium**	**Lead**	**Nickel**
4/30/87	NA / NA	NA / 0.005	NA / <0.01	NA / NA
6/3/88	NA / 0.21	NA / < 0.005	NA / <0.01	NA / < 0.1
7/26/92	NA / 0.087	NA / 0.038	NA / < 0.02	NA / NA
6/90	0.22 / NA	0.02 / NA	< 0.01 / NA	0.07 / NA
11/12/92	0.08 / 0.069	< 0.02 / < 0.02	< 0.02 / < 0.02	0.11 / 0.07
4/28/93	NA / NA	NA / NA	NA / NA	0.01 / NA
6/21/94	0.541 / NA	0.096 / NA	0.002 / NA	0.051 / NA
11/10/94	0.156 / NA	0.090 / NA	0.07 / NA	0.13 / NA
2/24/95	0.051 / NA	< 0.005 / NA	< 0.01 / NA	< 0.05 / NA
6/28/95	0.061 / NA	0.006 / NA	< 0.01 / NA	< 0.05 / NA
Total Metal Maximum / Average [2]	0.541 / 0.185	0.096 / 0.04	0.07 / 0.02	0.13 / 0.07

Notes:

1. Total and dissolved metal concentrations, respectively; NA, No Analysis.
2. Maximum and average concentrations for total metals only; full detection limit used in the average calculation for those constituents reported below detection limit.

H-2.2.2 Semivolatile Organic Constituents - Reported Groundwater Concentrations

The semivolatile organic constituent analytical data for groundwater samples collected at monitoring well MW-4A are presented in Table H-2 and Attachment H-1. The number of individual semivolatile constituents included for analysis in MW-4A groundwater varied widely among sampling events. Polycyclic aromatic hydrocarbon (PAH) semivolatile constituents detected in MW-4A groundwater samples and their reported concentrations resulting from an 8/14/87 sampling event included: 1-methyl naphthalene and acenaphthalene detected at 0.098 and 0.031 mg/l, respectively. Non-PAH semivolatiles and their reported concentrations were limited to the following phenolic constituents reported during a 7/26/89 sampling event: phenol - 0.03 mg/l; 4-nitrophenol - 0.036 mg/l; 2,4-dimethylphenol - 0.059 mg/l; and 2-chlorophenol - 0.003 mg/l.

In addition, laboratory analytical detection limits achieved for semivolatile constituent analyses for MW-4A samples also varied widely among sample events, with detection limits ranging from 0.001 to 0.1 mg/l, with a conservatively calculated overall average detection limit of 0.07 mg/l being obtained (Table H-2). A hydrocarbon matrix historically associated with groundwater collected at this location likely resulted in analytical matrix interferences which accounts for the generally elevated detection limits observed among the various sampling events.

For the purposes of the current assessment, a maximum concentration value of 0.1 mg/l for select semivolatile organic constituents was selected to serve as a default value for MW-4A groundwater. This concentration equals the maximum achieved detection limit for semivolatile analyses for any of the sampling events listed in Table H-1, and also exceeds all reported semivolatile constituent concentrations for groundwater samples obtained from MW-4A, as well as at all other groundwater monitoring wells included within the Navajo evaporation ponds monitoring system.

H-2.2.3 Metal Constituents - Reported Groundwater Concentrations

On the basis of the results of numerous environmental sampling events conducted in the vicinity of the Navajo evaporation ponds, arsenic, chromium, lead and nickel have previously been identified as potential metals of concern in groundwater zones impacted by the ponds. Table H-3 summarizes MW-4A groundwater monitoring data for those four metal constituents of concern. Analytical data for the metals of concern reported in groundwater samples from MW-4A includes analyses for total and/or dissolved metal concentrations. For the purposes of this assessment, only worst-case, maximum concentration values obtained by total metal analyses were utilized in the estimation of potential environmental risk.

H-3. Potential Exposure of Livestock Receptors

As discussed in Section H-2, the point of environmental exposure is assumed to be groundwater accessed by livestock at the location of MW-4A, encompassing groundwater originating from only that hydrogeologic strata in which the screened interval of MW-4A is installed. Based on local and regional agricultural land use patterns, livestock in the form of cattle and horses were anticipated to represent the most probable forms of domestic animal to be potentially exposed to contaminated groundwater. However, for simplification and convenience, cattle have been selected as the modeled environmental receptor, since it can be reasonably assumed that environmental exposure and toxicological response parameters for cattle and horses should be comparable.

For purposes of the assessment, it was assumed that a representative 400 kg steer will ingest groundwater at a rate of 30 liters per day at the point of exposure. This water consumption rate reportedly represents a reliable annual average value for livestock in southeastern New Mexico (Bud Wilson, U.S. BLM, personal communication, August, 1995).

Establishment of a specific value or range of values for the total duration of exposure was not deemed to be necessary for the development of this assessment, but was instead assumed to be chronic and long-term. As discussed in Section H-4, this risk assessment was constrained to the estimation of direct physiological impact to domestic livestock that could potentially result in a loss of economic productivity.

In the absence of directly applicable risk standards for livestock, much of the current assessment relied upon animal-based toxicological studies that identify lowest observed adverse effect levels (LOAELs) of constituent exposure. The LOAEL criteria cited herein are based on long-term, chronic and sub-chronic exposure bioassays. Therefore, for the purposes of this assessment, livestock exposure is considered to extend over a natural bovine life span. Since livestock production practices commonly result in herd turnover rates of about 50 percent every year, and turnover approaching 100 percent every four to five years, the adoption of a lifetime exposure assumption for the modeled livestock receptors contributes an inherent degree of conservatism to this risk evaluation.

H-4. Toxicity Assessment And Risk Characterization

Available and relevant toxicological information for the identified constituents of concern and the potential impact of the constituents of concern on hypothetical livestock receptors at the modeled exposure concentrations and ingestion rates are presented in the following sections. In accordance with the specified goals of this risk assessment, potential noncarcinogenic toxicological impacts to livestock health and productivity resulting from exposure to environmental contaminants reported in MW-4A groundwater samples are most appropriately evaluated in comparison to data from animal-based studies that identify lowest observed adverse effect levels (LOAELs), or from other dietary standards for livestock exposure to chemical constituents.

H-4.1 BTEX Constituents

In the development of this evaluation, no applicable information was identified that would provide a direct comparison of the hypothetical exposure levels of livestock to BTEX-contaminated groundwater with potential toxicological responses. Therefore, an alternative approach was developed for the risk characterization, in which available animal studies involving the constituents of concern were adapted in a conservative manner to derive worst-case risk estimates for potentially exposed livestock.

For three of the four BTEX constituents of concern (toluene, ethylbenzene and xylenes), the EPA Integrated Risk Information System (IRIS) database identifies LOAEL criteria based on animal test species and experiments in which a minimally adverse clinical response was elicited upon exposure to those compounds. For the remaining BTEX constituent (benzene), EPA has declined to identify an experimentally-derived LOAEL.

In the absence of agency-approved noncarcinogenic criteria for benzene, an alternative approach was selected in order to establish conservative animal toxicity criteria. Specifically, the average daily lifetime dosage required to cause a doubling in the incidence rate of tumors in test animals (50% tumorigenic dosage, or TD_{50}) at the end of a standard lifetime was selected as a conservative substitute value for the LOAEL. The average daily lifetime dosage rodent TD_{50} for benzene is approximately 51 mg/kg/day (Gold, et al., 1993). Long-term TD_{50} criteria can be expected to represent more subtle physiological response than the relatively overt physiological perturbations typically considered as criteria in the establishment of standard LOAEL values. Consequently, adoption of the rodent TD_{50} criteria for benzene is considered to represent a reasonable approximation of the standard LOAEL values that EPA has formally designated for other BTEX constituents.

In the case of all four BTEX constituents, the designated toxicity criteria (TD_{50} and LOAELs) are based on rodent bioassays. Direct extrapolation of toxicological benchmarks from rodent bioassays to humans and other species may be obtained by assuming that an approximately equivalent toxicological response per unit dose per unit body weight (i.e. mg dose/kg body weight) is valid across a range of species. However, many toxicologists believe that inter-species dosage extrapolations are more accurately represented on the basis of surface area equivalency (mg dose/square meter body area). EPA endorses this latter approach as the technically appropriate method for conducting inter-species dose comparisons (EPA, 1992a).

For the current toxicity evaluation, two inter-species scaling factors were considered. For a given dose-response relationship, EPA accomplishes the direct extrapolation of animal bioassay data to humans by use of a method whereby dosages (expressed in mg constituent /kg body weight) are converted according to the equation:

$$\textbf{human dosage} = (\textbf{animal dosage})^{2/3}$$

A more direct scaling factor dose can also be used to conduct inter-species dose-response extrapolations by means of dose per unit body surface area interconversions (Finkel, 1995). In this case, it is assumed that overall density of mammalian body organs and tissue is approximately equivalent among species, so that the relationship between body mass and surface area is described as a simple cubic function. For the extrapolation of a given constituent dosage from the results of a mouse bioassay to cattle, and where average body mass values for laboratory mice and cattle are 0.035 kg and 400 kg, respectively, the appropriate inter-species correction factor is derived by the equation:

$$\mathbf{dosage_{cattle} = (dosage_{mice})(400/0.035)^{1/3}}$$

Use of the scaling correction factor described above contributes a level of conservatism to the derivation of inter-species dose-response comparisons which exceeds the previously described scaling approach used by EPA. Consequently, the latter, more conservative scaling approach has been adopted for use in this risk evaluation.

Table H-4 summarizes the toxicological criteria for BTEX constituents, presents adjusted dosage criteria for livestock derived in accordance with the scaling factor methodology described above, and compares the adjusted toxicological criteria standards to the calculated BTEX contaminant exposure estimates for the modeled livestock receptor.

In order to facilitate the interpretation of potential environmental risk to livestock receptors resulting from exposure to BTEX constituents, the adjusted LOAEL criteria were considered to be analogous to human oral reference doses (RfDo), and constituent "hazard quotients" were generated by taking the ratio of the estimated contaminant intake rates by the adjusted LOAEL criteria. For the purposes of this risk evaluation it is assumed that a derived hazard quotient greater than 1 is indicative of a potentially significant level of environmental risk (consistent with standard practice for the use and interpretation of hazard quotients). As shown in Table H-4, individual hazard quotient values significantly less than unity (ranging from 0.0011 to 0.0055) were obtained for the various BTEX constituents, and an overall "hazard index" (sum of all hazard quotients) of 0.013 was calculated.

On the basis of the conservative worst-case risk evaluation described above, no significant adverse health effects are indicated for modeled livestock receptors as a result of exposure to BTEX constituents in groundwater at MW-4A.

Table H-4. Risk comparison of standard and adjusted BTEX constituent LOAEL criteria to worst-case BTEX contaminant exposure levels for livestock at MW-4A.

Constituent	Maximum / Average Groundwater Concentration (mg/l)[1]	Standard Rodent LOAEL (mg/kg)[2]	Cattle LOAEL (mg/kg)[3]	Maximum Livestock Exposure (mg/kg)[4]	Hazard Quotient[5]
benzene	0.051 / 0.026	51	2.3	0.004	0.0017
toluene	0.280 / 0.052	446	19.8	0.021	0.0011
ethylbenzene	0.156 / 0.042	480	21.3	0.117	0.0055
xylenes (total)	0.992 / 0.106	357	15.8	0.074	0.0047
Hazard Index[6]					**0.013**

Notes:

1. Maximum/average contaminant concentrations reported for monitoring well MW-4A.
2. For toluene, ethylbenzene and xylenes, standard LOAELs are specified by EPA (IRIS database); for benzene, the standard LOAEL is based on rodent TD_{50} criteria.
3. Standard LOAEL corrected for cattle using scaling correction factor, where: LOAEL cattle = (LOAEL mice) / (400/0.035) exp. 0.333
4. Estimated livestock exposure mg/kg/day = [maximum concentration (mg/l) x 30 l/day] / 400 kg body mass
5. Hazard quotient = (estimated contaminant exposure) / (adjusted cattle LOAEL)
6. Hazard Index = sum of all hazard quotients

H-4.2 Semivolatile Organic Constituents

For a number of reasons, the semivolatile analytical data compiled for groundwater samples collected from monitoring well MW-4A is insufficient to permit the development of an accurate risk estimate for hypothetically exposed livestock receptors. The number of individual semivolatile constituents included for analysis in MW-4A groundwater varied widely between sampling events, and laboratory analytical detection limits achieved for semivolatile constituent analyses for MW-4A samples also varied widely. Noncarcinogenic criteria and standards are unavailable for many semivolatile organic constituents. Moreover, even when such data is available from experimental animal testing, the data is not directly applicable to the domestic livestock species of concern considered herein.

Despite the limiting factors cited above, the data is sufficient to develop a highly conservative worst-case quantitative risk estimate for a number of refinery waste-related semivolatile constituents which could theoretically occur in groundwater at monitoring well MW-4A. On the basis of rodent bioassays, EPA has determined LOAEL values for a limited number of polycyclic aromatic hydrocarbon (PAH) constituents (none of which have been detected in MW-4A groundwater) and other non-PAH semivolatile constituents. In those instances where

LOAEL criteria have been established, relatively high dosages are typically required to induce a clinically observable physiological response.

In order to derive a conservative, worst-case risk estimate for livestock exposure to semivolatile constituents, an exposure model was developed which included the following methodologies and components:

- All PAH semivolatiles for which noncarcinogenic toxicological criteria have been established were assumed to be present in MW-4A groundwater at a concentration of 0.1 mg/l;
- Four phenolic semivolatile constituents previously detected in MW-4A groundwater samples during one sampling event at reported concentrations ranging from 0.03 to 0.059 mg/l were also assumed to be present in MW-4A groundwater at a concentration of 0.1 mg/l; and
- An adjusted livestock LOAEL was derived using a conservative scaling factor method, as previously described in Section H.4.1.

The risk parameters for livestock exposure to semivolatile contaminants, associated toxicological response criteria, and derived quantitative risks are presented in Table H-5.

As shown in Table H-5, six PAH constituents for which livestock toxicity criteria could be conservatively derived (none of which have been reported in MW-4A groundwater), and four phenolic semivolatile constituents (detected in MW-4A groundwater samples in the 7/26/89 sampling event) were considered in the risk estimate. In the absence of established LOAEL criteria for two of the evaluated semivolatile organic constituents (naphthalene and 4-nitrophenol) human reference dose criteria were adjusted by a factor of 100 to derive LOAEL values. For seven of the eight constituents presented in Table H-5 where established LOAEL criteria exist, the LOAEL exceeds their associated human reference dose values by factors ranging from 1000 to 3000 (the LOAEL for phenol exceeds its respective human reference dose by a factor of 100). It is also noted that the IRIS database states that dose-response profiles of naphthalene and acenaphthene are roughly comparable in terms of a range of clinically observed physiological effects for experimental animal subjects, while the default LOAEL derived for naphthalene shown in Table H-5 is nearly 90 times less than that which has been formally established for acenaphthene. Based on these considerations, the derived LOAEL values for napthtalene and 4-nitrophenol employed in the risk estimate are considered to constitute reasonable conservative default values.

Table H-5. Summary of established and derived LOAEL values for experimental test animals and livestock.

Constituent	Maximum (Assumed) Groundwater Concentration (mg/l)[1]	Standard Rodent LOAEL (mg/kg/day)[2]	Cattle LOAEL (mg/kg/day)[3]	Assumed Livestock Exposure (mg/kg/day)[4]	Hazard Quotient[5]
acenaphthene	0.1	350	15.5	0.0075	0.0005
anthracene [6]	0.1	1000	44.5	0.0075	0.0002
fluoranthene	0.1	250	11.1	0.0075	0.0007
fluorene	0.1	250	11.1	0.0075	0.0007
naphthalene [7]	0.1	4	0.17	0.0075	0.043
pyrene	0.1	125	5.6	0.0075	0.0013
phenol	0.1	120	5.3	0.0075	0.0014
2,4-dimethylphenol	0.1	250	11.1	0.0075	0.0007
2-chlorophenol	0.1	50	2.23	0.0075	0.0034
4-nitrophenol [7]	0.1	6	0.26	0.0075	0.0288
Hazard Index [8]					**0.0807**

Notes:

1. Hypothetical maximum constituent concentration, employed for illustrative purposes only.
2. Standard constituent LOAELs specified by EPA (IRIS database).
3. Standard LOAEL adjusted for cattle using scaling correction factor, where: LOAEL cattle = (LOAEL mice) / (400/0.035) exp. 0.333.
4. Estimated livestock exposure mg/kg/day = [maximum concentration (mg/l) x 30 l/day] / 400 kg body mass.
5. Hazard quotient = (estimated contaminant exposure) / (adjusted cattle LOAEL).
6. Anthracene has not been observed to result in adverse clinical effects at a maximum dosage of 1000 mg/kg/day in rodent bioassays.
7. In the absence of an EPA-designated value, the LOAEL was conservatively approximated by adjusting the human reference dose by a factor of 100.
8. Hazard Index calculated as the sum of all hazard quotients.

As shown in Table H-5, a comparison of the conservatively derived livestock LOAEL standards to extreme worst-case intake exposure rates yields relatively low hazard quotients which range from 0.0005 to 0.04. Of the constituents considered in the evaluation, 2-chlorophenol and 4-nitrophenol would appear to display the highest potential risk since they are documented to actually have occurred in MW-4A groundwater and yielded two of the highest hazard quotient values. However, when evaluated at assumed exposure concentrations which exceed actual reported concentrations, the obtained hazard quotient values for those two phenolic compounds were still at least 20 times less than unity.

In the current risk assessment, available toxicological criteria for various semivolatile organic constituents was employed in conjunction with highly conservative assumed exposure assumptions to develop a worst-case quantitative risk estimate for exposed livestock. The results of the environmental risk evaluation detailed herein do not indicate a significant health risk posed to livestock receptors from exposure to semivolatile organic constituents in groundwater at MW-4A.

H-4.3 Metal Constituents

For the evaporation pond groundwater metal constituents of concern, two widely cited compilations of agricultural standards for acceptable metal concentrations in livestock water are available for comparison to the worst-case maximum metal concentration values presented in Table H-3 (NAS, 1974 and CAST, 1974). A comparison of worst-case and average total metal concentrations reported for groundwater samples from MW-4A to the technical standards cited above is presented in Table H-6.

Table H-6. Comparison of maximum metal concentrations reported in groundwater samples from MW-4A to livestock water quality standards.

Constituent	MW-4A Maximum / Average Concentration [1]	NAS Livestock Standard [2]	CAST Livestock Standard [3]
Arsenic	0.541 / 0.249	0.2	0.5
Chromium	0.096 / 0.057	1.0	5.0
Lead	0.07 / 0.03	0.1	0.1
Nickel	0.13 / 0.07	1.0	ND

Notes:

1. Verified maximum total metal concentrations reported for monitoring well MW-4A
2. National Academy of Sciences, 1974
3. Council for Agricultural Science and Technology, 1974

Of the potential constituents of concern, only total arsenic concentrations provide any *indication of potential* concentrations of concern in groundwater at MW-4A. The maximum total arsenic concentration reported for MW-4A groundwater is 0.541 mg/l. However, there is reason to believe that this maximum arsenic value is not indicative of actual water quality conditions in the shallow groundwater zone in which MW-4A is screened.

The EPA has determined that the integrity of at least some hydrogeologic strata may be sensitive to physical perturbations caused by high well purging rates (EPA, 1992b). In particular, while colloidal materials present within hydrogeologic formations may be immobile under natural flow conditions, the agency cautions that, when such materials are located within the zone of influence of monitoring wells that are subject to well purging rates significantly in excess of natural flow conditions, particulate mobilization may result in the artifact accumulation of such materials in the well casing immediately prior to a sampling event. In addition, EPA (1992b) cites research demonstrating that the use of bailers to purge monitoring wells can result in a "plunger effect" associated with fluid pressure surges in the hydrogeologic formation caused by raising and lowering of the bailer. Thus, in those instances in which a potential exists for artifact mobilization of colloidal solids due to high purge rates, bailer-related surge effects may further exacerbate this problem.

