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Office of Environmental Audit

Environmental Survey
Preliminary Report

Naval Petroleum Reserves
in California (NPRC)
Tupman, California

February 1989

PREFACE
TO
THE DEPARTMENT OF ENERGY
ENVIRONMENTAL SURVEY PRELIMINARY REPORT
FOR THE NAVAL PETROLEUM RESERVES IN CALIFORNIA

This report contains the preliminary findings based on the first phase of an Environmental Survey at the U.S. Department of Energy (DOE) Naval Petroleum Reserves in California (NPRC) located at Tupman, California. The Survey is being conducted by the DOE Office of Environment, Safety and Health.

The NPRC Survey is a portion of the larger, comprehensive DOE Environmental Survey encompassing all major operating facilities of DOE. The DOE Environmental Survey is one of a series of initiatives announced on September 18, 1985, by Secretary of Energy John S. Herrington, to strengthen the environmental safety and health programs and activities within DOE. The purpose of the Environmental Survey is to identify, via a "no-fault" baseline Survey of all the Department's major operating facilities, environmental problems and areas of environmental risk. The identified problem areas will be prioritized on a Department-wide basis in order of importance in 1989.

The findings in this report are subject to modification based on comments from NPRC concerning the technical accuracy of the findings. The modified preliminary findings and any other appropriate changes will be incorporated into the Environmental Survey Summary Report.

February 1989
Washington, D.C.

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Introduction

This report presents the preliminary environmental findings from the first phase of the Environmental Survey of the U.S. Department of Energy (DOE) Naval Petroleum Reserves 1 (NPR-1) and 2 (NPR-2) in California (NPRC), conducted May 9-20, 1988.

The Survey is being conducted by an interdisciplinary team of environmental specialists, led and managed by the Office of Environment, Safety and Health's Office of Environmental Audit. Individual team specialists are outside experts being supplied by a private contractor. The objective of the Survey is to identify environmental problems and areas of environmental risk associated with NPRC. The Survey covers all environmental media and all areas of environmental regulation. It is being performed in accordance with the DOE Environmental Survey Manual. The on-site phase of the Survey involved the review of existing site environmental data, observations of the operations carried on at NPRC, and interviews with site personnel.

Site Description

The NPRC is located about 25 miles west of Bakersfield, California. NPR-1, referred to as Elk Hills, covers approximately 47,985 acres and now ranks sixth among domestic producing oil fields with an average daily production rates of over 100,000 barrels. The reserve is also a large producer of natural gas and natural gas liquids. Almost all of NPR-1 is operated according to the provisions of a Unit Plan Contract (UPC) executed in 1944 by the United States and Standard Oil Company of California, now Chevron, U.S.A. A small portion consisting of approximately 1 1/4 sections of NPR-1 owned by DOE has not been included in the unit. The UPC enables the unit participants to develop the field on a reservoir basis rather than a parcel-by-parcel basis. Under the UPC, costs and production revenues are shared in accordance with the percent of total oil reserves underlying the participants' fee lands. This percent is approximately 78 percent DOE and 22 percent Chevron. Operating and financial decisions are made by an Operating Committee consisting of one government member and one Chevron member, each having an equal vote.

The actual operation of the unit properties is the responsibility of the Federal Government. Revenues from sales of the Federal Government's share of production as well as reimbursement from Chevron for its share of costs are deposited in the U.S. Treasury's Miscellaneous Receipts account.

Facilities on NPR-1 include 2,200 wells (1,300 of which are active), 4 gas processing plants, numerous storage tank facilities, over 500 miles of pipelines, support facilities, and over 250 miles of roads. In August 1985, field development and daily operations of NPR-1, and some activities for DOE-owned land on NPR-2, were being performed under a 5-year management and operating contract with Bechtel Petroleum Operations, Inc. Since 1979, EG&G Energy Measurement, Inc., has been under contract to DOE for providing endangered species studies and monitoring on NPR-1 and NPR-2, including habitat restoration on NPR-1 since 1986.

NPR-2, referred to as Buena Vista Hills, covers 30,181 acres and is adjacent to and generally south of NPR-1. The Federal Government has surface ownership of 10,446 acres (34.6 percent) and the remainder is privately owned. About 90 percent of DOE's land has been leased for royalty share. There are seven unit agreements between DOE and six lessees (ARCO, Chevron, Mobil, Phillips, Texaco, and Unocal). The Buena Vista Hills field has been producing continuously since the early 1920s. Most wells on NPR-2 are considered "stripper wells" (i.e., wells that produce fewer than 10 barrels of oil per day (BOPD).

The Survey team met with representatives of 10 agencies representing Federal, state, and county governments on March 3, 1988. The representatives expressed concern over a wide variety of actual and potential environmental issues and problems. The major concerns raised involved potential groundwater contamination due to wells exceeding maximum authorized injection pressure and the lack of or unknown integrity of abandoned wells; the rate of habitat restoration, especially for the San Joaquin kit fox; nitrogen oxide emissions; lack of adequate secondary tank containment; and disposal of produced water (briny water from oil formations). All of the environmental concerns identified by the regulatory agencies, to the extent they were within the scope of the Environmental Survey, are addressed in this report.

Summary of Findings

The major preliminary findings of the Environmental Survey for the NPRC are as follows:

- There is no formal waste management program, which may lead to improper handling and disposal of hazardous wastes. This situation exists despite some waste management related policies and procedures.

- There is a potential for an uncontained release of toxic/hazardous materials, such as gasoline and crude oil, from storage tanks to natural drainages and in some instances to tributaries of regulated waterways due to inadequate secondary containment.

- Remediation of contaminated inactive waste disposal sites is occurring without an approved study, resulting in the potential for some sites to have inappropriate or incomplete remedial action.

- Disposal of produced briny water is degrading the on-site groundwater quality, and has the potential for contributing to off-site degradation of groundwater quality.