Evidence exists to suggest that groundwater formations in the vicinity of the Navajo evaporation ponds and the quality of water extracted from monitoring wells installed therein are indeed sensitive to the influence of variable well purging rates. Monitor well MW-4A is a 2-inch stainless steel well that has routinely been bailer purged and sampled during previous sampling events. Natural flow rates in the shallow groundwater zone in which MW-4A is screened are extremely slow, exhibiting an estimated seepage velocity of less than 1 inch per day (RFI Phase III report, Table 4-4). Thus, typical purging rates used to purge this well have likely significantly exceeded natural flow rates.

In order to assess whether monitoring wells included in the evaporation pond groundwater monitoring system were sensitive to purge rate and purge method effects, a series of sampling events were conducted by Navajo during February and June, 1995 in which select monitoring wells were purged and sampled using low-flow purge techniques. The analytical data resulting from those sampling events are presented in the RFI Phase III report (Section 4.5.2.2, Table 4-10). Under low-flow purge and sampling conditions, total arsenic concentrations obtained for MW-4A groundwater samples were observed to be significantly reduced, yielding total arsenic concentrations of 0.05 and 0.06 mg/l, respectively (Table H-3). Thus, the arsenic concentration values obtained for MW-4A groundwater samples using low-flow techniques are significantly less than the recommended arsenic concentration limits for stock water (Table H-6). Finally, it is also noted that the maximum total arsenic value for MW-4A groundwater does not represent an unvarying value in the available data set, even when sample data based on low flow purge and sample techniques are excluded. The data presented in Table H-3 shows that, for total arsenic values obtained on four sample dates for MW-4A groundwater samples, one sample exhibited total arsenic exceeding both sets of livestock water quality standards given in Table H-6, one sample exceeded one of the two standards, and total arsenic concentrations obtained from the remaining two sampling events were below both standards.

Because arsenic in the groundwater system at MW-4A is sensitive to mobilization of particulates at elevated flow rates, the arsenic intake rates for cattle ingesting groundwater at this location would to a significant extent be highly dependent upon the design and operational practices associated with the hypothetical livestock well. Mobilization of colloidal material and post-extraction settling of suspended solids in the receiving water tank would both be influenced to varying degrees by the nature of the system. Consequently, potential environmental risks to livestock resulting from exposure to MW-4A groundwater are associated with a corresponding degree of uncertainty. However, in normal operation of a low-flow well, such as a windmill-driven livestock well, turbidity typically decreases with time as fine grained material in the formation adjacent to the well bore is removed and flow rates further from the well are not of sufficient magnitude to cause replacement particulates to migrate to the discharge point.

H-5. Discussion and Conclusions

The livestock risk assessment presented above was intended to estimate potential adverse impacts to livestock health and productivity resulting from the ingestion of refinery waste related contaminants in shallow groundwater located at a point of exposure immediately downgradient from Pond 1. Based on conservative worst-case estimates no significant adverse impacts to livestock were indicated from exposure to organic constituents which might possibly occur in the impacted groundwater.

For the most part, permissible exposure limits to various organic contaminants are dictated by stringent carcinogenic risk standards for humans, which are in turn founded on conservative toxicological models which assume no safe threshold below which carcinogenic risk is negligible. Moreover, permissible human exposure limits to environmental contaminants are also derived by means of downward extrapolation from animal-based studies, and which typically result in acceptable exposure levels for humans that are several orders of magnitude less than the exposure levels at which adverse physiological effects are actually observed in animal bioassays. Consequently, the results of the current risk assessment, which do not indicate significant health risks to livestock exposed to significant concentrations (relative to applicable human exposure standards) of organic constituents, are considered reasonable and appropriate.

The herbivore rumen is constructed to process a high-volume throughput of mixed organic material, and may thus be relatively pre-adapted to tolerate ingested quantities of anthrpogenic organic materials. In particular, cattle are documented to exhibit a remarkable tolerance to ingestion of large quantities of hydrocarbon substances. With no apparent adverse effect, mixed-breed cattle have been documented to tolerate sub-chronic dosages of crude oil at ingestion rates equivalent to 2 liters per day for a 400 kg steer (Rowe, et al., 1973), and sheep fed massive dosages of Bunker C fuel oil at a rate of 10 percent (by weight) diet mixed with hay over a 10-day period exhibited no ill effects (Macintyre, 1970).

It is recognized that considerable uncertainty is associated with the quantitative risk estimates obtained herein for livestock exposed to refinery waste-related organic constituents. A particular area of uncertainty involved the adaptation of rodent TD_{50} criteria to evaluate potential environmental risks to livestock. However, the worst-case daily benzene ingestion rate for exposed livestock derived in this assessment (0.004 mg/kg/day) represents a value exceeded by the daily intake for the average human smoker (0.029 mg/kg/day, Wallace et al., 1987) by a factor of 7.25. It is recognized that contaminant dose-response criteria are not necessarily comparable when considered across species (cattle vs. human) and routes of assimilation (oral vs. inhalation). However, the comparison of potential benzene exposure to cattle from MW-4A groundwater to a human smoker still serves to provide a relatively familiar frame of reference to comprehend the magnitude of benzene intake for the modeled receptors under the conservative, worst-case, scenario employed herein.

Moreover, the maximum reported concentration values for BTEX constituents in groundwater used in this assessment were obtained in 1987 (the year in which Pond 1 was deactivated and de-watered). In the ensuing eight-plus years interval, groundwater monitoring events conducted at MW-4A document that BTEX concentrations have steadily declined below their historic maxima (Table H-1). That trend that can reasonably be anticipated to continue over time as natural biodegradation and attenuation processes proceed.

For semivolatile organic constituents of concern, the estimation of potential environmental risk to livestock was founded on an extremely improbable scenario in which a variety of semivolatile organic constituents were simultaneously present at concentrations in groundwater which, in fact, have not been documented for groundwater samples obtained from monitoring well MW-4A. Moreover, analysis of soil samples collected from the base of inactive pond units 1 and 2 do not suggest the presence of a reserve accumulation of semivolatile constituents which could serve as an originating source for the high groundwater concentrations employed in the assessment. Hence, no significant current or future risk to livestock as a result of exposure to hydrocarbon-contaminated groundwater downgradient of the evaporation pond system has been identified.

The evaluation of total metal concentrations in MW-4A groundwater indicate no potential environmental risk to livestock posed by either chromium, lead, or nickel. However, analytical data from some sample events indicates potential for adverse impacts to livestock from intake of excessive arsenic in the contaminated shallow groundwater at MW-4A. As discussed in Section H-4.3, the overall potential for arsenic related risk resulting from livestock exposure to arsenic contaminants in the shallow groundwater is uncertain. Due to the questionable safety of the shallow groundwater at MW-4A, its use as a livestock watering source is not considered to be advisable, particularly since other groundwater supplies are known to be accessible at that same location at greater depth, and which exhibit a contaminant profile that increasingly diminishes with depth.

H-6. REFERENCES

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Wallace, L.E., T.D. Pellizzari, T.D. Hartwell, R. Perritt, and R. Ziegenfus, 1987. Exposure to benzene and other volatile compounds from active and passive smoking. Arch. Environ. Health, 42:272-279.

ATTACHMENT H-1

LABORATORY ANALYTICAL SAMPLE DATA FOR MONITORING WELL MW-4A

Rocky Mountain Analytical Laboratory
4955 Yarrow Street, Arvada, CO 80002 (303) 421-6611

A DIVISION OF
ENSECO
INCORPORATED

September 19, 1986

Trent Thomas
Geoscience Consultants, Ltd.
500 Copper N.W., Suite 325
Albuquerque, NM 87102

Dear Trent:

Enclosed are the results for the analysis of the 13 groundwater samples (Navajo Refinery) received August 12, 1986. An ion balance was performed on relevant samples and all had a percent difference of less than five percent. The ion balance results are also enclosed.

We experienced some difficulty with organic acid surrogate spike recoveries. Samples MW-9, MW-2, MW-3, MW-1 and Well Pit #2 all had more than one acid surrogate spike recovery below our QC limits. Repreparation and analysis was performed on these five samples and all still had low acid surrogate spike recoveries except for Well Pit #2, which had acceptable recoveries. Limited sample was available for the repreparation of Well Pit #2 (260 mLs vs. 1000 mLs). This suggests that there was a matrix effect on the recovery of the acid surrogate compounds when the sample was at full strength (1000 mLs).

Please do not hesitate to call if you have any questions.

Sincerely,	Approved by:
Brian J. Rahn	Jerry L. Parr
Project Coordinator	Technical Director
Inorganic Chemistry	

BJR/JLP/bj
Enclosures

RMAL #61882

SAMPLE DESCRIPTION INFORMATION

for

Geoscience Consultants, Ltd.

RMA Sample No.	Sample Description	Sample Type	Date Sampled	Date Received
61882-01	MW-8✓	Water	08/06/86	08/12/86
61882-02	MW-9✓	Water	08/06/86	08/12/86
61882-03	MW-2✓	Water	08/06/86	08/12/86
61882-04	MW-6✓	Water	08/07/86	08/12/86
61882-05	MW-3✓	Water	08/07/86	08/12/86
61882-06	Equip Blank✓	Water	08/07/86	08/12/86
61882-07	Field Blank✓	Water	08/07/86	08/12/86
61882-08	MW-7✓	Water	08/07/86	08/12/86
61882-09	MW-5✓	Water	08/07/86	08/12/86
61882-10	MW-1✓	Water	08/07/86	08/12/86
61882-11	MW-4✓	Water	08/07/86	08/12/86
61882-12	#13✓	Water	08/07/86	08/12/86
61882-13	Well Pt #2✓	Water	08/07/86	08/12/86

September 19, 1986

ANALYTIC[illegible] RESULTS

for

Geoscience Consultants, Ltd.

NORGANIC PARAMETERS

arameter	Units	61882-11		61882-12		61882-13	
otal Dissolved Solids	mg/L	13000	(10)	1200	(10)	5100	(10)
luoride	mg/L	NR	-	2.1	(0.1)	NR	-
hloride	mg/L	NR	-	202	(3)	NR	-
itrate + Nitrite as N	mg/L	NR	-	ND	(0.1)	NR	-
ulfate	mg/L	NR	-	257	(5)	NR	-
issolved Sulfide	mg/L	NR	-	0.29	(0.05)	NR	-
arb. Alk. as CaCO3 at pH 8.3	mg/L	NR	-	ND	(5)	NR	-
icarb. Alk as CaCO3 at pH 4.5	mg/L	NR	-	184	(5)	NR	-
otal Kjeldahl Nitrogen as N	mg/L	NR	-	7.2	(0.1)	NR	-

D = Not detected. NR = Not requested. Detection limits in parentheses.

ANALYTIC[illegible] RESULTS

for

Geoscience Consultants, Ltd.

PURGEABLE ORGANICS - METHOD 602

Parameter	Units	61882-03		61882-06		61882-07		61882-08	
Benzene	ug/L	ND	(0.5)	ND	(0.5)	ND	(0.5)	ND	(0.5)
Chlorobenzene	ug/L	ND	(1)	ND	(1)	ND	(1)	ND	(1)
Ethylbenzene	ug/L	ND	(1)	ND	(1)	ND	(1)	ND	(1)
Toluene	ug/L	6.4	(1)	ND	(1)	ND	(1)	7.2	(1)
,2-Dichlorobenzene	ug/L	ND	(2)	ND	(2)	ND	(2)	ND	(2)
,3-Dichlorobenzene	ug/L	ND	(2)	ND	(2)	ND	(2)	ND	(2)
,4-Dichlorobenzene	ug/L	ND	(2)	ND	(2)	ND	(2)	ND	(2)

arameter	Units	61882-09		61882-11		61882-13	
enzene	ug/L	ND	(5)	ND	(5)	ND	(5)
hlorobenzene	ug/L	ND	(10)	ND	(10)	ND	(10)
thylbenzene	ug/L	ND	(10)	39	(10)	ND	(10)
oluene	ug/L	58	(10)	140	(10)	70	(10)
,2-Dichlorobenzene	ug/L	ND	(20)	ND	(20)	ND	(20)
,3-Dichlorobenzene	ug/L	ND	(20)	ND	(20)	ND	(20)
,4-Dichlorobenzene	ug/L	ND	(20)	ND	(20)	ND	(20)

D = Not detected. Detection limits in parentheses.

SCIENTIFIC LABORATORY DIVISION

700 Camino de Salud NE
Albuquerque, NM 87106 841-2570

HEALTH ... OF NEW MEXICO
87-0742-C

REPORT TO: David Boyer
N.M. Oil Conservation Division
P. O. Box 2088
Santa Fe, N.M. 87504-2088

S.L.D. No. OR- 742-4-B
DATE REC. 5/5/87
PRIORITY ______

PHONE(S): 827-5812
USER CODE: 8 2 2 3 5
SUBMITTER: David Boyer
CODE: 2 6 0
SAMPLE COLLECTION CODE: (YYMMDDHHMMIII) 8 7 0 4 3 0 1 1 1 5 0 A X B
SAMPLE TYPE: WATER ☒, SOIL ☐, FOOD ☐, OTHER: ______ CODE: ☐☐☐☐
COUNTY: Eddy ; CITY: Artesia CODE: ☐☐☐☐☐
LOCATION CODE: (Township-Range-Section-Tracts) 1 7 S + 2 6 E + 1 2 + 1 4 2 (10N06E24342)

ANALYSES REQUESTED: Please check the appropriate box(es) below to indicate the type of analytical screens required. Whenever possible list specific compounds suspected or required.

PURGEABLE SCREENS

- ☐ (753) Aliphatic Purgeables (1-3 Carbons)
- ☒ (754) Aromatic & Halogenated Purgeables
- ☐ (765) Mass Spectrometer Purgeables
- ☐ (766) Trihalomethanes

Other Specific Compounds or Classes

- ☐ ______
- ☐ ______
- ☐ ______
- ☐ ______
- ☐ ______

EXTRACTABLE SCREENS

- ☐ (751) Aliphatic Hydrocarbons
- ☐ (760) Organochlorine Pesticides
- ☐ (755) Base/Neutral Extractables
- ☐ (758) Herbicides, Chlorophenoxy acid
- ☐ (759) Herbicides, Triazines
- ☐ (760) Organochlorine Pesticides
- ☐ (761) Organophosphate Pesticides
- ☐ (767) Polychlorinated Biphenyls (PCB's)
- ☐ (764) Polynuclear Aromatic Hydrocarbons
- ☐ (762) SDWA Pesticides & Herbicides

Remarks: ______

FIELD DATA:

pH= 7 ; Conductivity= 5500 umho/cm at 18.5 °C; Chlorine Residual= ______ mg/l
Dissolved Oxygen= ______ mg/l; Alkalinity= ______ mg/l; Flow Rate ______ ____/____
Depth to water 8'5" ft.; Depth of well 22'4" ft.; Perforation Interval ____-____ ft.; Casing: S. Steel
Sampling Location, Methods and Remarks (i.e. odors, etc.)
Monitor Well #4 - Navajo Refinery. Slightly brown, Turbid
QRB ~~[illegible]~~ Strong hydrocarbon odor, Foamy

I certify that the results in this block accurately reflect the results of my field analyses, observations and activities.(signature collector): D F Boyer Method of Shipment to the Lab: State Car
This form accompanies 2 Septum Vials, ____ Glass Jugs, and/or ____ ______
Samples were preserved as follows:

- ☐ NP: No Preservation; Sample stored at room temperature.
- ☒ P-Ice Sample stored in an ice bath (Not Frozen).
- ☐ P-$Na_2S_2O_3$ Sample Preserved with Sodium Thiosulfate to remove chlorine residual.

CHAIN OF CUSTODY

I certify that this sample was transferred from ______ to ______
at (location) ______ on ___/___/___ - ___:___ and that
the statements in this block are correct. Evidentiary Seals: Not Sealed ☐ Seals Intact: Yes ☐ No ☐
Signatures ______ ______

For OCD Use: Date Owner Notified ______ Phone or Letter? ______ Initials ______

ANALYSES PERFORMED

LAB. No.: OR- 742

THIS PAGE FOR LABORATORY RESULTS ONLY

This sample was tested using the analytical screening method(s) checked below:

PURGEABLE SCREENS

☐ (753) Aliphatic Purgeables (1-3 Carbons)
☒ (754) Aromatic & Halogenated Purgeables
☐ (765) Mass Spectrometer Purgeables
☐ (766) Trihalomethanes

Other Specific Compounds or Classes

☐ ____
☐ ____
☐ ____
☐ ____
☐ ____

EXTRACTABLE SCREENS

☐ (751) Aliphatic Hydrocarbons
☐ (760) Organochlorine Pesticides
☐ (755) Base/Neutral Extractables
☐ (758) Herbicides, Chlorophenoxy acid
☐ (759) Herbicides, Triazines
☐ (760) Organochlorine Pesticides
☐ (761) Organophosphate Pesticides
☐ (767) Polychlorinated Biphenyls (PCB's)
☐ (764) Polynuclear Aromatic Hydrocarbons
☐ (762) SDWA Pesticides & Herbicides

ANALYTICAL RESULTS

COMPOUND(S) DETECTED	CONC. [PPB]	COMPOUND(S) DETECTED	CONC. [PPB]
aromatic purgeables	see remarks		
halogenated purgeables	N.D.		
* DETECTION LIMIT *	50 ug/L	+ DETECTION LIMIT +	

ABBREVIATIONS USED:

N D = NONE DETECTED AT OR ABOVE THE STATED DETECTION LIMIT
T R = DETECTED AT A LEVEL BELOW THE STATED DETECTION LIMIT (NOT CONFIRMED)
[RESULTS IN BRACKETS] ARE UNCONFIRMED AND/OR WITH APPROXIMATE QUANTITATION

LABORATORY REMARKS: Twelve compounds in the aromatic screen region at 50-100 ppb detected with the photoionization detector but not identified. Also, five late eluting unsaturated aliphatics at 50-100 ppb detected with the photoionization detector but not identified.

CERTIFICATE OF ANALYTICAL PERSONNEL

Seal(s) Intact: Yes ☐ No ☒ Seal(s) broken by: not sealed date:

I certify that I followed standard laboratory procedures on handling and analysis of this sample unless otherwise noted and that the statements on this page accurately reflect the analytical results for this sample.

Date(s) of analysis: 5/28/87. Analyst's signature: Gary C. Eden

I certify that I have reviewed and concur with the analytical results for this sample and with the statements in this block.

Reviewers signature: K Sherrill JUN 11 1987

New Mexico Health and Environment Department
SCIENTIFIC LABORATORY DIVISION
700 Camino de Salud NE
Albuquerque, NM 87106 — (505) 841-2555

Heavy Metal ~~GENERAL WATER CHEMISTRY and NITROGEN~~ ANALYSIS

DATE RECEIVED 5 | 5 | 87 LAB NO. ICAP-24
USER CODE ☐ 59300 ☐ 59600 ☒ OTHER: 82235

Collection DATE 87104130
Collection TIME 1150
Collected by — Person/Agency Roger Anderson /OCD

SITE INFORMATION ►
Sample location MW #4 Navajo Refinery
Collection site description

RECEIVED
JUL 10 1987
OIL CONSERVATION DIVISION
SANTA FE

SEND FINAL REPORT TO ►
ENVIRONMENTAL BUREAU
NM OIL CONSERVATION DIVISION
State Land Office Bldg, PO Box 2088
Santa Fe, NM 87504-2088
Attn: David Boyer
Phone: 827-5812

Station/well code
Owner

SAMPLING CONDITIONS

☐ Bailed ☒ Pump ☐ Dipped ☐ Tap	Water level	Discharge	Sample type GRAB
pH (00400) 7	Conductivity (Uncorrected) 5500 µmho	Water Temp. (00010) 18.5 °C	Conductivity at 25°C (00094) µmho

Field comments MW #4 Navajo Refinery - See VOC sheet for comments.

SAMPLE FIELD TREATMENT — *Check proper boxes*

No. of samples submitted 1
☐ NF: Whole sample (Non-filtered)
☒ F: Filtered in field with 0.45 µmembrane filter
☐ A: 2 ml H_2SO_4/L added
☐ NA: No acid added
☐ Other-*specify*:
☐ A: 5ml conc. HNO_3 added
☒ A: 4ml fuming HNO_3 added

ANALYTICAL RESULTS from SAMPLES

NA		Units	Date analyzed
☐ Conductivity (Corrected) 25°C (00095)		µmho	
☐ Total non-filterable residue (suspended) (00530)		mg/l	
☒ Other: Pb by AA	<0.01		
☒ Other: Cr by AA	<0.005		
☒ Other: ICAP			

A-H_2SO_4			
☐ Nitrate-N +, Nitrate-N total (00630)		mg/l	
☐ Ammonia-N total (00610)		mg/l	
☐ Total Kjeldahl-N ( )		mg/l	
☐ Chemical oxygen demand (00340)		mg/l	
☐ Total organic carbon ( )		mg/l	
☐ Other:			
☐ Other:			

From _____, NA Sample:

			Date Analyzed
☐ Calcium		mg/l	
☐ Potassium		mg/l	
☐ Magnesium		mg/l	
☐ Sodium		mg/l	
☐ Bicarbonate		mg/l	
☐ Chloride		mg/l	
☐ Sulfate		mg/l	
☐ Total Solids		mg/l	
☐			
☐			
☐ Cation/Anion Balance			

Analyst
Date Reported 7 | 9 | 87
Reviewed by Jim Ashley

Laboratory remarks

FOR OCD USE -- Date Owner Notified ________ Phone or Letter? _______ Initals _______

SCIENTIFIC LABORATORY DIVISION

700 Camino de Salud NE
Albuquerque, NM 87106 841-2570

754

HEALTH ENVIRONMENT NEW MEXICO

87- 1347 -C

REPORT TO: David Boyer
N.M. Oil Conservation Division
P. O. Box 2088
Santa Fe, N.M. 87504-2088

S.L.D. No. OR- 1347 #10
DATE REC. 8-14-87
PRIORITY ____

PHONE(S): 327-5812
USER CODE: 8 2 2 3 5
SUBMITTER: David Boyer
CODE: 2 6 0

SAMPLE COLLECTION CODE: (YYMMDDHHMMIII) 8 7 0 8 1 2 1 2 5 0 D G B

SAMPLE TYPE: WATER ☒ SOIL ☐, FOOD ☐, OTHER: ____ CODE: ____

COUNTY: EDDY ; CITY: ARTESIA CODE: ____

LOCATION CODE: (Township-Range-Section-Tracts) 1 7 S + 2 6 E + 1 2 + 1 4 2 (10N06E24342)

ANALYSES REQUESTED: Please check the appropriate box(es) below to indicate the type of analytical screens required. Whenever possible list specific compounds suspected or required.

PURGEABLE SCREENS	EXTRACTABLE SCREENS
☐ (753) Aliphatic Purgeables (1-3 Carbons)	☐ (751) Aliphatic Hydrocarbons
☒ (754) Aromatic & Halogenated Purgeables	☐ (760) Organochlorine Pesticides
☐ (765) Mass Spectrometer Purgeables	☐ (755) Base/Neutral Extractables
☐ (766) Trihalomethanes	☐ (758) Herbicides, Chlorophenoxy acid
Other Specific Compounds or Classes	☐ (759) Herbicides, Triazines
☐ ____	☐ (760) Organochlorine Pesticides
☐ ____	☐ (761) Organophosphate Pesticides
☐ ____	☐ (767) Polychlorinated Biphenyls (PCB's)
☐ ____	☐ (764) Polynuclear Aromatic Hydrocarbons
☐ ____	☐ (762) SDWA Pesticides & Herbicides

Remarks: Detection limit 10 or less if possible

FIELD DATA:

pH= 7 ; Conductivity= 9800 umho/cm at 22 °C; Chlorine Residual= ____ mg/l

Dissolved Oxygen= ____ mg/l; Alkalinity= ____ mg/l; Flow Rate ____ ____/____

Depth to water 11.47 ft.; Depth of well 20.97 ft.; Perforation Interval ____-____ ft.; Casing: S. STEEL

Sampling Location, Methods and Remarks (i.e. odors, etc.)

MW-4, NAVAJO REFINERY, PURGED 21.6 G, good Recovery
STRONG ODOR, SHEEN

I certify that the results in this block accurately reflect the results of my field analyses, observations and activities.(signature collector): D H Boyer Method of Shipment to the Lab: Hand Carry

This form accompanies 2 Septum Vials, 1 Glass Jugs, and/or ____ ____

Samples were preserved as follows:

☐ NP: No Preservation; Sample stored at room temperature.
☒ P-Ice Sample stored in an ice bath (Not Frozen).
☐ P-$Na_2S_2O_3$ Sample Preserved with Sodium Thiosulfate to remove chlorine residual.

CHAIN OF CUSTODY

I certify that this sample was transferred from ____ to ____

at (location) ____ on ___/___/___ - ___:___ and that

the statements in this block are correct. Evidentiary Seals: Not Sealed ☐ Seals Intact: Yes ☐ No ☐

Signatures ____ ____

For OCD Use: Date Owner Notified ____ Phone or Letter? ____ Initials ____

ANALYSES PERFORMED

LAB. No.: OR- 1307

THIS PAGE FOR LABORATORY RESULTS ONLY

This sample was tested using the analytical screening method(s) checked below:

PURGEABLE SCREENS

☐ (753) Aliphatic Purgeables (1-3 Carbons)
☒ (754) Aromatic & Halogenated Purgeables
☐ (765) Mass Spectrometer Purgeables
☐ (766) Trihalomethanes
Other Specific Compounds or Classes
☐ ____
☐ ____
☐ ____
☐ ____
☐ ____

EXTRACTABLE SCREENS

☐ (751) Aliphatic Hydrocarbons
☐ (760) Organochlorine Pesticides
☐ (755) Base/Neutral Extractables
☐ (758) Herbicides, Chlorophenoxy acid
☐ (759) Herbicides, Triazines
☐ (760) Organochlorine Pesticides
☐ (761) Organophosphate Pesticides
☐ (767) Polychlorinated Biphenyls (PCB's)
☐ (764) Polynuclear Aromatic Hydrocarbons
☐ (762) SDWA Pesticides & Herbicides

ANALYTICAL RESULTS

COMPOUND(S) DETECTED	CONC. [PPB]	COMPOUND(S) DETECTED	CONC. [PPB]
aromatic purgeables			
benzene	45		
toluene	280		
ethylbenzene	130		
p-xylene	10		
m-xylene	942		
o-xylene	40		
halogenated purgeables	N.D.		
• DETECTION LIMIT • *	1 ug/l	+ DETECTION LIMIT +	

ABBREVIATIONS USED:

N D = NONE DETECTED AT OR ABOVE THE STATED DETECTION LIMIT
T R = DETECTED AT A LEVEL BELOW THE STATED DETECTION LIMIT (NOT CONFIRMED)
[RESULTS IN BRACKETS] ARE UNCONFIRMED AND/OR WITH APPROXIMATE QUANTITATION

LABORATORY REMARKS: ____

CERTIFICATE OF ANALYTICAL PERSONNEL

Seal(s) Intact: Yes ☐ No ☑ Seal(s) broken by: not sealed date: ____

I certify that I followed standard laboratory procedures on handling and analysis of this sample unless otherwise noted and that the statements on this page accurately reflect the analytical results for this sample.

Date(s) of analysis: 8/17/87. Analyst's signature: Larry C. Eden

I certify that I have reviewed and concur with the analytical results for this sample and with the statements in this block.

Reviewers signature: K. Meyerhein

SCIENTIFIC LABORATORY DIVISION

700 Camino de Salud NE
Albuquerque, NM 87106 841-2570 764 WEY

HEALTH ENV W MEXICO 87-1367-B

REPORT TO: David Boyer
N.M. Oil Conservation Division
P. O. Box 2088
Santa Fe, N.M. 87504-2088

S.L.D. No. OR- 1367 A

DATE REC. 8-14-87

PRIORITY ______

PHONE(S): 327-5812

USER CODE: 8 2 2 3 5

SUBMITTER: David Boyer

CODE: 2 6 0

SAMPLE COLLECTION CODE: (YYMMDDHHMMIII) 8 7 0 8 1 2 1 2 5 0 DG B

SAMPLE TYPE: WATER ☒, SOIL ☐, FOOD ☐, OTHER: ______ CODE: ☐☐☐

COUNTY: EDDY ; CITY: ARTESIA CODE: ☐☐☐☐☐

LOCATION CODE: (Township-Range-Section-Tracts) 1 7 S + 2 6 E + 1 2 + 1 4 2 (10N06E24342)

ANALYSES REQUESTED: Please check the appropriate box(es) below to indicate the type of analytical screens required. Whenever possible list specific compounds suspected or required.

PURGEABLE SCREENS

- ☐ (753) Aliphatic Purgeables (1-3 Carbons)
- ☐ (754) Aromatic & Halogenated Purgeables
- ☐ (765) Mass Spectrometer Purgeables
- ☐ (766) Trihalomethanes

Other Specific Compounds or Classes

- ☐ ______
- ☐ ______
- ☐ ______
- ☐ ______
- ☐ ______

EXTRACTABLE SCREENS

- ☐ (751) Aliphatic Hydrocarbons
- ☐ (760) Organochlorine Pesticides
- ☐ (755) Base/Neutral Extractables
- ☐ (758) Herbicides, Chlorophenoxy acid
- ☐ (759) Herbicides, Triazines
- ☐ (760) Organochlorine Pesticides
- ☐ (761) Organophosphate Pesticides
- ☐ (767) Polychlorinated Biphenyls (PCB's)
- ☒ (764) Polynuclear Aromatic Hydrocarbons
- ☐ (762) SDWA Pesticides & Herbicides

Remarks: ______

FIELD DATA:

pH= 7 ; Conductivity= 9800 umho/cm at 22 °C; Chlorine Residual= ______ mg/l

Dissolved Oxygen= ______ mg/l; Alkalinity= ______ mg/l; Flow Rate ______ ___/___

Depth to water 11.47 ft.; Depth of well 20.97 ft.; Perforation Interval ___-___ ft.; Casing: S. STEEL

Sampling Location, Methods and Remarks (i.e. odors, etc.)

MW-4, NAVAJO REFINERY, PURGED 21.6 l, good RECOVERY STRONG ODOR, SHEEN

I certify that the results in this block accurately reflect the results of my field analyses, observations and activities.(signature collector): DG Boyer Method of Shipment to the Lab: State Car

This form accompanies ___ Septum Vials, 1 Glass Jugs, and/or ______

Samples were preserved as follows:

- ☐ NP: No Preservation; Sample stored at room temperature.
- ☒ P-Ice Sample stored in an ice bath (Not Frozen).
- ☐ P-$Na_2S_2O_3$ Sample Preserved with Sodium Thiosulfate to remove chlorine residual.

CHAIN OF CUSTODY

I certify that this sample was transferred from ______ to ______

at (location) ______ on ___/___/___ - ___:___ and that

the statements in this block are correct. Evidentiary Seals: Not Sealed ☐ Seals Intact: Yes ☐ No ☐

Signatures ______ ______

For OCD Use: Date Owner Notified ______ Phone or Letter? ______ Initials ______

ANALYSES PERFORMED

LAB. No.: OR- 1367

THIS PAGE FOR LABORATORY RESULTS ONLY

This sample was tested using the analytical screening method(s) checked below:

PURGEABLE SCREENS

- ☐ (753) Aliphatic Purgeables (1-3 Carbons)
- ☐ (754) Aromatic & Halogenated Purgeables
- ☐ (765) Mass Spectrometer Purgeables
- ☐ (766) Trihalomethanes

Other Specific Compounds or Classes

- ☐ ________
- ☐ ________
- ☐ ________
- ☐ ________
- ☐ ________

EXTRACTABLE SCREENS

- ☐ (751) Aliphatic Hydrocarbons
- ☐ (760) Organochlorine Pesticides
- ☐ (755) Base/Neutral Extractables
- ☐ (758) Herbicides, Chlorophenoxy acid
- ☐ (759) Herbicides, Triazines
- ☐ (760) Organochlorine Pesticides
- ☐ (761) Organophosphate Pesticides
- ☐ (767) Polychlorinated Biphenyls (PCB's)
- ☒ (764) Polynuclear Aromatic Hydrocarbons
- ☐ (762) SDWA Pesticides & Herbicides

ANALYTICAL RESULTS

COMPOUND(S) DETECTED	CONC. [PPB]	COMPOUND(S) DETECTED	CONC. [PPB]
NAPHTHALENE MDL = 10 ppB	TR <10	unknown (see remarks)	9700 ppB
2-Methylnaphthalene MDL = 10 ppB	TR <10		
1-Methylnaphthalene MDL = 10 ppB	98 ppB		
acenaphthalene MDL = 10 ppB	31 ppB		
acenaphthene MDL = 10 ppB	TR <10		
Fluorene MDL = 10 ppB	ND <10		
others MDL = 10 ppB	ND <10		
• DETECTION LIMIT • *		+ DETECTION LIMIT + +	

ABBREVIATIONS USED:

N D = NONE DETECTED AT OR ABOVE THE STATED DETECTION LIMIT

T R = DETECTED AT A LEVEL BELOW THE STATED DETECTION LIMIT (NOT CONFIRMED)

[RESULTS IN BRACKETS] ARE UNCONFIRMED AND/OR WITH APPROXIMATE QUANTITATION

Sample 800ml

LABORATORY REMARKS: Unknown calculated against Chlordane standard. Unknown is a complex blend whose chromatographic fingerprint is similar to Chlordane and Aroclor 1248 but is not a good match. Beside the PNA's approximately 90 compounds are present ranging in concentration from traces to 250 ppB whose origin may have been Gasoline.

CERTIFICATE OF ANALYTICAL PERSONNEL

Seal(s) Intact: Yes ☐ No ☐. Seal(s) broken by: no seals date: ________

I certify that I followed standard laboratory procedures on handling and analysis of this sample unless otherwise noted and that the statements on this page accurately reflect the analytical results for this sample.

Date(s) of analysis: 9/1/87 Analyst's signature: C S Burney

I certify that I have reviewed and concur with the analytical results for this sample and with the statements in this block.

Reviewers signature: K Meyerhein

corrected copy

SCIENTIFIC LABORATORY DIVISION

700 Camino de Salud NE
Albuquerque, NM 87106 841-2570

wpu
754

87-1833-C

REPORT TO: David Boyer
N.M. Oil Conservation Division
P. O. Box 2088
Santa Fe, N.M. 87504-2088

S.L.D. No. OR-1833 A+B

DATE REC. 11-16-87

PRIORITY ______

PHONE(S): 327-5812

USER CODE: 8 2 2 3 5

SUBMITTER: David Boyer

CODE: 2 6 0

SAMPLE COLLECTION CODE: (YYMMDDHHMMIII) 8711121250A&B

SAMPLE TYPE: WATER ☒, SOIL ☐, FOOD ☐, OTHER: ______ CODE: ______

COUNTY: Eddy ; CITY: Artesia CODE: ______

LOCATION CODE: (Township-Range-Section-Tracts) ______ (10N06E24342)

ANALYSES REQUESTED: Please check the appropriate box(es) below to indicate the type of analytical screens required. Whenever possible list specific compounds suspected or required.

PURGEABLE SCREENS

- ☐ (753) Aliphatic Purgeables (1-3 Carbons)
- ☒ (754) Aromatic & Halogenated Purgeables
- ☐ (765) Mass Spectrometer Purgeables
- ☐ (766) Trihalomethanes

Other Specific Compounds or Classes

- ☐ ______
- ☐ ______
- ☐ ______
- ☐ ______
- ☐ ______

EXTRACTABLE SCREENS

- ☐ (751) Aliphatic Hydrocarbons
- ☐ (760) Organochlorine Pesticides
- ☐ (755) Base/Neutral Extractables
- ☐ (758) Herbicides, Chlorophenoxy acid
- ☐ (759) Herbicides, Triazines
- ☐ (760) Organochlorine Pesticides
- ☐ (761) Organophosphate Pesticides
- ☐ (767) Polychlorinated Biphenyls (PCB's)
- ☐ (764) Polynuclear Aromatic Hydrocarbons
- ☐ (762) SDWA Pesticides & Herbicides

Remarks: Detection Limit 10ppb if possible

FIELD DATA:

pH= 7 ; Conductivity= 500 μmho/cm at 25 °C; Chlorine Residual= ______ mg/l

Dissolved Oxygen= ______ mg/l; Alkalinity= ______ mg/l; Flow Rate ______ ______/______

Depth to water ______ ft.; Depth of well ______ ft.; Perforation Interval ______-______ ft.; Casing: ______

Sampling Location, Methods and Remarks (i.e. odors, etc.)

Navajo Refinery - MW4

I certify that the results in this block accurately reflect the results of my field analyses, observations and activities.(signature collector): DBoyer Method of Shipment to the Lab: Car

This form accompanies 2 Septum Vials, ______ Glass Jugs, and/or ______ ______

Samples were preserved as follows:

- ☐ NP: No Preservation; Sample stored at room temperature.
- ☒ P-Ice Sample stored in an ice bath (Not Frozen).
- ☐ $P-Na_2S_2O_3$ Sample Preserved with Sodium Thiosulfate to remove chlorine residual.

CHAIN OF CUSTODY

I certify that this sample was transferred from ______ to ______

at (location) ______ on ____/____/____ - ____:____ and that

the statements in this block are correct. Evidentiary Seals: Not Sealed ☐ Seals Intact: Yes ☐ No ☐

Signatures ______ ______

For OCD Use: Date Owner Notified ______ Phone or Letter? ______ Initials ______

ANALYSES PERFORMED

LAB. No.: OR- 1833

THIS PAGE FOR LABORATORY RESULTS ONLY

This sample was tested using the analytical screening method(s) checked below:

PURGEABLE SCREENS

☐ (753) Aliphatic Purgeables (1-3 Carbons)
☒ (754) Aromatic & Halogenated Purgeables
☐ (765) Mass Spectrometer Purgeables
☐ (766) Trihalomethanes
Other Specific Compounds or Classes
☐ ______
☐ ______
☐ ______
☐ ______
☐ ______

EXTRACTABLE SCREENS

☐ (751) Aliphatic Hydrocarbons
☐ (760) Organochlorine Pesticides
☐ (755) Base/Neutral Extractables
☐ (758) Herbicides, Chlorophenoxy acid
☐ (759) Herbicides, Triazines
☐ (760) Organochlorine Pesticides
☐ (761) Organophosphate Pesticides
☐ (767) Polychlorinated Biphenyls (PCB's)
☐ (764) Polynuclear Aromatic Hydrocarbons
☐ (762) SDWA Pesticides & Herbicides

ANALYTICAL RESULTS

COMPOUND(S) DETECTED	CONC. [PPB]	COMPOUND(S) DETECTED	CONC. [PPB]
aromatic purgeables	see remarks		
[benzene]	[<1]		
[ethylbenzene]	[156]	corrected	
[p-xylene]	[15]		
[m-xylene]	~~1770~~	[12] G.E.	
[o-xylene]	[32]		
[Toluene]	[25]		
halogenated purgeables	N.D.		
* DETECTION LIMIT *	1.0 µg/l	+ DETECTION LIMIT +	

ABBREVIATIONS USED:
N D = NONE DETECTED AT OR ABOVE THE STATED DETECTION LIMIT
T R = DETECTED AT A LEVEL BELOW THE STATED DETECTION LIMIT (NOT CONFIRMED)
[RESULTS IN BRACKETS] ARE UNCONFIRMED AND/OR WITH APPROXIMATE QUANTITATION

LABORATORY REMARKS: Six compounds in the aromatic xylene region at 50-200 ppb and eight late eluting compounds in the C3 substituted benzene region at 50-800 ppb detected by the photoionization detector but not identified.