Overall Conclusions

The Survey found no environmental problems at the NPRC that represent an immediate threat to human life. The environmental problems identified at the NPRC by the Survey team confirm that the site is affected by a number of environmental problems that are the result of both past and present operating and waste management practices. These problems vary in terms of magnitude and risk. A complete understanding of the significance of some of the environmental problems identified requires a level of study and characterization that is beyond the scope of the Survey. Action currently underway or planned at the site will contribute toward meeting this requirement.

Transmittal and Follow-Up of Findings

The findings of the Environmental Survey for NPRC were shared with DOE's on-site management staff and contractors at the Survey closeout briefing held May 20, 1988. The Office of Environmental Guidance and Compliance (OEG) and Office of Petroleum Reserves were briefed on the Survey findings on May 31, 1988. By July 28, 1988, the NPRC management staff had developed a draft action plan to address the Survey preliminary findings. A final action plan addressing all the Survey preliminary findings cited herein will be prepared by NPRC staff within 45 days after receiving this Preliminary Report. Those problems that involve extended studies and multiyear budget commitments will be the subject of the Environmental Survey Summary Report and the DOE-wide prioritization.

Within the Office of the Assistant Secretary for Environment, Safety and Health, the OEG has immediate responsibility for monitoring environmental compliance and the status of the NPRC Survey findings. The Office of Environmental Audit will continue to assess the environmental problems through a program of systematic environmental audits that will be initiated toward the conclusion of the DOE Environmental Survey in 1989.

1.0 INTRODUCTION

The purpose of this report is to present the preliminary findings made during the Environmental Survey, conducted May 9 through May 20, 1988, at the U.S. Department of Energy (DOE) Naval Petroleum Reserves in California (NPRC) in Tupman, California. The Preliminary Report's contents are subject to revisions. Revisions to the preliminary findings based on the NPRC technical review, and based on other information that may come to the Survey team's attention, will be incorporated into the Environmental Survey Summary Report. NPR-1 is currently operated by Bechtel Petroleum Operations, Inc. (BPOI), DOE's management and operations contractor. Additionally, EG&G Energy Measurements, Inc. (EG&G), has been contracted by DOE to carry out the NPRC endangered species program, and Systematic Management Services, Inc. (SMS), is the DOE support services contractor. DOE NPR-2 leased properties are operated by the lessees. BPOI assists DOE in monitoring lessee operations, and EG&G assists in meeting environmental requirements there.

The NPRC Survey is part of the larger DOE-wide Environmental Survey announced by Secretary of Energy John S. Herrington on September 18, 1985. The purpose of this effort is to identify, via "no fault" baseline Surveys, existing environmental problems and areas of environmental risk at DOE facilities and to rank them on a DOE-wide basis. This ranking will enable DOE to more effectively establish priorities for addressing environmental problems and allocate the resources necessary to correct these problems. Because the Survey is "no fault" and is not an "audit," it is not designed to identify specific isolated incidents of noncompliance or to analyze environmental management practices. Such incidents and/or management practices will, however, be used in the Survey as a means of identifying existing and potential environmental problems.

The NPRC Environmental Survey was conducted by an interdisciplinary team of technical specialists headed and managed by a Team Leader and Assistant Team Leader from the DOE Office of Environmental Audit. A complete list of Survey participants and their affiliations is included in Appendix A.

The Survey team focused on all environmental media, using Federal, state, and local environmental statutes and regulations, accepted industry practices, and

professional judgment to make the preliminary findings included in this report. The team carried out its activities in accordance with the guidance and protocols in the DOE Environmental Survey Manual. Substantial use of existing information and of interviews with knowledgeable field office and site-contractor personnel accounted for a large part of the on-site effort. A summary of the site-specific Survey activities is presented in Appendix B, and the Survey Plan is presented in Appendix C.

The preliminary Survey findings, in the form of existing and potential environmental problems, are presented in Sections 3.0 and 4.0. Section 3.0 includes those findings that pertain to a specific environmental medium (e.g., air, soil, surface water, and groundwater), whereas Section 4.0 includes those that are non-media-specific (e.g., waste management, radiation, and quality assurance). Because the findings are highly varied in terms of magnitude, risk, and characterization, and consequently require different levels of management attention and response, they are further subdivided into four categories within Sections 3.0 and 4.0.

The criteria for placing a finding into one or more of the four categories are as follows:

Category I includes only those findings which, based upon the information available to the Team Leader, involve immediate threat to human life. Findings of this type shall be immediately conveyed to the responsible Environmental, Safety and Health personnel at the scene or in control of the facility or location in question for action. Category I findings are those environmental problems where the potential risk is highest, the confidence in the finding, based on the information available, is the strongest, and the appropriate response to the finding is the most restrictive in terms of alternatives.

Category II findings encompass one or more of the following situations:

- Multiple or continuing exceedances, past or present, of a health-based environmental standard where there is immediate potential for human population exposure, or a one-time exceedance where residual impacts pose an immediate potential for human population exposure.

- Evidence that a health-based environmental standard may be exceeded, as discussed in the preceding situation, within the timeframe of the DOE-wide Survey.

- Evidence that the likelihood is high for an unplanned release due to, for example, the condition or design of pollution abatement or monitoring equipment or other environmental management practices.

- Noncompliance with significant regulatory procedures, i.e., those substantive technical regulatory procedures designed to directly or indirectly minimize or prevent risks, such as inadequate monitoring or failure to obtain required permits.

Category II findings include those environmental problems where the risk is high but the definition of risk is broader than in Category I. The information available to the Team Leader is adequate to identify the problem but may be insufficient to fully characterize it. Finally, in this category, more discretion is available to the Program Office as to the appropriate response; however, the need for that response is such that management should not wait for the completion of the entire DOE-wide Survey to respond. Unlike Category I findings, a sufficient near-term response by the Program Office may include further characterization prior to any action taken to rectify the situation. These problems will be included in the DOE-wide prioritization effort to ensure that DOE's limited resources are used effectively.

Category III findings encompass one or both of the following criteria:

- The existence of pollutants or hazardous materials in the air, water, groundwater, or soil resulting from DOE operations that pose or may pose a hazard to human health or the environment.