CERTIFICATE OF ANALYTICAL PERSONNEL

Seal(s) Intact: Yes ☐ No ☑ Seal(s) broken by: not sealed date: ______

I certify that I followed standard laboratory procedures on handling and analysis of this sample unless otherwise noted and that the statements on this page accurately reflect the analytical results for this sample.

Date(s) of analysis: 11/15/83 . Analyst's signature: Gary C. Eden

I certify that I have reviewed and concur with the analytical results for this sample and with the statements in this block.

Reviewers signature: R Meyerhein

SCIENTIFIC LABORATORY DIVISION

700 Camino de Salud NE
Albuquerque, NM 87106 841-2570

754
wpu

88-0797-C

REPORT TO: David Boyer
N.M. Oil Conservation Division
P. O. Box 2088
Santa Fe, N.M. 87504-2088

S.L.D. No. OR- 797 A+B
DATE REC. 6-3-88
PRIORITY 3

PHONE(S): 327-5812
USER CODE: 8 2 2 3 5
SUBMITTER: David Boyer
CODE: 2 6 0

SAMPLE COLLECTION CODE: (YYMMDDHHMMIII) 8806011830DGB

SAMPLE TYPE: WATER ☒, SOIL ☐, FOOD ☐, OTHER: ____ CODE: ____

COUNTY: Eddy ; CITY: Artesia CODE: ____

LOCATION CODE: (Township-Range-Section-Tracts) 17S+26E+12+242 (10N06E24342)

ANALYSES REQUESTED: Please check the appropriate box(es) below to indicate the type of analytical screens required. Whenever possible list specific compounds suspected or required.

PURGEABLE SCREENS

☐ (753) Aliphatic Purgeables (1-3 Carbons)
☒ (754) Aromatic & Halogenated Purgeables
☐ (765) Mass Spectrometer Purgeables
☐ (766) Trihalomethanes

Other Specific Compounds or Classes
☐ ____
☐ ____
☐ ____
☐ ____
☐ ____

EXTRACTABLE SCREENS

☐ (751) Aliphatic Hydrocarbons
☐ (760) Organochlorine Pesticides
☐ (755) Base/Neutral Extractables
☐ (758) Herbicides, Chlorophenoxy acid
☐ (759) Herbicides, Triazines
☐ (760) Organochlorine Pesticides
☐ (761) Organophosphate Pesticides
☐ (767) Polychlorinated Biphenyls (PCB's)
☐ (764) Polynuclear Aromatic Hydrocarbons
☐ (762) SDWA Pesticides & Herbicides

Remarks: Not HCl preserved

FIELD DATA:

pH= 7 ; Conductivity= 5700 umho/cm at 20.5 C; Chlorine Residual= ____ mg/l

Dissolved Oxygen= ____ mg/l; Alkalinity= ____ mg/l; Flow Rate ____ ____/____

Depth to water 10.1 ft.; Depth of well 22.6 ft.; Perforation Interval ____-____ ft.; Casing: ____

Sampling Location, Methods and Remarks (i.e. odors, etc.)

Navajo Refinery - MW #4 Monitoring well, Strong H/C odor, Foamy Purged 10 gallons

I certify that the results in this block accurately reflect the results of my field analyses, observations and activities.(signature collector): D G Boyer Method of Shipment to the Lab: State Car

This form accompanies 2 Septum Vials, 0 Glass Jugs, and/or ____ ____

Samples were preserved as follows:

☐ NP: No Preservation; Sample stored at room temperature.
☒ P-Ice Sample stored in an ice bath (Not Frozen).
☐ P-$Na_2S_2O_3$ Sample Preserved with Sodium Thiosulfate to remove chlorine residual.

CHAIN OF CUSTODY

I certify that this sample was transferred from ____ to ____

at (location) ____ on ____/____/____ - ____:____ and that

the statements in this block are correct. Evidentiary Seals: Not Sealed ☐ Seals Intact: Yes ☐ No ☐

Signatures ____ ____

For OCD Use: Date Owner Notified 6/19/88 Phone or Letter? ____ Initials

ANALYSES PERFORMED

LAB. No.: OR- 797

THIS PAGE FOR LABORATORY RESULTS ONLY

This sample was tested using the analytical screening method(s) checked below:

PURGEABLE SCREENS

☐ (753) Aliphatic Purgeables (1-3 Carbons)
☒ (754) Aromatic & Halogenated Purgeables
☐ (765) Mass Spectrometer Purgeables
☐ (766) Trihalomethanes

Other Specific Compounds or Classes

☐ ______
☐ ______
☐ ______
☐ ______
☐ ______

EXTRACTABLE SCREENS

☐ (751) Aliphatic Hydrocarbons
☐ (760) Organochlorine Pesticides
☐ (755) Base/Neutral Extractables
☐ (758) Herbicides, Chlorophenoxy acid
☐ (759) Herbicides, Triazines
☐ (760) Organochlorine Pesticides
☐ (761) Organophosphate Pesticides
☐ (767) Polychlorinated Biphenyls (PCB's)
☐ (764) Polynuclear Aromatic Hydrocarbons
☐ (762) SDWA Pesticides & Herbicides

ANALYTICAL RESULTS

COMPOUND(S) DETECTED	CONC. [PPB]	COMPOUND(S) DETECTED	CONC. [PPB]
aromatic purgeables	see remarks	halogenated purgeables +	N.D.
* DETECTION LIMIT * *	25 ug/l	+ DETECTION LIMIT + +	25 ug/l

ABBREVIATIONS USED:

N D = NONE DETECTED AT OR ABOVE THE STATED DETECTION LIMIT
T R = DETECTED AT A LEVEL BELOW THE STATED DETECTION LIMIT (NOT CONFIRMED)
[RESULTS IN BRACKETS] ARE UNCONFIRMED AND/OR WITH APPROXIMATE QUANTITATION

LABORATORY REMARKS: fifteen compounds ranging from the aromatic screen region to the C3 substituted benzene region at less than 25 ppb to 50 ppb detected by the photoionization detector but not identified.

CERTIFICATE OF ANALYTICAL PERSONNEL

Seal(s) Intact: Yes ☐ No ☑ Seal(s) broken by: not sealed date: ______

I certify that I followed standard laboratory procedures on handling and analysis of this sample unless otherwise noted and that the statements on this page accurately reflect the analytical results for this sample.

Date(s) of analysis: 6/10/88 . Analyst's signature: Gary C. Eden

I certify that I have reviewed and concur with the analytical results for this sample and with the statements in this block.

Reviewers signature: K Meyerhein

New Mexico Health and Environment Department
SCIENTIFIC LABORATORY DIVISION
700 Camino de Salud NE
Albuquerque, NM 87106

HEAVY METAL ANALYSIS FORM

Telephone: (505)841-2553

Date Received	6 13 88	Lab No. ICP-238	User Code	☒ 82235	☐ Other:

COLLECTION DATE & TIME: yy 88 mm 06 dd 01 hh 18 mm 30

COLLECTION SITE DESCRIPTION: MW #4 Monitor Well

COLLECTED BY: Boyer/Anderson ock

TO:

ENVIRONMENTAL BUREAU
NM OIL CONSERVATION DIVISION
State Land Office Bldg., PO Box 2088
SANTA FE, NM 87504-2088

RECEIVED
AUG 17 1988
OIL CONSERVATION DIVISION
SANTA FE

ATTN: D. Boyer
TELEPHONE: 827-5812

OWNER: [illegible]

SITE LOCATION:
County: Eddy

Township, Range, Section, Tract: (10N06E24342)
U17S+31E+12+~~1~~4124

STATION/ WELL CODE:

LATITUDE, LONGITUDE:

SAMPLING CONDITIONS:

☒ Bailed ☐ Dipped	☒ Pump ☐ Tap	Water Level: 10.1	Discharge: -	Sample Type: Grab

pH(00400) 7	Conductivity (Uncorr.) 5,700 µmho	Water Temp. (00010) 20.5 °C	Conductivity at 25°C (00094) µmho

FIELD COMMENTS:

SAMPLE FIELD TREATMENT
Check proper boxes:

☐ WPN: Water Preserved w/HNO_3 Non-Filtered

☒ WPF: Water Preserved w/HNO_3 Filtered

LAB ANALYSIS REQUESTED:

☒ ICAP Scan
Mark box next to metal if AA is required.

ANALYTICAL RESULTS (MG/L)

ELEMENT	ICAP VALUE	AA VALUE
Aluminum	<0.1	
Barium	<0.1	
Beryllium	<0.1	
Boron	0.7	
Cadmium	<0.1	☐
Calcium	340.	
Chromium	<0.1	☒ <0.005
Cobalt	<0.05	
Copper	<0.1	
Iron	1.5	
Lead	<0.1	☒ <0.01
Magnesium	92.	
Manganese	2.4	
Molybdenum	<0.1	
Nickel	<0.1	

ELEMENT	ICAP VALUE	AA VALUE
Silicon	17.	
Silver	<0.1	☐
Strontium	5.3	
Tin	<0.1	
Vanadium	<0.1	
Zinc	<0.1	
Arsenic		☒ 0.21
Selenium		☐
Mercury		☐
		☐
		☐
		☐
		☐
		☐
		☐
		☐

LAB COMMENTS: digest

For OCD Use:
Date Owner Notified: 8/17/88
Phone or Letter?
Initials: LRB

ICAP Analyst JA
Date Analyzed 6/7/88

Reviewer
Date Reviewed 8/10/88

STATE OF NEW MEXICO
ENERGY, MINERALS AND NATURAL RESOURCES DEPARTMENT
OIL CONSERVATION DIVISION

1829

ANALYSIS REQUEST FORM

Contract Lab INTER Mountain Contract No.

OCD Sample No. 8907261221

Collection Date	Collection Time	Collected by —Person/Agency
7 26 89	1221	BOYER, ENGLERT /OCD

SITE INFORMATION

Sample location NAVAJO REFINERY: MW-4

Collection Site Description

Township, Range, Section, Tract: | 1 | 7 | S+3 | 6 | E+1 | 2+1 | 4 | 2

SEND FINAL REPORT TO
ENVIRONMENTAL BUREAU
NM OIL CONSERVATION DIVISION
PO Box 2088
Santa Fe, NM 87504-2088

SAMPLING CONDITIONS

☒ Bailed ☐ Pump
☐ Dipped ☐ Tap

Water level 11.84

Discharge 7 gallons

Sample type GRAB

pH(00400) 7.04

Conductivity (Uncorrected) 6000 μmho

Water Temp. (00010) 17°C

Conductivity at 25° C μmho

SAMPLE FIELD TREATMENT — *Check proper boxes*

No. of samples submitted: 1

☐ NF: Whole sample (Non-filtered)
☒ F: Filtered in field with 0.45 μ membrane filter
☐ PF: Pre-filtered w/45 μ membrane filter

☒ NA: No acid added
☐ A: HCL
☐ A: $2ml\ H_2SO_4/L$ added
☐ A: 5ml conc. HNO_3 added
☐ A: 4ml fuming HNO_3 added

FIELD COMMENTS:

clear water, very strong HC like odor, brown greasy film on pump

LAB ANALYSIS REQUESTED:

ITEM	DESC	METHOD	ITEM	DESC	METHOD	ITEM	DESC	METHOD
☐ 001	VOA	8020	☐ 013	PHENOL	604	☐ 026	Cd	7130
☐ 002	VOA	602	☐ 014	VOC	8240	☐ 027	Pb	7421
☐ 003	VOH	8010	☐ 015	VOC	624	☐ 028	Hg(L)	7470
☐ 004	VOH	601	☐ 016	SVOC	8250	☐ 031	Se	7740
☐ 005	SUITE	8010-8020	☐ 017	SVOC	625	☐ 032	ICAP	6010
☐ 006	SUITE	601-602	☐ 018	VOC	8260	☒ 033	CATIONS/ANIONS	
☐ 007	HEADSPACE		☐ 019	SVOC	8270	☐ 034	N SUITE	
☐ 008	PAH	8100	☐ 020	O&G	9070	☐ 035	NITRATE	
☐ 009	PAH	610	☐ 022	AS	7060	☐ 036	NITRITE	
☐ 010	PCB	8080	☐ 023	Ba	7080	☐ 037	AMMONIA	
☐ 011	PCB	608	☐ 024	Cr	7190	☐ 038	TKN	
☐ 012	PHENOL	8040	☐ 025	Cr6	7198	☒	OTHER Floaride	

ANA-LAB CORP.
THE COMPLETE SERVICE LAB

2600 DUDLEY ROAD — KILGORE, TEXAS 75662 — 214/984-0551
Analytical Chemistry • Waste Treatment & Disposal • Equipment Sales

09/21/89

Environmental Bureau NM Oil D.
PO Box 2088
Santa Fe, NM 87504

RECEIVED
SEP 22 1989
OIL CONSERVATION DIV.
SANTA FE

Sample Identification: MW4 Navajo Ref.
Flow or other on site data: 4 Vials +2 Clear, Strong HC Od
Collected by: Royer, Englert
Date & Time Taken: 07/26/89 1221
Additional Sample Information: 175-26E-12-142 Bailed 7 gal pH 7.04 Temp 17 Cond 6000 NF 8020:A 8010:NA WL 11.3
Lab Sample Number: 149759 Received: 07/29/89

PARAMETER:	RESULTS	QUALITY CONTROL	ANALYZED ON	AT	ANALYST
1,1,1-Trichloroethane, ug/l EPA Method 8010	<5		08/05/89	1253	BP
1,1,2,2-Tetrachloroethane, ug/l EPA Method 8010	<5		08/05/89	1253	BP
1,1,2-Trichloroethane, ug/l EPA Method 8010	<5		08/05/89	1253	BP
1,1-Dichloroethane, ug/l EPA Method 8010	<5		08/05/89	1253	BP
1,1-Dichloroethene, ug/l EPA Method 8010	<1		08/05/89	1253	BP
1,2-Dichloroethane, ug/l EPA Method 8010	<5		08/05/89	1253	BP
1,2-Dichloropropane, ug/l EPA Method 8010	<5		08/05/89	1253	BP
2-Chloroethylvinyl ether, ug/l EPA Method 8010	<10		08/05/89	1253	BP
Benzene, ug/l EPA Method 8020	<5		08/05/89	1253	BP
Bromodichloromethane, ug/l EPA Method 8010	<5		08/05/89	1253	BP

continued

Lab Sample Number: 149759 Continued

PARAMETER:	RESULTS	QUALITY CONTROL	ANALYZED ON	AT	ANALYST
Bromoform, ug/l EPA Method 8010	<5		08/05/89	1253	BP
Bromomethane, ug/l EPA Method 8010	<10		08/05/89	1253	BP
Carbon Tetrachloride, ug/l EPA Method 8010	<5		08/05/89	1253	BP
Chlorobenzene, ug/l EPA Method 8010	<5		08/05/89	1253	BP
Chloroethane, ug/l EPA Method 8010	<10		08/05/89	1253	BP
Chloroform, ug/l EPA Method 8010	<5		08/05/99	1253	BP
Chloromethane, ug/l EPA Method 8010	<10		08/05/89	1253	BP
Cis-1,3-Dichloropropene, ug/l EPA Method 8010	<5		08/05/89	1253	BP
Dibromochloromethane, ug/l EPA Method 8010	<5		08/05/89	1253	BP
Ethyl benzene, ug/l EPA Method 8020	<5		08/05/89	1253	BP
Freon, ug/l EPA Method 8010	<5		08/05/89	1253	BP
Methylene Chloride, ug/l EPA Method 8010	<5		08/05/89	1253	BP
Tetrachloroethene, ug/l EPA Method 8010	<5		08/05/89	1253	BP
Toluene, ug/l EPA Method 8020	<5		08/05/89	1253	BP

continued

Lab Sample Number: 149759 Continued

PARAMETER:	RESULTS	QUALITY CONTROL	ANALYZED ON	AT	ANALYST
Trans-1,2-Dichloroethene, ug/l EPA Method 8010	<5		08/25/89	1253	BP
Trans-1,3-Dichloropropene, ug/l EPA Method 8010	<5		08/05/89	1253	BP
Trichloroethene, ug/l EPA Method 8010	<5		08/05/89	1253	BP
Vinyl Chloride, ug/l EPA Method 8010	<1		08/05/89	1253	BP
Xylenes, ug/l EPA Method 8020	<10		08/05/89	1253	BP
2,4,6-Trichlorophenol, ug/l EPA Method 8270	<10		09/20/89	1832	BP
2,4-Dichlorophenol, ug/l EPA Method 8270	<10		09/20/89	1832	BP
2,4-Dimethylphenol, ug/l EPA Method 8270	<10		09/20/89	1832	BP
2,4-Dinitrophenol, ug/l EPA Method 8270	<50		09/20/89	1832	BP
2-Chlorophenol, ug/l EPA Method 8270	<10		09/20/89	1832	BP
2-Methyl-4,6-dinitrophenol,ug/l EPA Method 8270	<50		09/20/89	1832	BP
2-Nitrophenol, ug/l EPA Method 8270	<10		09/20/89	1832	BP
4-Chloro-3-methylphenol, ug/l EPA Method 8270	<20		09/20/89	1832	BP
4-Nitrophenol, ug/l EPA Method 8270	<50		09/20/89	1832	BP

continued

Lab Sample Number: 149759 Continued

PARAMETER:	RESULTS	QUALITY CONTROL	ANALYZED ON	AT	ANALYST
Pentachlorophenol, ug/l EPA Method 8270	<50		09/20/89	1832	BP
Phenol, ug/l EPA Method 8270	<10		09/20/89	1832	BP
2-Chloronapthalene, ug/l EPA Method 8270	<10		09/20/89	1832	BP
Acenaphthene, ppb EPA Method 610	<10		09/20/89	1832	BP
Acenaphthylene, ug/l EPA Method 8270	<10		09/20/89	1832	BP
Benzo(a)anthracene, ug/l EPA Method 8270	<10		09/20/89	1832	BP
Benzo(a)pyrene, ug/l EPA Method 8270	<10		09/20/89	1832	BP
Benzo(b)fluoranthene, ug/l EPA Method 8270	<10		09/20/89	1832	BP
Benzo(ghi)perylene, ug/l EPA Method 8270	<10		09/20/89	1832	BP
Benzo(k)fluoranthene, ug/l EPA Method 8270	<10		09/20/89	1832	BP
Chrysene, ug/l EPA Method 8270	<10		09/20/89	1832	BP
Dibenzo(a,h)anthracene, ug/l EPA Method 8270	<10		09/20/89	1832	BP
Fluoranthene, ug/l EPA Method 8270	<10		09/20/89	1832	BP
Fluorene, ug/l EPA Method 8270	<10		09/20/89	1832	BP

continued

Lab Sample Number: 149759 Continued

PARAMETER:	RESULTS	QUALITY CONTROL	ANALYZED ON	AT	ANALYST
Indeno(1,2,3-cd)pyrene, ug/l EPA Method 8270	<10		09/20/89	1832	BP
Naphthalene, ug/l EPA Method 8270	<10		09/20/89	1832	BP
Phenanthrene, ug/l EPA Method 8270	<10		09/20/89	1832	BP
Pyrene, ug/l EPA Method 8270	<10		09/20/89	1832	BP

==

Bill Peery

C. H. Whiteside, Ph.D., President

iml
Inter·Mountain
Laboratories, Inc.

2506 West Main Street
Farmington, New Mexico 87401
Tel. (505) 326-4737

CLIENT:	OCD	DATE REPORTED:	08/21/89
SAMPLE:	8907261221		
SITE:	MW-4	DATE RECEIVED:	07/31/89
LAB NO:	F1829	DATE COLLECTED:	07/26/89

Lab pH	8.08
Lab Conductivity, umhos/cm	8288
Lab resistivity, ohm-m	1.2066
Total Dissolved Solids (180), mg/l	6830
Total Dissolved Solids (calc), mg/l	6639
Total Alkalinity as $CaCO_3$, mg/l	255.78
Total Acidity as $CaCO_3$, mg/l	0.00
Total Hardness as $CaCO_3$, mg/l	2105.31
Sodium Absorption Ratio	13.28
Fluoride, mg/l	1.57

	mg/l	meq/l
Bicarbonate as HCO_3	312.05	5.12
Carbonate as CO_3	0.00	0.00
Chloride	1744.14	49.20
Sulfate	2612.20	54.42
Calcium	547.54	27.32
Magnesium	179.77	14.78
Potassium	1.00	0.03
Sodium	1400.70	60.93
Major Cations		103.06
Major Anions		108.74
Cation/Anion Difference		2.68 % **

Trace metals (Dissolved Concentration), mg/l

Arsenic	0.087
Lead	<0.02
Chromium	0.038

** This large ion % difference is most likely due to an abundance of metal cations which were not analyzed. All major ions were reanalyzed without significant changes.

C Neal Schaeffer

C. Neal Schaeffer
Senior Chemist

Inter-Mountain
Laboratories, Inc.

2506 West Main Street
Farmington, New Mexico 87401
Tel. (505) 326-4737

CLIENT: OCD
ID: 8907261221
SITE: MW-4
LAB NO: F1829

DATE REPORTED: 08/22/89
DATE EXTRACTED: 08/08/89
DATE RECEIVED: 08/02/89
DATE COLLECTED: 07/26/89

Analysis Requested: Purgeable aromatics in water.

Parameter	Concentration	Units
Benzene	ND (0.2)	ug/l
Ethylbenzene	ND (0.2)	ug/l
Toluene	35.72 (0.2)	ug/l
1,2-Dichlorobenzene	ND (0.2)	ug/l
1,3-Dichlorobenzene	ND (0.2)	ug/l
1,4-Dichlorobenzene	ND (0.2)	ug/l
Chlorobenzene	ND (0.2)	ug/l
m-Xylene	ND (0.2)	ug/l
o-Xylene	ND (0.2)	ug/l
p-Xylene	ND (0.2)	ug/l

Method:
8020 Aromatic Volatile Organics, SW-846, USEPA (1982)

(Detection limit in parenthesis.)
ND - Parameter not detected at the stated detection limit.

C. Neal Schaeffer
Senior Chemist

CLIENT: OCD
ID: 8907261221
SITE: MW-4
LAB NO: F1829

DATE REPORTED: 08/22/89
DATE EXTRACTED: 08/07/89
DATE RECEIVED: 08/02/89
DATE COLLECTED: 07/26/89

Analysis Requested: Purgeable halocarbons in water.

Parameter	Concentration	Units
Bromobenzene	ND (1.0)	ug/l
Bromodichloromethane	ND (1.0)	ug/l
Bromoform	ND (1.0)	ug/l
Carbon Tetrachloride	ND (1.0)	ug/l
Chlorobenzene	ND (1.0)	ug/l
Chloroethane	ND (1.0)	ug/l
Chloroform	ND (1.0)	ug/l
Chloromethane	ND (1.0)	ug/l
Dibromochloromethane	ND (1.0)	ug/l
Dibromomethane	ND (1.0)	ug/l
1,2-Dichlorobenzene	ND (1.0)	ug/l
1,3-Dichlorobenzene	ND (1.0)	ug/l
1,4-Dichlorobenzene	ND (1.0)	ug/l
Dichlorodifluoromethane	ND (1.0)	ug/l
1,1-Dichloroethane	ND (1.0)	ug/l
1,2-Dichloroethane	ND (1.0)	ug/l
1,1-Dichloroethene	ND (1.0)	ug/l
trans-1,2-Dichloroethene	ND (1.0)	ug/l
1,2-Dichloropropane	ND (1.0)	ug/l
1,3-Dichloropropylene	ND (1.0)	ug/l
2,2-Dichloropropane	ND (1.0)	ug/l
Dichloromethane	ND (1.0)	ug/l
1,1,1,2-Tetrachloroethane	ND (1.0)	ug/l
1,1,2,2-Tetrachloroethane	ND (1.0)	ug/l
Tetrachloroethene	ND (1.0)	ug/l
1,1,1-Trichloroethane	ND (1.0)	ug/l
1,1,2-Trichloroethane	ND (1.0)	ug/l
Trichloroethene	ND (1.0)	ug/l
Trichlorofluoromethane	ND (1.0)	ug/l
1,2,3-Trichloropropane	ND (1.0)	ug/l

ID: 8907261221
LAB NO: F1829

DATE REPORTED: 08/22/89

Benzyl Chloride	ND	(1.0)	ug/l
bis(2-chloroethoxy)methane	ND	(1.0)	ug/l
bis(2-Cloroisopropyl)ether	ND	(1.0)	ug/l
Bromomethane	ND	(1.0)	ug/l
Chloracetaldehyde	ND	(1.0)	ug/l
1-Chlorohexane	ND	(1.0)	ug/l
1-Chloroethyl Vinyl Ether	ND	(1.0)	ug/l
Chloromethyl methyl ether	ND	(1.0)	ug/l
Chlorotoluene	ND	(1.0)	ug/l
1,3-Dichloropropene	ND	(1.0)	ug/l

Method:
8010 Halogenated Volatile Organics, SW-846, USEPA (1982).

(Detection limit in parenthesis.)
ND - Parameter not detected at the stated detection limit.

C. Neal Schaeffer
Senior Chemist

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2506 West Main Street
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Tel. (505) 326-4737

CLIENT: OCD
SAMPLE: 8907261221
SITE: MW-4
LAB NO: F1829

DATE REPORTED: 09/26/89
DATE EXTRACTED: 08/02/89
DATE RECEIVED: 07/31/89
DATE COLLECTED: 07/26/89

Analysis Requested: Phenols in water.

Parameter	Concentration		Units
4-Chloro-3-methylphenol	ND	(1.0)	ug/l
2-Chlorophenol	3.1	(1.0)	ug/l
2,4-Dichlorophenol	ND	(1.0)	ug/l
2,4-Dimethylphenol	59.0	(1.0)	ug/l
2,4-Dinitrophenol	ND	(15.0)	ug/l
2-Methyl-4,6-dinitrophenol	ND	(15.0)	ug/l
2-Nitrophenol	ND	(1.0)	ug/l
4-Nitrophenol	36.0	(3.0)	ug/l
Pentachlorophenol	ND	(8.0)	ug/l
Phenol	30.0	(1.0)	ug/l
2,4,6-Trichlorophenol	ND	(1.0)	ug/l
2-sec-Butyl-4,6-dinitrophenol	ND	(1.0)	ug/l
Cresols (methyl phenols)	ND	(1.0)	ug/l
2-Cyclohexyl-4,6-dinitrophenol	ND	(1.0)	ug/l
2,6-Dichlorophenol	ND	(1.0)	ug/l
Tetrachlorophenols	ND	(1.0)	ug/l
Trichlorophenols	ND	(1.0)	ug/l

Method:
8040 Phenols, SW-846, USEPA (1982).
604 Phenols, 40 CFR Part 136 (1984).

(Detection limit in parenthesis.)
ND - Parameter not detected at the stated detection limit.

C. Neal Schaeffer
Senior Chemist

CLIENT: OCD
SAMPLE: 8907261221
SITE: MW-4
LAB NO: F1829

DATE REPORTED: 09/11/89
DATE EXTRACTED: 08/01/89
DATE RECEIVED: 07/31/89
DATE COLLECTED: 07/26/89

Analysis Requested: Polynuclear aromatic hydrocarbons in water.

Parameter	Concentration	Units
Acenaphthene	ND (1.8)	ug/l
Acenaphthylene	ND (2.3)	ug/l
Anthracene	ND (1.0)	ug/l
Benzo(a)Anthracene	ND (1.0)	ug/l
Benzo(a)pyrene	ND (1.0)	ug/l
Benzo(k)fluoranthene	ND (1.0)	ug/l
Benzo(g,h,i)perylene	ND (1.0)	ug/l
Dibenzo(a,h)anthracene	ND (1.0)	ug/l
Chrysene	ND (1.0)	ug/l
Fluoranthene	ND (1.0)	ug/l
Fluorene	ND (1.0)	ug/l
Indeno(1,2,3-cd)pyrene	ND (1.0)	ug/l
Naphthalene	ND (1.8)	ug/l
Phenanthrene	ND (1.0)	ug/l
Pyrene	ND (1.0)	ug/l
Benzo(b)fluoranthene	ND (1.0)	ug/l
Benzo(a)fluoranthene	ND (1.0)	ug/l
Benzo(j)fluoranthene	ND (1.0)	ug/l
Dibenzo(a,h)acridine	ND (1.0)	ug/l
Dibenzo(a,j)acridine	ND (1.0)	ug/l
Dibenzo(a,h)anthracene	ND (1.0)	ug/l
7H-dibenzo(c,g)carbazole	ND (1.0)	ug/l
Dibenzo(a,e)pyrene	ND (1.0)	ug/l
Dibenzo(a,h)pyrene	ND (1.0)	ug/l
Dibenzo(a,i)pyrene	ND (1.0)	ug/l
3-Methylcholanthrene	ND (1.0)	ug/l

Method:
8100 Polynuclear Aromatic Hydrocarbons, SW-846, USEPA (1982).
610 Polyaromatic Hydrocarbons, 40 CFR Part 136 (1984).

(Detection limit in parenthesis.)
ND - Parameter not detected at the stated detection limit.

C. Neal Schaeffer
C. Neal Schaeffer
Senior Chemist

RFI PHASE I REPORT

Prepared for

Navajo Refining Company
Artesia, New Mexico

By

Mariah Associates, Inc.
Laramie, Wyoming
MAI Project No. 524

October 1990

Table 6.13. Evaporation Ponds, Groundwater Analytical Results - Volatiles
RFI Phase I Report, Navajo Refining Company, October, 1990

*********** Sample Number **************
Well Number

COMPOUND	UNITS	NEP-GW-000-01	NEP-GW-005-01	NEP-GW-008-01	NEP-GW-010-01	NEP-GW-021-01
		OCD-3	MW-3	MW-6	MW-4	OCD-8
Benzene	ug/l	brl	41	brl	brl	brl
Toluene	ug/l	brl	brl	13	brl	brl
Ethyl benzene	ug/l	32	brl	11	32	brl
Xylenes	ug/l	23	brl	19	23	brl
2-Hexanone	ug/l	brl	14	23	brl	12

Table 6.14. Evaporation Ponds, Groundwater Analytical Results - Semivolatiles
RFI Phase I Report, Navajo Refining Company, October, 1990

---------- Sample Number ------------
Monitor Well

COMPOUND	UNITS	NEP-GW- 002-01	NEP-GW- 005-01	NEP-GW- 008-01	NEP-GW- 009-01	NEP-GW- 010-01	NEP-GW- 011-01	NEP-GW- 019-01	NEP-GW- 020-01	NEP-GW- 021-01	NEP-GW- 022-01
		OCD-7	MW-3	MW-6	MW-7	MW-4	MW-5	OCD-5	EPA-1	OCD-8	OCD-6
bis(2-Chloroisopropyl)ether	ug/l			22							
bis(2-ethylhexyl)phthalate	ug/l	44	22	20	17	11	16	16	14	26	20
Di-n-butylphthalate								31			

Table 6.15 Evaportation Ponds, Groundwater Analytical Results - Metals
RFI Phase I Report, Navajo Refing Company, October 1990

		************ SAMPLE NUMBER ****************								
		Monitor Well								
		NEP-GW-001-01	NEP-GW-002-01	NEP-GW-003-01	NEP-GW-004-01	NEP-GW-005-01	NEP-GW-008-01	NEP-GW-009-01	NEP-GW-010-01	NEP-GW-011-01
COMPOUND	UNITS	OCD-3	OCD-7	OCD-6	WIND MILL	MW-3	MW-6	MW-7	MW-4	MW-5
Antimony	mg/l	< 0.01	< 0.01		< 0.01	< 0.01	<.1	0.01	<.1	<.1
Arsenic	mg/l	< 0.01	0.05		< 0.01	0.11	0.056	0.09	0.22	0.14
Barium	mg/l	< 0.10	< 0.10		< 0.10	< 0.10	< 0.01	< 0.10	0.14	0.07
Beryllium	mg/l	< 0.01	< 0.001		< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Cadmium	mg/l	0.025	< 0.001		< 0.001	<0.005	< 0.005	< 0.005	< 0.005	< 0.005
Chromium	mg/l		< 0.01		< 0.01	0.01	0.01	0.02	0.02	0.04
Lead	mg/l	< 0.01	0.01		< 0.01	< 0.01	< 0.01	0.117	< 0.01	< 0.01
Mercury	mg/l	< 0.001	< 0.001		< 0.001	<0.001	< 0.001	< 0.001	< 0.001	< 0.001
Nickel	mg/l	0.01	0.02		< 0.01	0.01	< 0.01	0.01	0.07	0.07
Selenium	mg/l	< 0.01	< 0.01		< 0.01	<0.05	<0.05	<0.05	<0.05	<0.05
Silver	mg/l	0.02	< 0.01		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.03
Zinc	mg/l	0.073	0.037		0.038	<0.01	<0.01	<0.01	<0.01	0.03

TELEPHONE
(505) 748-3311

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

EASYLINK
62905278
FAX
(505) 746-6410

October 12, 1992

Mr. Roger Anderson
NM Oil Conservation Division
Land Office Building
P.O. Box 2088
Santa Fe, NM 87501

RE: SPRING 1992 REPORT - GROUNDWATER SAMPLING AROUND EVAPORATION PONDS

Dear Roger:

Enclosed are results from our Spring '92 sampling. This is on a staggered schedule per your letter of October 21, 1991. The following is a summary of field observations:

Well #	Groundwater ft amsL	pH	EC umhos	Deg. C	Description
MW-3	3303.75	6.88	7100	21.7	Mod. Odor, Slightly Soapy
MW-4	3306.48	7.06	6830	20.5	Mod. Odor, Slightly Foamy
MW-5	3302.79	6.99	28200	19.9	Soapy, Slt. Odor, Silty, Oil Sheen
MW-6	3304.01	7.07	4380	23.7	Brown H_2O, Silty, Organic Odor
MW-7	3302.48	7.2	13900	18.9	Slight Odor, Mod. Silt, Brown
OCD-1	3306.08	7.15	14800	17.7	Lt. Oily Sheen, Murky Water
OCD-3	3303.04	6.93	15600	18.8	Murky Water
OCD-5	3302.82	6.99	16200	18.3	Brown Color
OCD-7	3304.61	7.31	13500	20.0	Gas Odor, Brown Color

Sample Description: MW-4
Date Sampled: 6/10/92

Laboratory ID: C0612576

TEST	VALUE	UNITS	METHOD	ANALYZED
M-Alkalinity, as CaCO3	217.0	mg/L	SM 403 16th	6/25/92
P-Alkalinity, as CaCO3	0.0	mg/L	SM 403 16th	6/25/92
Chloride, as Cl	1500.0	mg/L	EPA 9251	6/24/92
Flouride, total	1.70	mg/L	EPA 340.2	6/16/92
Sulfate, as SO4	1630.0	mg/L	EPA 9038	6/19/92
Calcium, total	382.0	mg/L	EPA 6010	6/26/92
Magnesium, total	117.0	mg/L	EPA 6010	6/26/92
Potassium, total	6.0	mg/L	EPA 6010	6/26/92
Sodium, total	1010.0	mg/L	EPA 6010	6/26/92
Bicarbonate, alk as CaCO3	217.0	mg/L	calculation	N/A
Carbonate, alk as CaCO3	0.0	mg/L	calculation	N/A

Sample Description: MW-4
Date Sampled: 6/10/92

Laboratory ID: C0612576
Date Analyzed: 6/17/92 20:04
Analyst: AF/RDW

TEST	VALUE	QUANT. LIM.	METHOD
BTEX		5.0 ug/L	EPA 8020
Benzene	18 ug/L		
Ethylbenzene	14 ug/L		
Toluene	6 ug/L		
*Total Xylenes	35 ug/L		

8020 Surrogate recovery:		Limits:
Trifluorotoluene	121 %	78-168 %

* = 2 times limit of detection.

Sample Description: MW-4
Date Sampled: 6/10/92
Date Extracted: 6/15/92
Dilution: 1:10

Laboratory ID: C0612576
Date Analyzed: 7/24/92 09:51
Analyst: JC

ACID EXTRACTABLE ORGANICS (EPA 8270)

Compound	ug/L
4-Chloro-3-methylphenol	ND
2-Chlorophenol	ND
2,4-Dichlorophenol	ND
2,4-Dimethylphenol	ND
2,4-Dinitrophenol	ND *
2-Methyl-4,6-dinitrophenol	ND *
2-Nitrophenol	ND
4-Nitrophenol	ND *
Pentachlorophenol	ND *
Phenol	ND
2,4,6-Trichlorophenol	ND

Limit of Practical Quantitation is 100 ug/L, unless otherwise noted in brackets.
* = 5 times limit of detection

Surrogate Recovery:		Recovery Limits:
2-Fluorophenol	39 %	10- 94 %
Phenol-d5	69 %	21-100 %
2,4,6-Tribromophenol	60 %	10-123 %

Sample Description: MW-4
Date Sampled: 6/10/92
Date Extracted: 6/15/92
Dilution: 1:10

Laboratory ID: C0612576
Date Analyzed: 7/24/92 09:51
Analyst: JC

BASE NEUTRAL EXTRACTABLE ORGANICS (EPA 8270)

Compound	ug/L
Acenaphthene	ND
Acenaphthylene	ND
Anthracene	ND
Benzidine	ND
Benzo(a)anthracene	ND
Benzo(b)fluoranthene	ND
Benzo(k)fluoranthene	ND
Benzo(a)pyrene	ND
Benzo(ghi)perylene	ND
Benzyl alcohol	ND
Benzyl butyl phthalate	ND
Bis(2-chloroethyl)ether	ND
Bis(2-chloroethoxy)methane	ND
Bis(2-ethylhexyl)phthalate	ND
Bis(2-chloroisopropyl)ether	ND
4-Bromophenyl phenyl ether	ND
4-Chloroaniline	ND
2-Chloronaphthalene	ND
4-Chlorophenyl phenyl ether	ND
Chrysene	ND
Dibenzo(a,h)anthracene	ND
Di-n-butyl phthalate	ND
1,2-Dichlorobenzene	ND
1,3-Dichlorobenzene	ND
1,4-Dichlorobenzene	ND
3,3'-Dichlorobenzidine	ND *

BASE/NEUTRAL EXTRACTABLE ORGANICS (EPA 8270)
Laboratory ID: C0612576 (Continued)

Compound	ug/L
Diethyl phthalate	ND
Dimethyl phthalate	ND
2,4-Dinitrotoluene	ND
2,6-Dinitrotoluene	ND
Di-n-octyl phthalate	ND
Fluoranthene	ND
Fluorene	ND
Hexachlorobenzene	ND
Hexachlorobutadiene	ND
Hexachloroethane	ND
Indeno(1,2,3-cd)pyrene	ND
Isophorone	ND
2-Methylnaphthalene	ND
Naphthalene	ND
2-Nitroaniline	ND
3-Nitroaniline	ND
4-Nitroaniline	ND
Nitrobenzene	ND
N-Nitrosodi-n-propylamine	ND
N-Nitrosodimethyamine	ND
N-Nitrosodiphenylamine	ND
Phenanthrene	ND
Pyrene	ND
1,2,4-Trichlorobenzene	ND

Limit of Practical Quantitation is 100 ug/L, unless otherwise noted in brackets.
* = 2 times limit of detection

			Recovery Limits
Surrogate Recovery:	Nitrobenzene-d5	70 %	35 - 114 %
	2-Fluorobiphenyl	91 %	43 - 116 %
	Terphenyl-d14	98 %	33 - 141 %

iml

Inter-Mountain Laboratories, Inc.