- The existence of conditions at a DOE facility that pose or may pose a hazard to human health or the environment.

Category III findings are those environmental problems for which the broadest definition of risk is used. As in Category II, the information available to the Team Leader may not be sufficient to fully characterize the problem. Under this category,

the range of alternatives available for response, and the corresponding timeframes for response, are the greatest. Environmental problems included within this category will typically require lengthy investigation and remediation phases as well as multiyear budget commitments. These problems will also be included in the DOE-wide prioritization effort.

In general, the levels of pollutants or materials that constitute a hazard or potential for hazard are those that exceed some Federal, state, or local regulations for release of, contamination by, or exposure to such pollutants or materials. However, in some cases, the Survey may determine that the presence of some nonregulated material is in a concentration that presents a concern for local populations or the environment that is sufficient to be included as an environmental problem. Likewise, the presence of regulated materials in concentrations, even though below those established by regulatory authorities, that nevertheless present a potential for hazard or concern may be classified as an environmental problem. In general, however, conditions that meet regulatory or other requirements, where such exist, should not present a potential hazard and will not be identified as an environmental problem.

Conditions that pose or may pose a hazard are generally those which are violations of regulations or requirements (e.g., improper storage of hazardous chemicals in unsafe tanks). Such conditions present a potential hazardous threat to human health and the environment and should be identified as an environmental problem. Additionally, potentially hazardous conditions are those where the likelihood of the occurrence of release is high.

The definition of the term "environmental problem" is broad and flexible to allow for the wide differences among the DOE sites and operations. Therefore, a good deal of professional judgment must be applied to the identification of environmental problems.

Category IV findings include instances of administrative noncompliance and management practices that are indirectly related to environmental risk, but are not appropriate for inclusion in Categories I-III. Such findings can be based upon any level of information available to the Team Leader, including direct observations by the team members. Findings in this category are generally expected to lend

themselves to relatively simple, straightforward resolution without further evaluation or analysis. These findings, although not part of the DOE-wide prioritization effort, will be passed along to the applicable Program Office for appropriate action.

Based on the professional judgment of the Team Leader and Assistant Team Leader, the findings within categories are arranged in order of relative significance. Comparing the relative significance of one finding to another between media categories is not appropriate or valid. The categorization and listing of findings in order of significance within each media category in this report is only the first step in a multistep iterative process to prioritize DOE problems.

It is clear that certain findings and observations contained in this report, especially those in Category II, can and should be addressed in the near term (i.e., prior to the DOE-wide prioritization effort). It is also clear that the findings and observations in this report are highly varied in terms of magnitude, risk, and characterization. Consequently, the priority, magnitude, and timeliness of near-term responses will require careful planning to ensure appropriate and effective action. The information in this Preliminary Report will assist NPRC in the planning of these near-term responses.

Lastly, NPRC submitted a draft action plan on July 28, 1988, in response to the preliminary findings presented at the conclusion of the on-site Survey activities and summarized in the NPRC Survey Status Report dated June 2, 1988. The draft action plan for the NPRC Survey has been reviewed by the Office of Environmental Guidance and Compliance (OEG), which has immediate responsibility for monitoring the status and overseeing the adequacy of corrective actions taken by NPRC in response to the Survey findings.

As required in the December 2, 1987, memorandum from the Assistant Secretary for Environment, Safety and Health to the Operations Office Managers entitled, Follow-up of Environmental Survey Findings, NPRC will prepare and submit a final action plan to the Deputy Assistant Secretary (DAS) for Environment within 45 days after receiving this Preliminary Report. The final action plan for the NPRC Survey will address all of the preliminary findings cited herein and incorporate OEG's comments on the draft action plan.

2.0 GENERAL SITE INFORMATION

2.1 Site History

In 1909, the Department of Interior issued Withdrawal Order No. 5 which withdrew over 3 million acres of public oil land in California and Wyoming from entry and settlement under the public land laws. Lands in Kern County, California, were included in the withdrawal order.

In September 1912, President Taft issued an Executive Order setting aside 38,072 acres in Elk Hills of Kern County, California, as Naval Petroleum Reserve No. 1 (NPR-1). The issuance of this Executive Order was in response to a request by the Secretary of the Navy for oil-bearing public lands in California sufficient to insure a supply of 500,000,000 barrels of oil for the new oil-burning U.S. Navy fleet. In December 1912, President Taft issued another Executive Order that set aside 30,181 acres in Buena Vista Hills of Kern County, California, as Naval Petroleum Reserve No. 2 (NPR-2). NPR-2 was created due to fears in the Navy Department that Elk Hills did not contain enough oil to meet the needs of the oil-burning fleet (Department of the Navy, 1985). However, NPR-2, where drilling and leasing preceded the land withdrawals of 1909, had been withdrawn too late to be preserved as a whole unit.

The new Naval Petroleum Reserves were the subject of considerable litigation involving the titles to private claimants. At this time the Navy had no authority to explore or develop the Reserves. The Mineral Leasing Act of 1920 provided that claimants to lands within the Naval Reserves would be given leases only to producing wells and covering only sufficient acreage to operate the wells. The Act also provided that the President, at his discretion, could permit leases on the remainder of the claim. No producing wells were located on public lands within NPR-1 at that time. However, there were privately-owned, producing wells on NPR-2 and this accounts for the current "checkerboard" land distribution on NPR-2.

The Standard Oil Company of California (currently Chevron U.S.A.) is generally believed to have begun production from a well drilled to the Shallow Oil Zone in the central part of NPR-1 (government land) in 1919. Rapid development on industry-owned leases on NPR-1 followed. In 1921, production reached approximately 60,000 barrels of oil per day (BOPD) (DOE, 1979). Production

dropped off after 1921 due to the cancellation of leases following passage of the Naval Appropriations Act.

The Naval Appropriations Act of 1920 placed the NPR in the possession and under the authority of the Secretary of the Navy. In 1921 an Executive Order from President Harding transferred the administration of the Reserves to the Secretary of the Interior. The period that followed resulted in Congressional investigations into the circumstances of the leasing of portions of the Reserves, particularly NPR-1, by the Secretary of the Interior. This period ended in 1927 with the issuance of an Executive Order which restored jurisdiction of the NPRs to the Secretary of the Navy.

On October 1, 1935, the Plan-Agreement for Cooperative Development of Lands of the United States in Buena Vista Hills Oil and Gas Field, Kern County, California (NPR-2) was executed. This agreement is still in effect and will remain so during "such period of time as oil and gas and other hydrocarbon substances can be produced in paying quantities or until the area shall be proven non-productive" (U.S. Government, 1935).

In October 1942, President Roosevelt signed an Executive Order enlarging the limits of NPR-1 to the east in order to include the balance of the known geologic structure of the Elk Hills Field. This enlargement and other additions of land in the late 1940s and late 1970s brought NPR-1 up to the current size of 47,985 acres. In November 1942, a Unit Plant Contract (UPC) was entered into with Standard Oil Company of California for the cooperative exploration, development, and operation of all lands in NPR-1. Shortly after this agreement, the United States entered World War II and an oil shortage began. This resulted in the enactment of the Act of June 17, 1944, which amended the Naval Petroleum Reserve legislation so as to authorize the Secretary of the Navy to enter into the UPC with Standard Oil of California. The new UPC was made retroactive to November 1942. In June 1944, an extensive development program was begun in NPR-1 to raise production from 10,000 to 65,000 BOPD as specified by joint resolution of Congress. This period of elevated production was brief, and after hostilities ceased in 1945, production returned to pre-war levels of 10,000 BOPD on NPR-1 (DOE, 1979).

In July 1945, the United States Geological Survey (USGS), an agency within the Department of Interior, was authorized to administer the oil and gas leases on

NPR-2 as an agent for the U.S. Navy. USGS remained in this capacity until October 1976, at which time its authority as an agent for the U.S. Navy on NPR-2 was terminated and authority was returned to the Navy. In August 1977, management of the Naval Petroleum Reserves in California (NPRC) was transferred to the Energy Research and Development Administration (ERDA), which was subsequently reorganized into the U.S. Department of Energy (DOE).

Except for brief periods of production in the 1920s and during World War II and the Korean War, NPR-1 was maintained in an essentially undeveloped state until the 1973-74 Arab oil embargo demonstrated the nation's vulnerability to oil supply interruptions. As a result of the embargo, the Congress in 1974 authorized and directed that the NPRC be explored and developed to their full economic and production potential. Congress subsequently passed the Naval Petroleum Reserves Production Act of 1976, which required that the NPRC be operated at its maximum efficient rate of production for 6 years. The law also provided the President with discretionary authority to extend production subsequent to the initial 6 years of production, in increments of up to 3 years each, if continued production is found to be in the national interest. President Reagan has exercised this authority three times, and production at maximum efficient rates is presently authorized through April 5, 1991 (DOE, 1987).

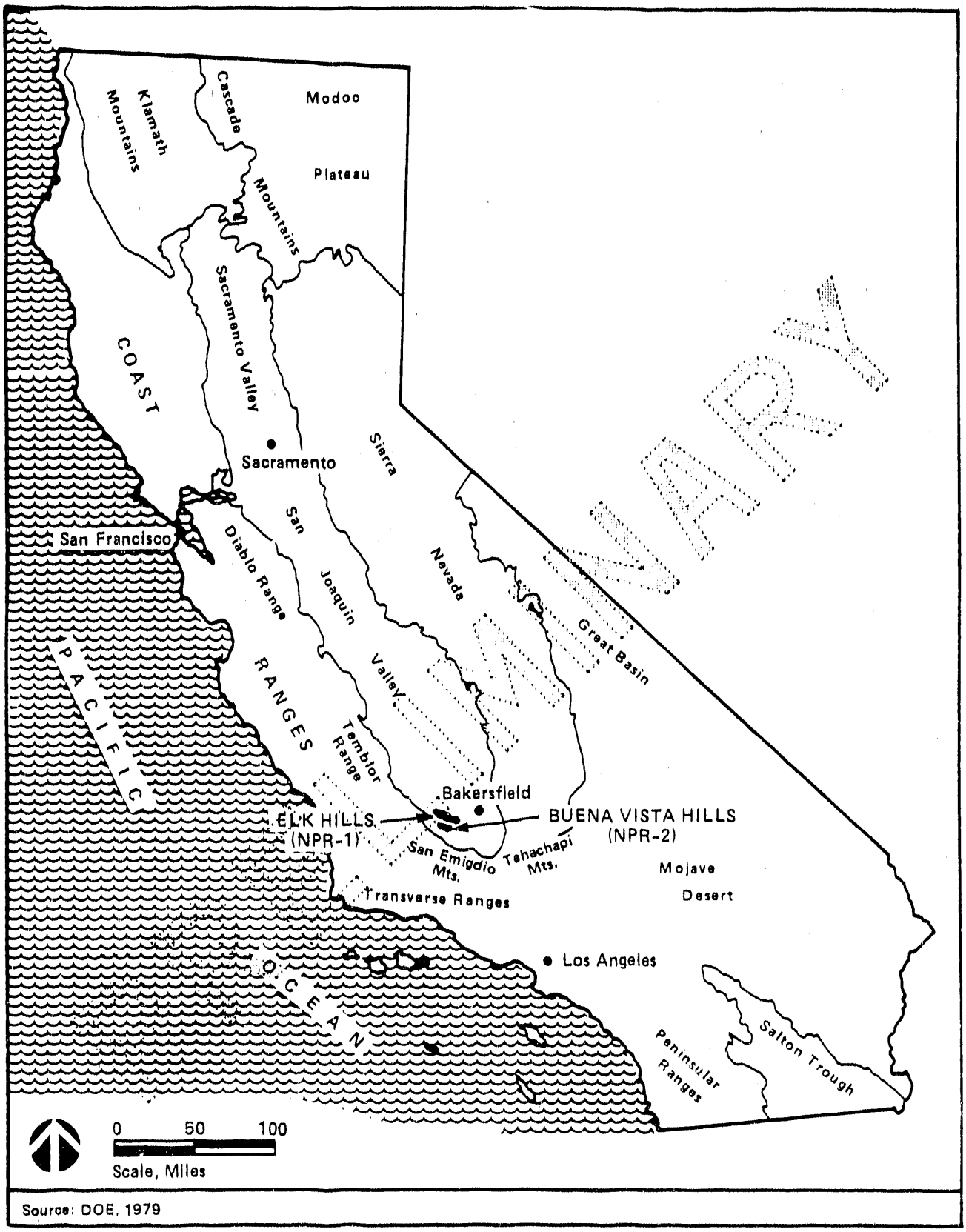
At the time of the Survey, NPR-1 was the sixth largest petroleum reserve in the United States and was operating under the UPC agreement with Chevron U.S.A., with the exception of Sections 14Z and 26Z on NPR-1 which are 100 percent DOE owned and not part of the UPC. The UPC enables the Government and Chevron to develop the field on a reservoir basis rather than a parcel-by-parcel basis, and allows for more efficient and greater recovery of petroleum resources by avoiding competitive production of the individual units. Under the UPC, each participant shares in unit costs and production of petroleum in proportion to the acre-feet of commercially productive formations underlying its surface lands (DOE, 1987). The Federal Government's average share of costs and production revenues is approximately 78 percent, with the revenues going directly to the U.S. Treasury; the Chevron U.S.A. share of costs and revenues is about 22 percent (DOE, 1987).