Phone (409) 776-8945 FAX (409) 774-4705

11183 SH 30 College Station, Texas 77845

WATER QUALITY REPORT
GENERAL CHEMISTRY

CLIENT: K.W. BROWN ENVIRONMENTAL SERVICES
PROJECT: NAVAJO - #622092005

Sample ID:	NEP-GW-MW-4	**Report Date:**	03/26/93
Laboratory Number:	C922333/15644	**Date Sampled:**	11/12/92
Sample Matrix:	WATER	**Date Received:**	11/16/92
Preservative:	COOL		
Condition:	INTACT		

Analyte	Concentration	Units	Detection Limit	Method Reference
pH (Lab)	7.3	s.u.	0.1	SW-846 9040
Conductivity (Lab)	7610.	umhos/cm	1.	SW-846 9050
Total Dissolved Solids (180 C)	5360.	mg/L	10.	EPA 160.1
Total Dissolved Solids (Calc.)	5080.	mg/L	N/A	Calc.
Total Alkalinity (as $CaCO_3$)	234.	mg/L	1.	EPA 310.1
Total Hardness (as $CaCO_3$)	1410.	mg/L	1.	SW-846 6010
Fluoride	1.8	mg/L	0.1	EPA 340.2

Analyte	Concentration		Detection Limit	Method Reference
	mg/L	meq/L	mg/L	
Calcium	370.	18.46	1.	SW-846 6010
Magnesium	119.	9.79	1.	SW-846 6010
Potassium	6.	0.15	1.	SW-846 6010
Sodium	1180.	51.33	1.	SW-846 6010
Bicarbonate	285.	4.67	1.	EPA 310.1
Carbonate	0.	0.00	1.	EPA 310.1
Hydroxide	0.	0.00	1.	EPA 310.1
Chloride	1380.	38.93	1.	SW-846 9251
Sulfate	1880.	39.14	1.	EPA 375.3
Major Cation Sum		79.73	N/A	Calc.
Major Anion Sum		82.74	N/A	Calc.
Cation/Anion Balance	% Difference =	-1.85	N/A	Calc.

ND - Parameter not detected at stated detection limit.
Detection limits are derived from practical quantitation levels.

REFERENCE:

SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods," United States Environmental Protection Agency, November, 1986.

EPA - "Methods for Chemical Analysis of Water and Wastes," US EPA, EPA 600/4-79-020, Revised March 1983.

Reviewed by:

Mitch Swan

Mitch Swan
Supervisor--Water Operations

iml

Inter-Mountain Laboratories, Inc.

Phone (409) 776-8945 FAX (409) 774-4705

11183 SH 30 College Station, Texas 77845

WATER QUALITY REPORT
TRACE METALS

CLIENT: K.W. BROWN ENVIRONMENTAL SERVICES

PROJECT: NAVAJO - #622092005

Sample ID:	NEP-GW-MW-4	**Report Date:**	12/30/92
Laboratory Number:	C922333/15644	**Date Sampled:**	11/12/92
Sample Matrix:	WATER	**Date Received:**	11/16/92
Preservative:	HNO3, COOL	**Date Extracted:**	11/19/92
Condition:	INTACT		

Analyte	Concentration	Units	Detection Limit	Method Reference
Total Arsenic	0.080	mg/L	0.005	7061
Dissolved Arsenic	0.069	mg/L	0.005	7061
Total Chromium	ND	mg/L	0.02	7191
Dissolved Chromium	ND	mg/L	0.02	7191
Total Lead	ND	mg/L	0.02	7421
Dissolved Lead	ND	mg/L	0.02	7421
Total Nickel	0.11	mg/L	0.01	7520
Dissolved Nickel	0.07	mg/L	0.01	7520

ND - Parameter not detected at stated detection limit.
Detection limits are derived from practical quantitation levels.

REFERENCE: Analysis performed according to SW-846 "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods," United States Environmental Protection Agency, November, 1986.

Reviewed by:

Mitch Swan

Mitch Swan
Supervisor--Water Operations

EPA Method 8270
SEMIVOLATILE HYDROCARBONS
ADDITIONAL DETECTED COMPOUNDS

Client:	**K. W. BROWN ENVIRONMENTAL SERVICES**		
Project Name:	Navajo Refinery		
Project Location:	Artesia, NM	Report Date:	01/07/93
Project Number:	622092005	Date Sampled:	11/10/92
Sample ID:	NEP - GW - MW - 4	Date Analyzed:	11/13/92
Laboratory ID:	C922333		

Tentative Identification	Retention Time (Minutes)	Concentration* (ug/L)
Unknown Hydrocarbon	8.76	730
Unknown Hydrocarbon	10.53	95
Hydrocarbon Envelope	9 - 30	

* - Concentration calculated using assumed Relative Response Factor = 1

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	84%	21 - 100%
Phenol - d5	94%	10 - 110%
Nitrobenzene - d5	91%	35 - 114%
2 - Fluorobiphenyl	106%	43 - 116%
2,4,6 - Tribromophenol	116%	10 - 123%
Terphenyl - d14	121%	33 - 141%

References:

Method 3510: Separatory Funnel Liquid - Liquid Extraction
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, United States Environmental Protection Agency, September 1986.

Comments:

Analyst

Review

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS (cont)

Client:	**K. W. BROWN ENVIRONMENTAL SERVICES**		
Project Name:	Navajo Refinery		
Project Location:	Artesia, NM	Report Date:	01/07/93
Project Number:	622092005	Date Sampled:	11/12/92
Sample ID:	NEP - GW - MW - 4	Date Analyzed:	11/24/92
Laboratory ID:	C922333		

Analyte	Concentration (ug/L)	Detection Limit (ug/L)
4,6 - Dinitro - o - cresol	ND	125
2,4 - Dinitrophenol	ND	125
2,4 - Dinitrotoluene	ND	50
2,6 - Dinitrotoluene	ND	50
Di - n - octyl phthalate	ND	125
Fluoranthene	ND	50
Fluorene	ND	50
Hexachlorobenzene	ND	50
Hexachlorocyclopentadiene	ND	125
Hexachloroethane	ND	50
Hexachlorobutadiene	ND	50
Ideno(1,2,3-cd)pyrene	ND	50
Isophorone	ND	50
2 - Methylnaphthalene	ND	50
Naphthalene	ND	50
o - Nitroaniline	ND	50
m - Nitroaniline	ND	50
p - Nitroaniline	ND	50
Nitrobenzene	ND	50
o - Nitrophenol	ND	50
p - Nitrophenol	ND	50
n - Nitrosodimethylamine	ND	50
n - Nitrosodiphenylamine	ND	50
n-Nitroso-di-n-propylamine	ND	50
Pentachlorophenol	ND	125
Phenanthrene	ND	50
Phenol	ND	50
Pyrene	ND	50
1,2,4 - Trichlorobenzene	ND	50
2,4,5 - Trichlorophenol	ND	50
2,4,6 - Trichlorophenol	ND	50

ND - Analyte not detected at stated limit of detection

3304 Longmire
College Station, Texas 77845

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client: **K. W. BROWN ENVIRONMENTAL SERVICES**
Project Name: Navajo Refinery
Project Location: Artesia, NM
Project Number: 622092005
Sample ID: NEP - GW - MW - 4
Laboratory ID: C922333
Sample Matrix: Water
Condition: Cool, Intact

Report Date: 01/07/93
Date Sampled: 11/12/92
Date Received: 11/16/92
Date Extracted: 11/19/92
Date Analyzed: 11/24/92

Analyte	Concentration (ug/L)	Detection Limit (ug/L)
Acenaphthene	ND	50
Acenaphthylene	ND	50
Anthracene	ND	50
Benzo(a)anthracene	ND	50
Benzo(b)fluoranthene	ND	50
Benzo(k)fluoranthene	ND	50
Benzo(g,h,i)perylene	ND	50
Benzo(a)pyrene	ND	50
Benzoic acid	ND	50
Benzyl alcohol	ND	50
bis(2-Chloroethoxy)methane	ND	50
bis(2-Chloroethyl)ether	ND	50
bis(2-Chloroisopropyl)ether	ND	50
bis(2-Ethylhexyl)phthalate	ND	125
4-Bromophenyl phenyl ether	ND	50
Butyl benzyl phthalate	ND	50
p - Chloroaniline	ND	50
p - Chloro - m - cresol	ND	50
2 - Chloronaphthalene	ND	50
2 - Chlorophenol	ND	50
4-Chlorophenyl phenyl ether	ND	50
Chrysene	ND	50
o - Cresol / 2 - Methylphenol	ND	50
p - Cresol / 4 - Methylphenol	ND	50
Di - n - butylphthalate	ND	125
Dibenz(a,h)anthracene	ND	50
Dibenzofuran	ND	50
o - Dichlorobenzene	ND	50
m - Dichlorobenzene	ND	50
p - Dichlorobenzene	ND	50
3,3' - Dichlorobenzidine	ND	50
2,4 - Dichlorophenol	ND	50
Diethyl phthalate	ND	50
2,4 - Dimethylphenol	ND	50
Dimethyl phthalate	ND	50

3304 Longmire
College Station, Texas 77845

EPA Method 8240

VOLATILE ORGANIC COMPOUNDS

ADDITIONAL DETECTED COMPOUNDS

Client:	**K.W. BROWN ENVIRONMENTAL SERVICES, INC.**		
Project Name:	Navajo Refinery		
Project Location:	Artesia, NM		
Project Number:	622092005	Report Date:	12/19/92
Sample ID:	NEP-GW-MW-4	Date Sampled:	11/12/92
Laboratory ID	C922333	Date Analyzed:	11/25/92

Tentative Identification	Retention Time (Minutes)	Concentration (ug/L)
Unknown hydrocarbon	17.06	148*
Unknown hydrocarbon	17.99	2300*
Unknown hydrocarbon	18.61	118*
Unknown hydrocarbon	19.47	115*
Unknown hydrocarbon	19.71	245*
Unknown hydrocarbon	20.24	263*
Unknown hydrocarbon	20.64	120*
Unknown hydrocarbon	21.30	115*

* - Concentration calculated using assumed Relative Response Factor = 1

Quality Control:

Surrogate	Percent Recovery	Water Acceptance Limits
1,2-Dichloroethane-d4	99%	76 - 114%
Toluene-d8	102%	88 - 110%
Bromofluorobenzene	112%	86 - 115%

Reference: Method 8240: Gas Chromatography / Mass Spectrometry for Volatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, United States Environmental Protection Agency, September 1986.

Comments:

Analyst

Review

Inter·Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client: **K.W. BROWN ENVIRONMENTAL SERVICES, INC.**
Project Name: Navajo Refinery
Project Location: Artesia, NM
Project Number: 622092005
Sample ID: NEP-GW-MW-4
Laboratory ID: C922333
Sample Matrix: Water
Condition: Cool, intact

Report Date: 12/19/92
Date Sampled: 11/12/92
Date Received: 11/16/92
Date Extracted: 11/25/92
Date Analyzed: 11/25/92

Analyte	Concentration (ug/L)	Detection Limit (ug/L)
Acetone	ND	10
Benzene	21	5
Bromodichloromethane	ND	5
Bromoform	ND	5
Bromomethane	ND	5
2-Butanone (MEK)	ND	10
Carbon disulfide	ND	5
Carbon tetrachloride	ND	5
Chlorobenzene	ND	5
Chloroethane	ND	10
2-Chloroethyl vinyl ether	ND	50
Chloroform	ND	5
Chloromethane	ND	5
Dibromochloromethane	ND	5
1,1-Dichloroethane	ND	5
1,1-Dichloroethene	ND	5
trans-1,2-Dichloroethene	ND	5
1,2-Dichloroethane	ND	5
1,2-Dichloropropane	ND	5
cis-1,3-Dichloropropene	ND	5
trans-1,3-Dichloropropene	ND	5
Ethylbenzene	19	5
2-Hexanone	ND	5
Methylene chloride	ND	5
4-Methyl-2-pentanone	ND	5
Styrene	ND	5
1,1,2,2-Tetrachloroethane	ND	5
Tetrachloroethene	ND	5
Toluene	9	5
1,1,1-Trichloroethane	ND	5
1,1,2-Trichloroethane	ND	5
Trichloroethene	ND	5
Vinyl acetate	ND	5
Vinyl chloride	ND	5
Xylenes (total)	32	5

ND - Analyte not detected at stated limit of detection

Sample Description: MW-4
Date Sampled: 4/28/93

Laboratory ID: D0430513

TEST	VALUE	UNITS	METHOD	ANALYZED
M-Alkalinity, as CaCO3	244	mg/L	EPA 310.1	5/3/93
P-Alkalinity, as CaCO3	0	mg/L	EPA 310.1	5/3/93
Chloride, as Cl	1500	mg/L	EPA 9251	5/14/93
Fluoride, total	1.6	mg/L	EPA 340.2	5/5/93
Sulfate, as SO4	2070	mg/L	EPA 9038	5/4/93
Bicarbonate, alk as CaC03	298	mg/L	Calculation	5/3/93
Carbonate, alk as CaC03	0	mg/L	Calculation	5/3/93
Aluminum, total	0.74	mg/L	EPA 6010	5/5/95
Boron, total	0.66	mg/L	EPA 6010	5/5/93
Calcium, total	458	mg/L	EPA 6010	5/5/93
Magnesium, total	130	mg/L	EPA 6010	5/5/93
Cobalt, total	< 0.01	mg/L	EPA 6010	5/5/93
Nickel, total	0.01	mg/L	EPA 6010	5/5/93
Potassium, total	7.8	mg/L	EPA 6010	5/5/93
Sodium, total	1010	mg/L	EPA 6010	5/5/93
Vanadium, total	< 0.01	mg/L	EPA 6010	5/5/93

Sample Description: MW-4
Date Sampled: 4/28/93
Date Extracted: 5/3/93

Laboratory ID: D0430513
Date Analyzed: 5/4/93
Analyst: JR

BASE NEUTRAL EXTRACTABLE ORGANICS (EPA 8270)

Compound	ug/L
Naphthalene	ND
Mononaphthalene	ND

Limit of Practical Quantitation is 10 ug/L, unless otherwise noted in brackets.

			Recovery Limits
Surrogate Recovery:	Nitrobenzene-d5	60 %	35 - 114 %
	2-Fluorobiphenyl	72 %	43 - 116 %
	Terphenyl-d14	80 %	33 - 141 %

EPA Method 8020
Aromatic Volatiles

Betz Laboratory ID	D0430513
Client Identification	MW-4
Date Sampled	4/28/93
Date Analyzed	5/3/93
Analyst	KS
PQL, ug/L	5

Analyte	Concentration, ug/L (Liquid)
Benzene	20
Toluene	12
Ethyl Benzene	19
*Xylenes, total	43

*2 times PQL

Navajo REFINING COMPANY

TELEPHONE
(505) 748-3311

501 EAST MAIN STREET • P. O. BOX 159
ARTESIA, NEW MEXICO 88211-0159

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(505) 748-9077 ENGR
(505) 746-4438 P / L

August 2, 1994

Mr. Roger Anderson
NM Oil Conservation Division
Land Office Building
P.O. Box 2088
Santa Fe, NM 87501

RE: SPRING 1994 REPORT - GROUNDWATER SAMPLING AROUND EVAPORATION PONDS

Dear Roger:

Enclosed are results from our Spring 1994 sampling of the monitor wells around the evaporation ponds. This is on a staggered schedule per your letter of October 21, 1991. The following is a summary of field observations:

Well #	Groundwater ft amsL	pH	EC umhos	Deg. C	Description
MW-3	3300.17	7.4	4350	23	Slight Odor, Silty,
MW-4	3299.97	6.8	4550	23	Odor
MW-5	3299.59	7.1	10720	21	Moderate odor
MW-6	3300.45	6.8	8240	22	Mod. Odor, , Turbid
MW-7	3299.57	6.9	7680	21	Odor, Silty, Turbid
OCD-1	3302.66	7.0	7290	22	Odor,Murky
OCD-3	3300.55	7.0	9520	20	Murky, odor
OCD-5	3300.24	7.1	10550	20	Brown, Mild odor
OCD-7	3301.10	7.0	6400	22	Brown,Turbid

If you have any questions, please contact me at 748-3311, extension 281.

Respectfully yours,

Darrell Moore

Darrell Moore
Environmental Specialist

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TRACEANALYSIS, INC.
6701 Aberdeen Avenue Lubbock, Texas 79424 806•794•1296 FAX 806•794•1298

ANALYTICAL RESULTS FOR
NAVAJO REFINING COMPANY
Attention: Darrell Moore
501 E. Main
Artesia, NM 88210

June 27, 1994
Receiving Date: 06/23/94
Sample Type: Water
Project No: Semi-Annual Evap Ponds (Wells)
Project Location: NA

Analysis Date: 06/27/94
Sampling Date: 06/21-22/94
Sample Condition: Intact & Cool
Sample Received by: BL
Project Name: NA

TA#	Field Cod	BENZENE (ppb)	TOLUENE (ppb)	ETHYL-BENZENE (ppb)	M,P,O XYLENE (ppb)	TOTAL BTEX (ppb)
T22796	MW - 6	<2	<2	<2	<2	<2
T22797	MW - 4	<2	<2	<2	<2	<2
T22798	MW - 3	<2	<2	<2	<2	<2
T22799	MW - 5	<2	<2	<2	<2	<2
T22800	MW - 7	<2	<2	<2	<2	<2
T22801	OCD - 7	<2	<2	<2	<2	<2
T22802	OCD - 5	<2	<2	<2	<2	<2
T22803	OCD - 3	<1	<1	<1	<1	<1
T22804	OCD - 1	<2	<2	<2	<2	<2
QC	Quality Control	200	200	201	605	
Detection Limit		1	1	1	1	
% Precision		99	99	100	100	
% Extraction Accuracy		99	98	100	99	
% Instrument Accuracy		100	100	100	101	

METHODS: EPA SW 846-8020.
BTEX SPIKE AND QC: Sample and Blank Spiked with 200 ppb EACH VOLATILE ORGANICS.

Director, Dr. Blair Leftwich
Director, Dr. Bruce McDonell

7/15/94
Date

TRACEANALYSIS, INC.
6701 Aberdeen Avenue Lubbock, Texas 79424 806•794•1296 FAX 806•794•1298

ANALYTICAL RESULTS FOR
NAVAJO REFINING CO.
Attention: Darrell Moore
501 E. Main
Artesia, NM 88210

July 12, 1994
Receiving Date: 06/23/94
Sample Type: Water
Project No: Semi-Annual Evap Ponds
Project Location: NA (Wells)

Analysis Date: 07/05/94
Sampling Date: 06/21-22/94
Sample Condition: Intact & Cool
Sample Received by: BL
Project Name: NA

TOTAL METALS

TA#	FIELD CODE	As (ppm)	Cr (ppm)	Ni (ppm)	Pb (ppm)
T22796	MW - 6	0.192	0.012	0.002	0.001
T22797	MW - 4	0.541	0.096	0.051	0.002
T22798	MW - 3	0.209	0.013	0.011	0.003
T22799	MW - 5	0.050	0.014	0.018	0.005
T22800	MW - 7	0.061	0.004	<0.001	0.003
T22801	OCD - 7	0.256	0.001	0.017	0.001
T22802	OCD - 5	0.038	0.001	0.031	0.005
T22803	OCD - 3	0.001	0.004	0.014	0.001
T22804	OCD - 1	0.048	<0.001	0.047	0.004
QC	Quality Control	0.099	0.040	0.100	0.0505
Detection Limit		0.001	0.001	0.001	0.001
% Precision		102	100	102	100
% Extraction Accuracy		111	82	86	94
% Instrument Accuracy		99	92	100	101

METHODS: EPA 239.2, 206.2, 218.2, 249.2.
TOTAL METALS QC: Blank Spiked with 0.100 ppm As, Ni; 0.050 ppm Cr, Pb.