2.2 Site Setting

The Naval Petroleum Reserves in California (NPRC), comprising NPR-1 and 2, is located approximately 35 miles west of Bakersfield, California, and 110 miles north-northwest of Los Angeles, California, as shown in Figure 2-1. NPR-1 encompasses most of the Elk Hills, a long, narrow ridge that projects eastward from the California Coast Ranges into the southwestern corner of the San Joaquin Valley. More specifically, Elk Hills is a foothill spur that extends from the Temblor Range southeastward, about a third of the distance across the flat San Joaquin Valley (BPOI, 1986c). The San Joaquin Valley forms the southern half of a large structural depression called the Great or Central Valley of California. The Central Valley extends for nearly 500 miles, and separates the Coast Ranges to the west from the Sierra Nevada to the east. The southern boundary of the San Joaquin Valley is the Tehachapi Mountains.

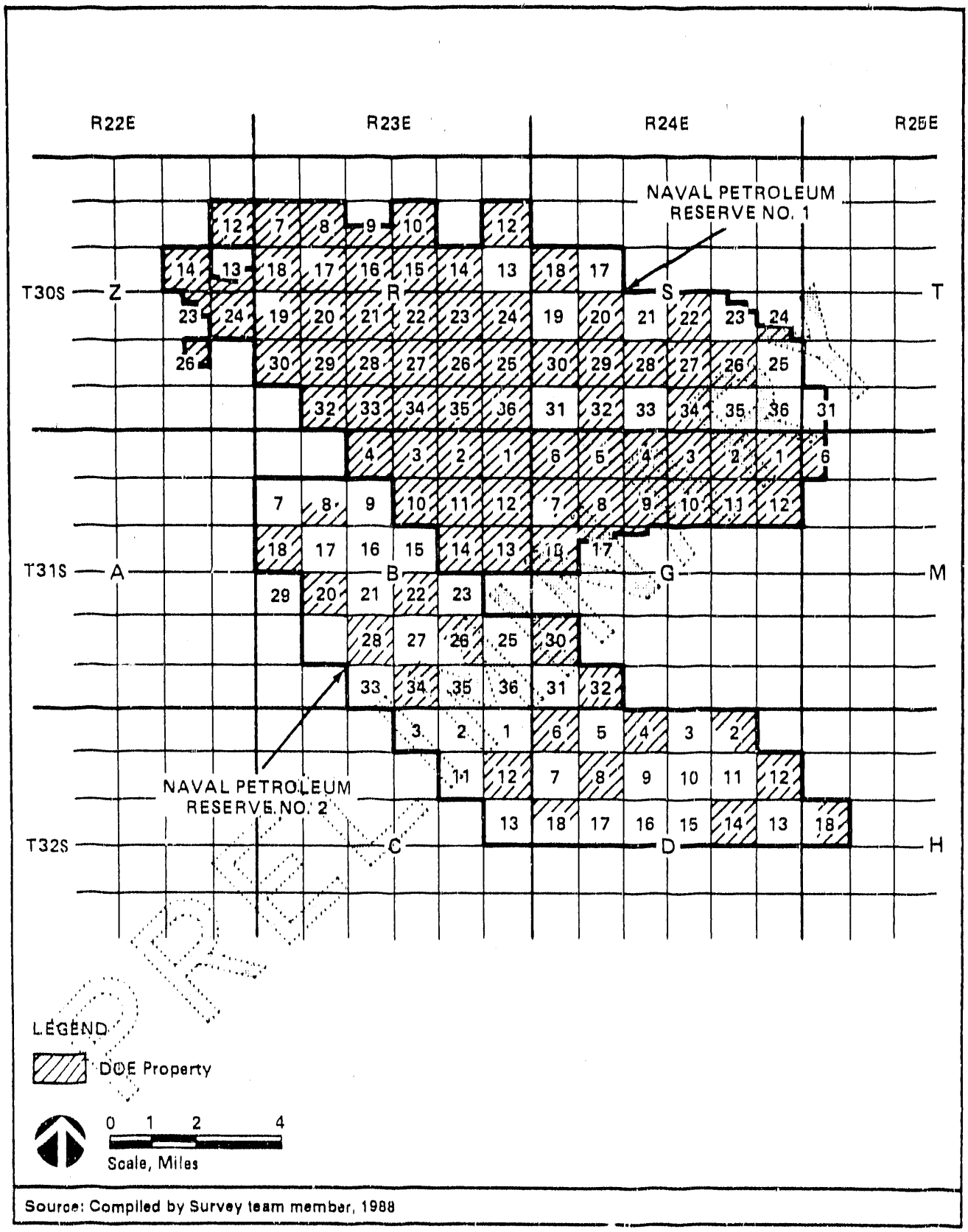
NPR-2 is adjacent to and south of NPR-1. It includes portions of Buena Vista Valley, Midway Valley, and all of Buena Vista Hills. The Buena Vista Valley is a crescent-shaped alluvial plain ringing the southwest portion of the Elk Hills. The Midway Valley runs northwest to southeast paralleling the Buena Vista Valley southwest of the Buena Vista Hills. The Buena Vista Hills extend northwest to southwest, between Buena Vista Valley and Midway Valley.

The township and range coordinates for the NPRC are depicted in Figure 2-2. The western boundary of NPR-1 is situated in township quadrant (T) 30 south, range quadrant (R) 22 East (denoted as T30S R22E or Section Z), while the eastern boundary is situated in both T30S R25E or Section T and T31S R25E or Section M. The northern boundary is situated from T30S R22E (Section Z) to T30S R24E (Section S), while the southern boundary is in both T31S R23E (Section B) and T315 R24E (Section G). A more detailed site map of NPR-1 is shown in Figure 2-3. The location of DOE land on NPR-2 is shown in Figure 2-4. A portion of the City of Taft is located within the NPR-2 boundaries, in quadrant T32S R23E, Section B or C, as is Ford City, which is in Section 12.



LOCATION OF ELK HILLS AND BUENA VISTA HILLS IN CALIFORNIA

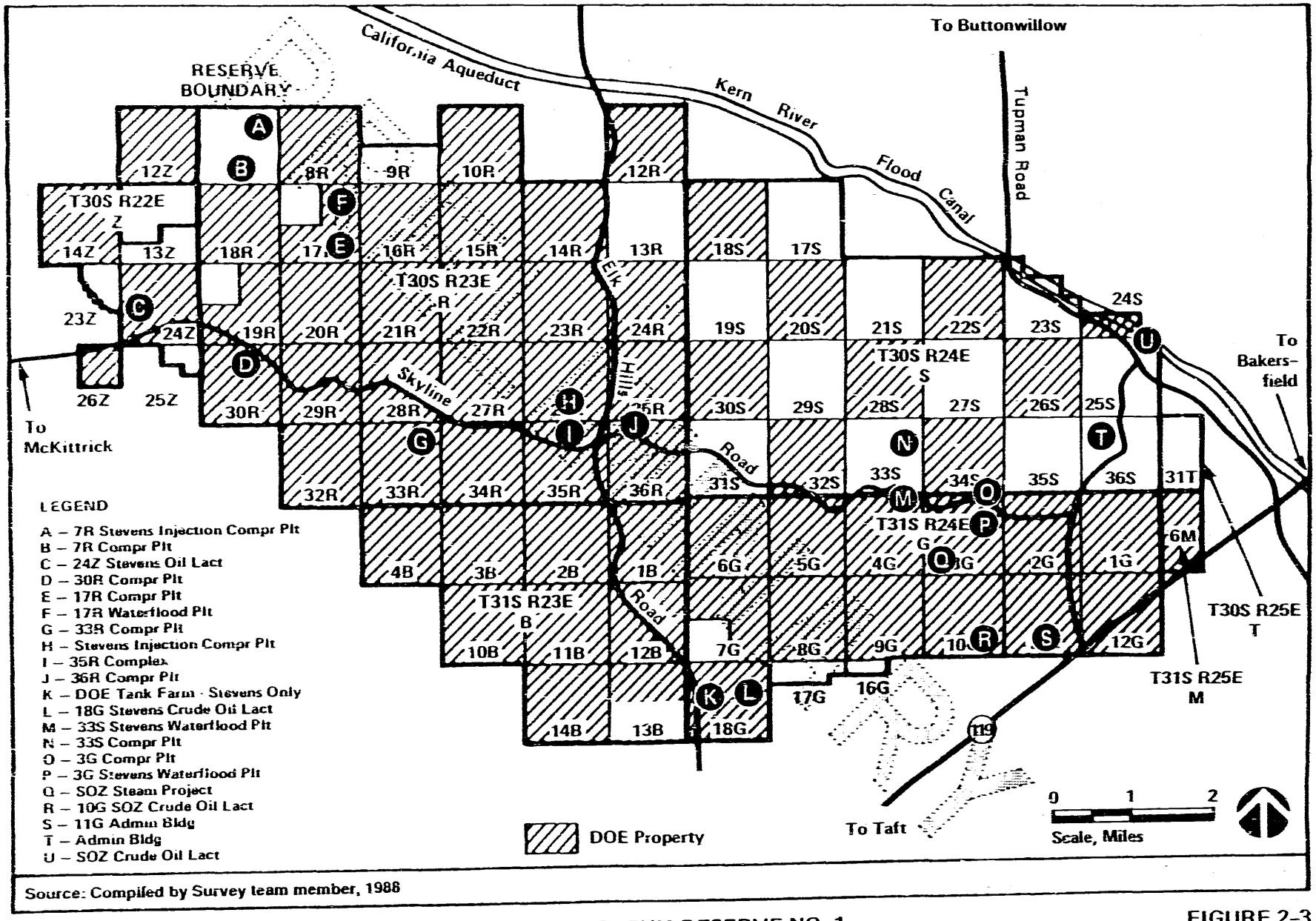
FIGURE 2-1



Source: Compiled by Survey team member, 1988

NAVAL PETROLEUM RESERVES IN CALIFORNIA
TOWNSHIP AND RANGE COORDINATES

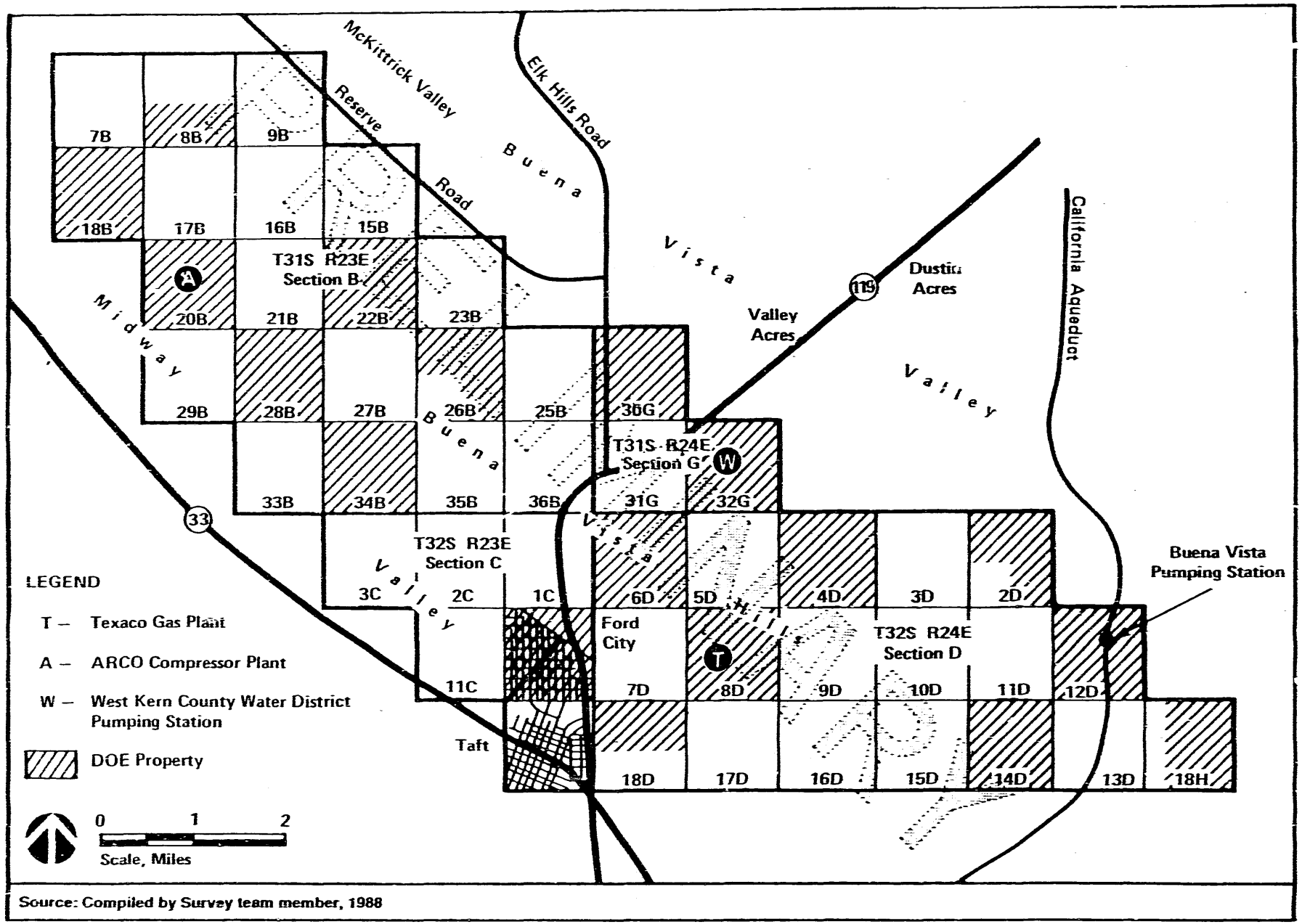
FIGURE 2-2



Source: Compiled by Survey team member, 1988

NAVAL PETROLEUM RESERVE NO. 1
MAJOR FACILITIES

FIGURE 2-3



Source: Compiled by Survey team member, 1988

NAVAL PETROLEUM RESERVE NC. 2
MAJOR FACILITIES

FIGURE 2-4

Site and Regional Population

NPR-1 has a site population of approximately 70 DOE personnel, 700 Bechtel Petroleum Operations, Incorporated (BPOI) personnel, 19 EG&G Energy Measurements, Inc. (EG&G) personnel, and 500-1,000 subcontractor personnel for well installation and maintenance. Personnel on NPR-2 are employed by the various lessees. No DOE, BPOI, or EG&G offices are situated on NPR-2 (BPOI, 1988c).