Director, Dr. Blair Leftwich
Director, Dr. Bruce McDonell

7/15/94
Date

TRACEANALYSIS, INC.
6701 Aberdeen Avenue   Lubbock, Texas 79424   806•794•1296   FAX 806•794•1298

ANALYTICAL RESULTS FOR
NAVAJO REFINING
Attention: Darrell Moore
501 E. Main
Artesia, NM 88210

July 12, 1994
Receiving Date: 06/23/94
Sample Type: Water
Project No: Semi-Annual Evap Ponds
Project Location: NA (Wells)

Analysis Date: 06/27/94
Sampling Date: 06/21-22/94
Sample Condition: Intact & Cool
Sample Received by: BL
Project Name: NA

TA#	FIELD CODE	CHLORIDE (mg/L)	FLUORIDE (mg/L)	SULFATE (mg/L)	ALKALINITY (mg/L as CaCo3) HCO3	ALKALINITY (mg/L as CaCo3) CO3
T22796	MW - 6	590	2.9	1,715	137	0
T22797	MW - 4	1,310	1.7	3,669	243	0
T22798	MW - 3	1,086	2.5	3,109	296	0
T22799	MW - 5	4,118	3.4	6,025	391	0
T22800	MW - 7	2,901	1.5	5,359	264	0
T22801	OCD - 7	1,825	2.5	4,416	581	0
T22802	OCD - 5	4,679	0.9	4,187	254	0
T22803	OCD - 3	5,194	0.8	4,095	254	0
T22804	OCD - 1	2,667	6.6	5,106	677	0
QC	Quality Control	510	1.0	10	---	---
% Precision		98	99	95	99	99
% Extraction Accuracy		101	115	94	---	---
% Instrument Accuracy		102	96	95	---	---
DETECTION LIMIT		1	0.1	1	10	---

METHODS: EPA 375.4, 310.1, 340.2; 4500 Cl-B.
QC: Blank Spiked with 500 mg/L CHLORIDE; 2.0 mg/L FLUORIDE; 20.0 mg/L SULFATE.

Director, Dr. Blair Leftwich
Director, Dr. Bruce McDonell

7/15/94
Date

/701 Aberdeen Avenue
Lubbock, Texas 79424
806•794•1296
[illegible]06•794•1298

ANALYTICAL RESULTS FOR
NAVAJO REFINING
Attention: Darrell Moore
501 E. Main
Artesia, NM 88210

July 01, 1994
Receiving Date: 06/23/94
Sample Type: Water
Project No: Semi-Annual Evap. Ponds (Wells)
Project Location: NA

Analysis Date: 06/26/94
Sampling Date: 06/21/94
Sample Condition: I & C
Sample Received by: BL
Project Name: NA

EPA 8270 Compounds (ppm)	T22797 MW - 4	Detection Limit	QC	%P	%EA	%IA
Naphthalene	ND	0.001	0.542	NR	NR	108
2-Methylnaphthalene	ND	0.001	0.486	NR	NR	97

ND = Not Detected

	% RECOVERY
2[illegible]orophenol SURR	101
P[illegible]ol-d5 SURR	121
Nitrobenzene-d5 SURR	118
2-Fluorobiphenyl SURR	128
2,4,6-Tribromophenol SURR	107
Terphenyl-d14 SURR	103

METHODS: EPA 8270.

Director, Dr. Blair Leftwich
Director, Dr. Bruce McDonell

7/15/94
Date

TRACEANALYSIS, INC.
A Laboratory for Advanced Environmental Research and Analysis

TRACEANALYSIS, INC.
6701 Aberdeen Avenue Lubbock, Texas 79424 806•794•1296 FAX 806•794•1298

ANALYTICAL RESULTS FOR
NAVAJO REFINING
Attention: Darrell Moore
501 E. Main
Artesia, NM 88210

July 22, 1994
Receiving Date: 06/23/94
Sample Type: Water
Project No: Semi-Annual Evap Ponds
Project Location: NA (Wells)

Analysis Date: 07/22/94
Sampling Date: 06/21/94
Sample Condition: Intact & Cool
Sample Received by: BL
Project Name: NA

TOTAL METALS

TA#	FIELD CODE	Cd (ppm)	Hg (ppm)	Be (ppm)	V (ppm)	Cu (ppm)	Fe (ppm)	Zn (ppm)	Al (ppm)	Co (ppm)	Mn (ppm)	Mo (ppm)
T22797	MW - 4	0.02	<0.001	<0.01	0.29	0.08	113.0	0.28	135	<0.05	6.47	<0.05
QC	Quality Control	5.40	0.010	5.09	5.27	5.24	5.30	5.54	1.05	4.86	5.49	5.31
DETECTION LIMIT		0.01	0.001	0.01	0.05	0.05	0.05	0.01	0.08	0.05	0.05	0.05
% Precision		100	100	100	100	101	100	100	101	102	100	101
% Extraction Accuracy		91	100	97	94	98	101	97	74	70	98	89
% Instrument Accuracy		106	100	102	103	103	104	106	108	98	107	103

TA#	FIELD CODE	U (ppm)	Ba (ppm)	B (ppm)	Se (ppm)	Ag (ppm)
T22797	MW - 4	0.7	2.14	0.84	<0.2	0.10
QC	Quality Control	9.7	1.05	1.04	2.4	11.6
DETECTION LIMIT		0.5	0.05	0.05	0.2	0.01
% Precision		101	98	99	108	101
% Extraction Accuracy		100	90	104	118	111
% Instrument Accuracy		101	111	106	118	116

METHODS: EPA 200.7, 245.1.
QC: Blank Spiked with 5.0 ppm Cd, Be, V, Cu, Fe, Zn, Co, Mn, Mo; 1.0 ppm Al Ba, B; 0.010 ppm Hg; 2.0 ppm Se; 10.0 ppm Ag, U.

Director, Dr. Blair Leftwich
Director, Dr. Bruce McDonell

7/22/94
DATE

Navajo REFINING COMPANY

501 EAST MAIN STREET • P. O. BOX 159
ARTESIA, NEW MEXICO 88211-0159

TELEPHONE
(505) 748-3311

EASYLINK
62905278
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(505) 746-6410 ACCTG
(505) 746-6155 EXEC
(505) 748-9077 ENGR
(505) 746-4438 P / L

January 12, 1994

Mr. Roger Anderson
NM Oil Conservation Division
Land Office Building
P.O. Box 2088
Santa Fe, NM 87501

RE: FALL 1993 REPORT - GROUNDWATER SAMPLING AROUND EVAPORATION PONDS

Dear Roger:

Enclosed are results from our Fall 1993 sampling of the monitor wells around the evaporation ponds. This is on a staggered schedule per your letter of October 21, 1991.We have also included analysis that Navajo agreed to do as part of our consent agreement with EPA. This includes testing for arsenic, chromium, nickel, and lead. Also, Navajo agreed to resample well OCD 11A and OCD 3 for the above mentioned metals. The following is a summary of field observations:

Well #	Groundwater ft amsL	pH	EC umhos	Deg. C	Description
MW-1	3300.62	7.00	13040	19	Mod. Odor, , Turbid
MW-2	3301.65	6.94	12820	19.2	Odor, Silty, Turbid
MW-3	3299.70	7.12	7160	19	Slight Odor, Silty,
MW-4	3299.49	7.22	6890	17.6	Odor
MW-5	3298.83	7.32	17560	18.1	Moderate odor
OCD-2	3300.93	6.92	12750	18	Odor,Murky
OCD-3	3299.90	7.17	14390	17.6	Murky, odor
OCD-4	3300.06	7.21	15610	17.2	Brown, Mild odor
OCD-6	3299.28	6.93	11800	15.6	Brown,Turbid
OCD-8	3298.94	7.12	11120	15.8	odor, turbid
OCD-11A	3299.61	6.99	18160	17.1	Brown, odor,

6701 Aberdeen Avenue
Lubbock, Texas 79424
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ANALYTICAL RESULTS FOR
NAVAJO REFINING
Attention: Darrell Moore
501 E. Main
Artesia, NM 88210

January 06, 1994
Receiving Date: 12/22/93
Sample Type: Water
Project No: NA
Project Location: Artesia, NM

Analysis Date: 12/29/93
Sampling Date: 12/20/93
Sample Condition: Intact & Cool
Sample Received by: MS
Project Name: NA

EPA 8240 Compounds (ppb)	T16900 MW - 4	Detection Limit	QC	%P	%EA	%IA
Naphthalene	ND	0.001	0.477	100	NR	95
2-Methylnapthalene	ND	0.001	0.474	100	NR	94

ND = Not Detected

	% RECOVERY
2-[illegible]uorophenol SURR	105
Phenol-d5 SURR	109
Nitrobenzene-d5 SURR	107
2-Fluorobiphenyl SURR	92
2,4,6-Tribromophenol SURR	100
Terphenyl-d14 SURR	108

METHODS: EPA SW 846-8270.

Director, Dr. Blair Leftwich
Director, Dr. Bruce McDonell

1-6-94
DATE

TRACEANALYSIS, INC.
A Laboratory for Advanced Environmental Research and Analysis

TRACEANALYSIS, INC.
6701 Aberdeen Avenue Lubbock, Texas 79424 806•794•1296 FAX 806•794•1298

ANALYTICAL RESULTS FOR
NAVAJO REFINING
Attention: Darrell Moore
501 E. Main
Artesia, NM 88210

January 06, 1994
Receiving Date: 12/22/93
Sample Type: Water
Project No: NA
Project Location: Artesia, NM

Analysis Date: 12/23/93
Sampling Date: 12/20/93
Sample Condition: Intact & Cool
Sample Received by: MS
Project Name: Evaporation Ponds

TOTAL METALS

TA#	Field Code	As (ppm)	Cr (ppm)	Pb (ppm)	Ni (ppm)	K (ppm)	Mg (ppm)	Ca (ppm)	Na (ppm)
T16897	MW - 1	<0.1	<0.05	<0.05	<0.05	10	472	749	1,870
T16898	MW - 2	<0.1	<0.05	<0.05	0.19	13	69	365	1,800
T16899	MW - 3	0.2	<0.05	<0.05	<0.05	12	138	475	998
T16900	MW - 4	0.2	<0.05	<0.05	<0.05	8	89	548	1,060
T16901	MW - 5	0.1	<0.05	<0.05	<0.05	20	675	583	4,480
T16902	OCD - 2	0.2	<0.05	<0.05	<0.05	19	201	513	2,480
T16904	OCD - 4	<0.1	<0.05	<0.05	<0.05	66	224	892	2,720
QC	Quality Control	5.2	5.1	5.1	5.0	100.8	20.3	19.8	19.6
% Precision		100	100	100	100	97	95	98	101
% Extraction Accuracy		103	101	100	103	104	95	97	102
% Instrument Accuracy		104	102	101	100	101	101	99	98
Detection Limit		0.1	0.05	0.05	0.05	1.0	1.0	1.0	1.0

METHODS: EPA 200.7.
TOTAL METALS QC: Blank Spiked with 5.0 ppm As, Cr, Pb, Ni; 100.0 ppm K; 20.0 ppm Mg, Ca, Na.

1-6-94

Director, Dr. Blair Leftwich
Director, Dr. Bruce McDonell

Date

TRACEANALYSIS, INC.
6701 Aberdeen Avenue Lubbock, Texas 79424 806•794•1296 FAX 806•794•1298

ANALYTICAL RESULTS FOR
NAVAJO REFINING
Attention: Darrell Moore
501 E. Main
Artesia, NM 88210

January 06, 1994
Receiving Date: 12/22/93
Sample Type: Water
Project No: NA
Project Location: Artesia, NM

Analysis Date: 12/24/93
Sampling Date: 12/20/93
Sample Condition: Intact & Cool
Sample Received by: MS
Project Name: Evaporation Ponds

					-------Alkalinity-------		
					CARBONATE	BICARBONATE	
					(as CaCO3)		
TA#	Field Code	CHLORIDE (mg/L)	FLUORIDE (mg/L)	SULFATE (mg/L)	(mg/L)	(mg/L)	pH (s.u.)
T16897	MW - 1	4,418	1.1	2,523	0	429	6.94
T16898	MW - 2	2,090	11.3	1,808	0	521	7.11
T16899	MW - 3	1,330	2.9	2,452	0	327	7.34
T16900	MW - 4	1,473	1.9	2,205	0	235	7.12
T16901	MW - 5	5,178	3.1	4,913	0	398	7.27
T16902	OCD - 2	3,325	1.2	4,328	0	500	7.08
T16904	OCD - 4	5,510	0.9	3,711	0	191	7.61
T16905	OCD - 6	2,233	3.7	5,044	0	562	7.15
T16906	OCD - 8	2,233	2.9	4,127	0	429	7.06
QC	Quality Control	504	2.10	29.8	---	---	7.01
% Precision		100	100	93	99	99	100
% Extraction Accuracy		99	110	116	---	---	99
% Instrument Accuracy		101	107	94	---	---	100
DETECTION LIMIT		1	0.1	1	---	10	---

METHODS: EPA 375.4, 310.1, 150.1, 340.2; 3500 Cl-B.
QC: Blank Spiked with 500 mg/L CHLORIDE; 2.0 mg/L FLUORIDE; 30.0 mg/L SULFATE.

1-6-94

Director, Dr. Blair Leftwich
Director, Dr. Bruce McDonell

Date

TRACEANALYSIS, INC.
6701 Aberdeen Avenue Lubbock, Texas 79424 806•794•1296 FAX 806•794•1298

ANALYTICAL RESULTS FOR
NAVAJO REFINING
Attention: Darrell Moore
501 E. Main
Artesia, NM 88210

January 06, 1994
Receiving Date: 12/22/93
Sample Type: Water
Project No: NA
Project Location: Artesia, NM

Analysis Date: 12/24/93
Sampling Date: 12/20/93
Sample Condition: Intact & Cool
Sample Received by: MS
Project Name: Evaporation Ponds

TA#	Field Code	MTBE (ppb)	BENZENE (ppb)	TOLUENE (ppb)	ETHYL-BENZENE (ppb)	M,P,O XYLENE (ppb)	TOTAL BTEX (ppb)
T16897	MW - 1	<1	<1	<1	<1	<1	<1
T16898	MW - 2	<10	<10	<10	<10	<10	<10
T16899	MW - 3	<10	<10	<10	<10	<10	<10
T16900	MW - 4	<10	<10	<10	<10	<10	<10
T16901	MW - 5	<10	<10	<10	<10	<10	<10
T16902	OCD - 2	10	<2	<2	<2	<2	<2
T16904	OCD - 4	2	<1	<1	<1	<1	<1
T16905	OCD - 6	<10	<10	<10	<10	<10	<10
T16906	OCD - 8	<10	<10	<10	<10	77	77
QC	Quality Control	207	189	187	186	556	
Detection Limit		1	1	1	1	1	
% Precision		99	101	100	101	100	
% Extraction Accuracy		111	97	96	94	97	
% Instrument Accuracy		103	94	93	93	92	

METHODS: EPA SW 846-8020.
BTEX SPIKE AND QC: Sample and Blank Spiked with 200 ppb EACH VOLATILE ORGANICS.

Director, Dr. Blair Leftwich
Director, Dr. Bruce McDonell

1-6-94
Date

Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/21/94
Sample ID:	MW-4	Date Sampled:	11/10/94
Laboratory ID:	0694G02156	Date Received:	11/14/94
Sample Matrix:	Water	Date Extracted:	11/21/94
Preservative:	Cool, HCl	Date Analyzed:	11/21/94
Condition:	Intact, pH<2		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	0.013	0.005
Toluene	0.006	0.005
Ethylbenzene	0.015	0.005
m,p-Xylene	0.006	0.005
o-Xylene	0.022	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	98%	86 - 118%
Toluene - d8	99%	88 - 110%
Bromofluorobenzene	103%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/22/94
Sample ID:	MW - 4	Date Sampled:	11/10/94
Laboratory ID:	0694G02156	Date Received:	11/14/94
Sample Matrix:	Water	Date Extracted:	11/17/94
Condition:	Intact	Date Analyzed:	11/21/94
Preservative:	Cool		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.10
Acenaphthylene	ND	0.10
Anthracene	ND	0.10
Benzo(a)anthracene	ND	0.10
Benzo(b)fluoranthene	ND	0.10
Benzo(k)fluoranthene	ND	0.10
Benzo(g,h,i)perylene	ND	0.10
Benzo(a)pyrene	ND	0.10
Chrysene	ND	0.10
Dibenz(a,h)anthracene	ND	0.10
Fluoranthene	ND	0.10
Fluorene	ND	0.10
Ideno(1,2,3-cd)pyrene	ND	0.10
Naphthalene	ND	0.10
Phenanthrene	ND	0.10
Pyrene	ND	0.10

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	54%	21 - 110%
Phenol - d5	67%	10 - 110%
Nitrobenzene - d5	52%	35 - 114%
2 - Fluorobiphenyl	77%	43 - 116%
2,4,6 - Tribromophenol	57%	10 - 123%
Terphenyl - d14	77%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

Ramona R. Dennis
Analyst

Review

iml

Inter-Mountain Laboratories, Inc.

Phone (409) 776-8945 FAX (409) 774-4705

11183 SH 30 College Station, Texas 77845

WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III
Sample ID: MW-4
Lab ID: 0494W10214/0694G02156
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/15/94
Sample Date: 11/10/94

Parameter	Concentration	PQL	Method
pH (Lab)	7.4 s.u.	0.1	SW-846 9040
Conductivity (Lab)	7480 µmhos/cm	1	SW-846 9050
Total Dissolved Solids (180° C)	5410 mg/L	10	EPA 160.1
Total Alkalinity (as CaCO3)	255 mg/L	1	EPA 310.1
Total Hardness (as CaCO3)	1810 mg/L	1	Calculation
Fluoride	1.9 mg/L	0.1	EPA 340.2

Calcium	495 mg/L	24.70 meq/L	1 mg/L	SW-846 6010A
Magnesium	139 mg/L	11.44 meq/L	1 mg/L	SW-846 6010A
Potassium	3 mg/L	0.07 meq/L	1 mg/L	SW-846 6010A
[illegible]dium	1230 mg/L	53.54 meq/L	1 mg/L	SW-846 6010A
[illegible]rbonate	311 mg/L	5.10 meq/L	1 mg/L	EPA 310.1
Carbonate	ND*	0.00	1 mg/L	EPA 310.1
Chloride	1310 mg/L	36.87 meq/L	1 mg/L	SW-846 9251
Sulfate	2370 mg/L	49.24 meq/L	5 mg/L	SW-846 9036
Major Cation Sum	89.76 meq/L		N/A	Calculation
Major Anion Sum	91.21 meq/L		N/A	Calculation
Cation/Anion Balance	-0.80 % Diff		N/A	Calculation

Total Metals			
Total Arsenic	0.156 mg/L	0.005	SW-846 7061A
Total Chromium	0.090 mg/L	0.005	SW-846 7191
Total Lead	0.07 mg/L	0.01	SW-846 7421
Total Nickel	0.13 mg/L	0.05	SW-846 7520

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

David N Poelstra

David N. Poelstra
Laboratory Manager

Inter-Mountain Laboratories, Inc.
Phone (409) 776-8945 FAX (409) 774-4705
11183 SH 30 College Station, Texas 77845

WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III
Sample ID: MW-4
Lab ID: 0494W10214/0694G02156
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/15/94
Sample Date: 11/10/94

Parameter	Concentration	PQL	Method
Dissolved Aluminum	ND*	0.1 mg/L	SW-846 6010A
Dissolved Antimony	ND*	0.1 mg/L	SW-846 6010A
Dissolved Arsenic	0.076 mg/L	0.005	SW-846 7061A
Dissolved Barium	ND*	0.05 mg/L	SW-846 6010A
Dissolved Beryllium	ND*	0.01 mg/L	SW-846 6010A
Dissolved Boron	0.74 mg/L	0.05	SW-846 6010A
Dissolved Cadmium	0.04 mg/L	0.02	SW-846 6010A
Dissolved Chromium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Cobalt	ND*	0.02 mg/L	SW-846 6010A
Dissolved Copper	ND*	0.01 mg/L	SW-846 6010A
Dissolved Iron	2.40 mg/L	0.05	SW-846 6010A
Dissolved Lead	ND*	0.1 mg/L	SW-846 6010A
[illegible]solved Manganese	2.61 mg/L	0.02	SW-846 6010A
Dissolved Molybdenum	ND*	0.05 mg/L	SW-846 6010A
Dissolved Nickel	ND*	0.05 mg/L	SW-846 7520
Dissolved Selenium	ND*	0.2 mg/L	SW-846 6010A
Dissolved Silica	30.72 mg/L	0.05	SW-846 6010A
Dissolved Silver	ND*	0.01 mg/L	SW-846 6010A
Dissolved Thallium	ND*	0.2 mg/L	SW-846 6010A
Dissolved Vanadium	ND*	0.01 mg/L	SW-846 6010A
Dissolved Zinc	ND*	0.01 mg/L	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