The communities closest to NPRC are Tupman, located within the boundary of NPR-1 (24-S), with a population of less than 200; Buttonwillow, 4.5 miles north of NPR-1, with a population of 1,350; McKittrick, 2 miles west of NPR-1, with a population of less than 200; Derby Acres, 4.5 miles southwest of NPR-1; Fellows, 4.5 miles southwest of NPR-1, with a population of less than 200; Valley Acres, 2 miles south of NPR-1, with a population of less than 200; and Dustin Acres, 1.25 miles south of NPR-1 (BPOI, 1986b). Taft is the closest major population center, about 5 miles south of NPR-1, partially witnin the bounda y of NPR-2. In the 1980 census, the Taft area (Taft, South Taft, Taft Heights, Ford City) contained about 13,000 people (BPOI, 1986b). The greater Bakersfield metropoliten region had a population as of 1980 of approximately 345,000.

Land Use

Historically, land use within NPRC and in adjacent areas has been primarily oil and gas production. Until 1955, parts of the Reserves were leased to ranches for cattle and sheep grazing. In March 1960, approximately 500 sheep died after drinking water from a sump in the northwest corner of Section 6M on NPR-1. It was later determined that the water was contaminated with arsenic, which was a component in a corrosion inhibitor used in a nearby well. After this incident, grazing was prohibited on Government lands; however, these activities continued on portions of Chevron holdings until 1967 (DOE, 1979).