David N. Poelstra
Laboratory Manager

3304 Longmire
College Station, Texas 77845

EPA Method 8141
ORGANOPHOSPHORUS COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	12/12/94
Sample ID:	MW-4	Date Sampled:	11/10/94
Laboratory ID:	0694G02156	Date Received:	11/14/94
Sample Matrix:	Water	Date Extracted:	11/17/94
Preservative:	Cool	Date Analyzed:	12/08/94
Condition:	Intact		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Azinphos Methyl	ND	0.0002
Bolstar	ND	0.0002
Chlorpyrifos	ND	0.0002
Coumaphos	ND	0.0004
Demeton	ND	0.0002
Diazinon	ND	0.0002
Dichlorvos	ND	0.0002
Dimethoate	ND	0.001
Disulfoton	ND	0.0002
EPN	ND	0.0002
Ethoprop	ND	0.0002
Fensulfothion	ND	0.001
Fenthion	ND	0.0002
Malathion	ND	0.0002
Merphos	ND	0.0002
Mevinphos	ND	0.001
Monocrotophos	ND	0.001
Naled	ND	0.002
Ethyl Parathion	ND	0.0002
Methyl Parathion	ND	0.0002
Phorate	ND	0.0002
Ronnel	ND	0.0002
Sulfotep	ND	0.0002
Tetrachlorovinphos	ND	0.0002
TEPP	ND	0.0002
Tokuthion	ND	0.0002
Trichloronate	ND	0.0002

ND - Analyte not detected at stated limit of detection

Reference: Method 8141: Organophosphorus Compounds by Gas Chromatography: Capillary Column Technique. Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8151
CHLORINATED HERBICIDES

Client:	NAVAJO REFINING COMPANY		
Project Name:	RFI Phase III / Artesia, NM	Report Date:	12/09/94
Sample ID:	MW - 4	Date Sampled:	11/10/94
Sample Number:	0694G02156	Date Received:	11/14/94
Sample Matrix:	Water	Date Extracted:	11/17/94
Preservative:	Cool	Date Analyzed:	12/07/94
Condition:	Intact		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Dalapon	ND	0.01
3,5-Dichlorobenzoic acid	ND	0.01
4-Nitrophenol	ND	0.01
Dicamba	ND	0.01
MCPP	ND	1
MCPA	ND	1
Dichlorprop	ND	0.01
2,4-D	ND	0.01
Pentachlorophenol	ND	0.01
Chloramben	ND	0.01
2.4.5 - TP	ND	0.01
2,4,5 - T (Silvex)	ND	0.01
2,4 - DB	ND	0.01
Dinoseb	ND	0.01
Bentazon	ND	0.01
Picloram	ND	0.01
DCPA	ND	0.01
Acifluorfen	ND	0.01

ND - Analyte not detected at stated detection limit

Reference: Method 8151: Chlorinated Herbicides
Test Methods for Evaluating Solid Wastes, SW-846, United States Environmental Protection Agency, Final Update I, July 1992.

Analyst

Review

iml **Inter-Mountain Laboratories, Inc.**

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Organics Laboratory
3304 Longmire Drive College Station, Texas 77845
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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW--4A
Lab ID: 0495W01931/0695G00609
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 03/01/95
Sample Date: 02/24/95

Parameter	Concentration	PQL	Method
Total Metals			
Total Arsenic	0.051 mg/L	0.005	SW-846 7061A
Total Chromium	ND*	0.005 mg/L	SW-846 7191
Total Lead	ND*	0.01 mg/L	SW-846 7421
Total Nickel	ND*	0.05 mg/L	SW-846 7520

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

wed By:

Robert Alford

Robert Alford
Supervisor, Water Laboratory

iml **Inter-Mountain Laboratories, Inc.**

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Phone (409) 776-8945 FAX (409) 774-4705

Organics Laboratory
3304 Longmire Drive College Station, Texas 77845
Phone (409) 774-4999 Fax (409) 696-0692

EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	Artesia, NM	Report Date:	07/18/95
Sample ID:	MW-4A	Date Sampled:	06/28/95
Laboratory ID:	0695G00981	Date Received:	06/30/95
Sample Matrix:	Water	Date Extracted:	07/11/95
Preservative:	Cool, HCl	Date Analyzed:	07/11/95
Condition:	Intact, pH<2	Time Analyzed:	11:07 PM

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	0.015	0.005
Toluene	0.008	0.005
Ethylbenzene	0.019	0.005
m,p-Xylene	0.008	0.005
o-Xylene	0.028	0.005
Methyl ethyl ketone	0.012	0.020
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
1,2-Dichloroethane-d4	99%	86 - 118%
Toluene-d8	103%	88 - 110%
Bromofluorobenzene	1418%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update II, United States Environmental Protection Agency, September 1994.

Comments: A capillary column is used instead of a packed column as in the reference above. One surrogate recovery is out of acceptance limit due to matrix interference.

Analyst

Review

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EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	Artesia, NM	Report Date:	07/03/95
Sample ID:	MW-4A	Date Sampled:	06/28/95
Laboratory ID:	0695G00981	Date Received:	06/30/95
Sample Matrix:	Water	Date Extracted:	06/30/95
Condition:	Intact	Date Analyzed:	07/03/95
Preservative:	Cool	Time Analyzed:	11:34 AM

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.050
Acenaphthylene	ND	0.050
Anthracene	ND	0.050
Benzo(a)anthracene	ND	0.050
Benzo(b)fluoranthene	ND	0.050
Benzo(k)fluoranthene	ND	0.050
Benzo(g,h,i)perylene	ND	0.050
Benzo(a)pyrene	ND	0.050
Benzoic acid	ND	0.050
Benzyl alcohol	ND	0.050
Bis(2-chloroethoxy)methane	ND	0.050
Bis(2-chloroethyl)ether	ND	0.050
Bis(2-chloroisopropyl)ether	ND	0.125
Bis(2-ethylhexyl)phthalate	ND	0.125
4-Bromophenyl phenyl ether	ND	0.050
Butyl benzyl phthalate	ND	0.050
p - Chloroaniline	ND	0.050
p - Chloro - m - cresol	ND	0.050
2 - Chloronaphthalene	ND	0.050
2 - Chlorophenol	ND	0.050
4-Chlorophenyl phenyl ether	ND	0.050
Chrysene	ND	0.050
o - Cresol	ND	0.050
m,p - Cresol	ND	0.050
Di - n - butylphthalate	ND	0.125
Dibenz(a,h)anthracene	ND	0.050
o - Dichlorobenzene	ND	0.050
m - Dichlorobenzene	ND	0.050
p - Dichlorobenzene	ND	0.050
3,3 - Dichlorobenzidine	ND	0.050
2,4 - Dichlorophenol	ND	0.050
Diethyl phthalate	ND	0.050
2,4 - Dimethylphenol	ND	0.050
Dimethyl phthalate	ND	0.050

ND - Analyte not detected at stated limit of detection

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**
Project:	Artesia, NM
Sample ID:	MW-4A
Laboratory ID:	0695G00981

Report Date:	07/03/95
Date Sampled:	06/28/95
Date Analyzed:	07/03/95

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
4,6 - Dinitro -2- methylphenol	ND	0.125
2,4 - Dinitrophenol	ND	0.125
2,4 - Dinitrotoluene	ND	0.050
2,6 - Dinitrotoluene	ND	0.050
Di-n-octyl phthalate	ND	0.125
Fluoranthene	ND	0.050
Fluorene	ND	0.050
Hexachlorobenzene	ND	0.050
Hexachlorocyclopentadiene	ND	0.125
Hexachloroethane	ND	0.050
Hexachlorobutadiene	ND	0.050
Ideno(1,2,3-cd)pyrene	ND	0.050
Isophorone	ND	0.050
2 - Methylnaphthalene	ND	0.050
Naphthalene	ND	0.050
Mono-Naphthalene	ND	0.050
o - Nitroaniline	ND	0.050
m - Nitroaniline	ND	0.050
p - Nitroaniline	ND	0.050
Nitrobenzene	ND	0.050
o - Nitrophenol	ND	0.050
p - Nitrophenol	ND	0.050
n - Nitrosodimethylamine	ND	0.050
n - Nitrosodiphenylamine	ND	0.050
n-Nitroso-di-n-propylamine	ND	0.050
Pentachlorophenol	ND	0.125
Phenanthrene	ND	0.050
Phenol	ND	0.050
Pyrene	ND	0.050
1,2,4 - Trichlorobenzene	ND	0.050
2,4,5 - Trichlorophenol	ND	0.050
2,4,6 - Trichlorophenol	ND	0.050

ND - Analyte not detected at stated limit of detection

EPA Method 8270
SEMIVOLATILE HYDROCARBONS
ADDITIONAL DETECTED COMPOUNDS

Client: **NAVAJO REFINING COMPANY**
Project: Artesia, NM
Sample ID: MW-4A
Laboratory ID: 0695G00981

Report Date: 07/03/95
Date Sampled: 06/28/95
Date Analyzed: 07/03/95

Tentative Identification	Retention Time (Minutes)	Concentration (mg/L)
Unknown hydrocarbon	8.65	0.29
Hydrocarbon envelope	7 - 29	-

* - Concentration calculated using assumed Relative Response Factor = 1

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	64%	21 - 110%
Phenol - d5	68%	10 - 110%
Nitrobenzene - d5	91%	35 - 114%
2 - Fluorobiphenyl	**124%**	43 - 116%
2,4,6 - Tribromophenol	95%	10 - 123%
Terphenyl - d14	140%	33 - 141%

References:

Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update II, United States Environmental Protection Agency, September 1994.

Comments:

Analyst

Review

iml

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW - 4A
Lab ID: 0495W05736/0695G00981
Matrix: Water
Condition: Intact

Report Date: 07/13/95
Receipt Date: 06/30/95
Sample Date: 06/28/95

Parameter	Concentration	PQL	Method
Total Metals			
Total Arsenic	0.061 mg/L	0.005	SW-846 7061A
Total Chromium	0.006 mg/L	0.005	SW-846 7191
Total Lead	ND*	0.01 mg/L	SW-846 7421
Total Nickel	ND*	0.05 mg/L	SW-846 7520

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

Robert Alford

Robert Alford
Supervisor, Water Laboratory

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW - 4A
Lab ID: 0495W05736/0695G00981
Matrix: Water
Condition: Intact

Report Date: 07/13/95
Receipt Date: 06/30/95
Sample Date: 06/28/95

Parameter	Concentration	PQL	Method
pH (Lab)	7.3 s.u.	0.1	SW-846 9040
Conductivity (Lab)	7520 µmhos/cm	1	SW-846 9050
Total Dissolved Solids (180° C)	5750 mg/L	10	EPA 160.1
Total Alkalinity (as CaCO3)	247 mg/L	1	EPA 310.1
Total Hardness (as CaCO3)	1820 mg/L	1	Calculation
Fluoride	1.9 mg/L	0.1	EPA 340.2

Calcium	472 mg/L	23.55 meq/L	1 mg/L	SW-846 6010A
Magnesium	157 mg/L	12.92 meq/L	1 mg/L	SW-846 6010A
Potassium	2 mg/L	0.06 meq/L	1 mg/L	SW-846 6010A
Sodium	1250 mg/L	54.50 meq/L	1 mg/L	SW-846 6010A
Bicarbonate	301 mg/L	4.93 meq/L	1 mg/L	EPA 310.1
Carbonate	ND*	0.00	1 mg/L	EPA 310.1
Chloride	1630 mg/L	46.07 meq/L	1 mg/L	SW-846 9251
Sulfate	1820 mg/L	37.91 meq/L	5 mg/L	SW-846 9036
Major Cation Sum	91.03 meq/L		N/A	Calculation
Major Anion Sum	88.90 meq/L		N/A	Calculation
Cation/Anion Balance	1.18 % Diff		N/A	Calculation

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

Robert Alford

Robert Alford
Supervisor, Water Laboratory

Appendix I

APPENDIX I

APPENDIX I

Listing and Location Map of Landowners Adjacent to Three-Mile Ditch

OWNERSHIP SEARCH Effective to January 3, 1996

Beginning at the SE corner of the NW¼ of Section 9, Township 17 South, Range 26 East, N.M.P.M.; Thence Easterly along the "three-mile ditch" to the West end of Pond 1 as shown on the Location Map, Navajo Refinery, RFI, Phase II. Ownership is given for those lands on both the north side and the south side of said "three-mile ditch".

TOWNSHIP 17 SOUTH, RANGE 26 EAST, N.M.P.M.
SECTION 9: S½S½NE¼NW¼
OWNER: NAVAJO REFINING COMPANY
RE: ECR BOOK 192, page 238
MAP LOCATION: A

SECTION 9: SE¼NW¼, SW¼NE¼
OWNER: NAVAJO REFINING COMPANY
RE: DEED BOOK 255, page 863
MAP LOCATION: B, C

SECTION 9: N½NE¼
OWNER: CHASE FARMS
P.O. BOX 693
ARTESIA, NM 88211-0693
RE: DEED BOOK 269, page 759
MAP LOCATION: D

SECTION 9: SE¼NE¼
OWNER: KATHLEEN COLL, TRUSTEE
901 E. MAIN
ARTESIA, NM 88210
RE: ECR BOOK 216, page 667
MAP LOCATION: E

SECTION 10: N½
OWNER: CHASE FARMS
RE: ECR BOOK 190, page 641
MAP LOCATION: F

SECTION 10: SW¼
OWNER: CHASE FARMS
RE: DEED BOOK 269, page 116
MAP LOCATION: G

SECTION 11: N½N½
OWNER: VICTOR HALDEMAN, ET AL.
805 SO. HALDEMAN ROAD
ARTESIA, NM 88210
RE: DEED BOOK 210, page 511
MAP LOCATION: H

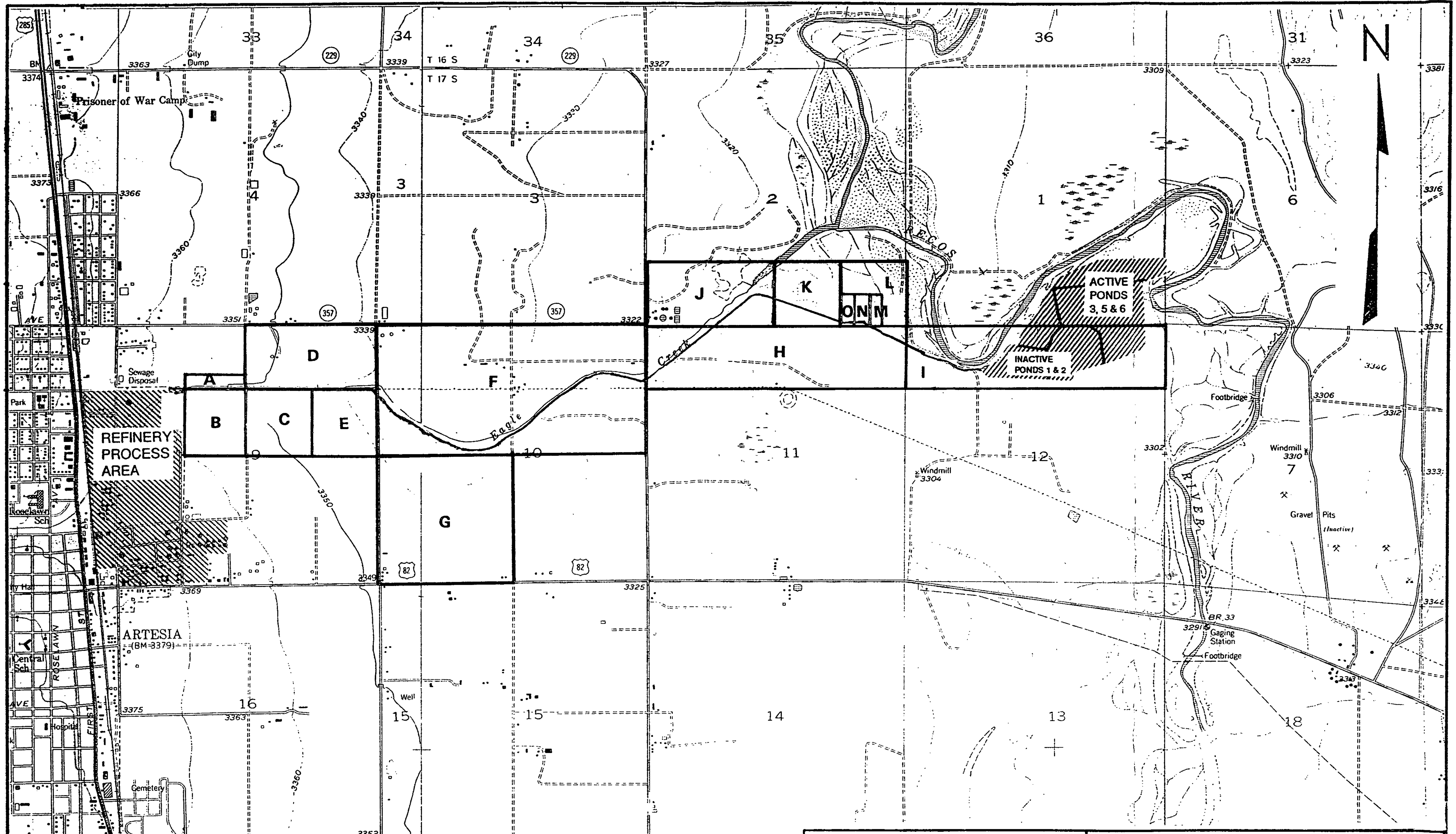
SECTION 12: N½N½
OWNER: NAVAJO REFINING COMPANY
RE: DEED BOOK 203, page 965
MAP LOCATION: I

SECTION 2: S½SW¼, SW¼SE¼
OWNER: CITY OF ARTESIA
P.O. BOX 1310
ARTESIA, NM 88211-1310
RE: DEED BOOK 79, page 264
MAP LOCATION: J, K

SECTION 2: FAIRCHILD FARM
TRACTS NO, 572 AND 575
OWNER: CHASE OIL CORPORATION
P.O. BOX 1767
ARTESIA, NM 88211-1767
RE: ECR BOOK 138, page 21
MAP LOCATION: L, M

SECTION 2: FAIRCHILD FARM
TRACT NO. 576
OWNER: ALBERT P. BACH
1603 W. WASHINGTON
ARTESIA, NM 88210
RE: ECR BOOK 80, page 1086
MAP LOCATION: N

SECTION 2: FAIRCHILD FARM
TRACT NO. 577
OWNER: LORETTA JEAN SNUFFER
208 SO. SECOND
KING CITY, MISSOURI 64463
RE: ECR BOOK 63, page 392
MAP LOCATION: O



2000 0 2000 6000 FEET

NOTE: MAP COMPILED FROM USGS ARTESIA AND SPRING LAKE 7.5 MINUTE QUADRANGLE (1973). MONITOR WELLS ADJACENT TO EVAPORATION PONDS NOT SHOWN.

LATA

prepared for:

Navajo

LOCATION MAP, THREE-MILE DITCH AND EVAPORATION PONDS, NAVAJO REFINERY, RFI INVESTIGATIONS

PROJECT: 318/3
LOCATION: ARTESIA, NEW MEXICO
APPR:
DATE: 4-28-95
DRAWN BY: DB
SCALE:
DATE:
FIGURE: I-1