A portion of the City of Taft and all of Ford City are within the boundary of NPR-2. Taft maintains a landfarm in T32S R24E or D, Section 18 (18D) for the production of alfalfa. Irrigation of this landfarm is provided by effluent water from the City of Taft-Ford City-Taft Heights Sanitation District Joint Wastewater Treatment Plant. Surface rights for this landfarm have been leased from DOE by the City of Taft.

Other surface rights on NPR-2 have been leased to Warner Cable, West Kern Water District, and Valley Waste (BPOI, 1988c).

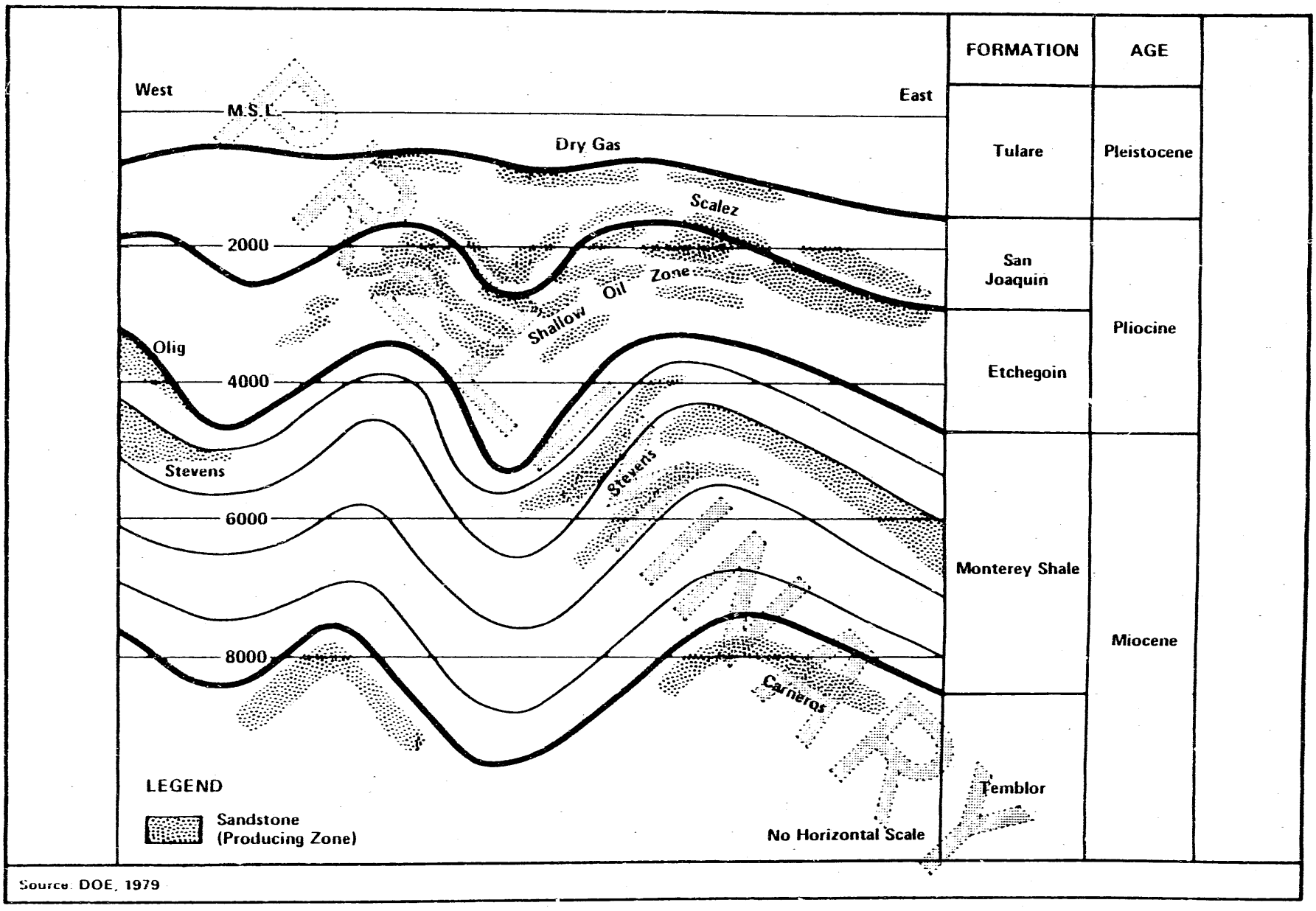
2.3 Overview of Major Site Operations

The original mission of the NPRC was to develop oil and gas reserves for national defense use during emergencies. Historically, NPR-1 was activated during World War II and the Korean War. Most recently, NPR-1 increased oil and gas production in 1976, in response to the oil shortage of the early 1970s. NPR-1 hydrocarbons are sold competitively on the open market (BPOI, 1986b) pursuant to the Naval Petroleum Reserves Production Act of 1976. The Energy Security Act of 1979 also authorized the transfer of petroleum to the Strategic Petroleum Reserve or to the Department of Defense.

From 1975 to 1985, Williams Brothers Engineering Company (WBEC) was the NPR-1 unit operator, under contract to, first, the United States Department of the Navy, and, subsequent to October 1, 1977, the Department of Energy. In 1985, BPOI became the unit operator, responsible for day-to-day operations; engineering/construction; exploration, development, remedial drilling; reservoir management; and financial management and technical/administrative support (BPOI, 1988c).

Other site contractors include: (1) EG&G, hired by DOE in 1979 to manage the endangered species studies on NPR-1 and NPR-2 and habitat restoration since 1986 on NPR-1; (2) Evans, Carey and Crozier (EC&C), hired by DOE in 1984 to provide reservoir performance studies and one-time special projects on an assigned task basis; (3) Systematic Management Services (SMS), hired by DOE in 1987 to provide administrative support services in the areas of management, planning and analysis, quality assurance, and environmental protection; and (4) Argonne National Laboratory, hired by DOE in early 1988 to prepare an Environmental Impact Statement (EIS) for NPR-1.

On NPR-1, approximately 2,200 wells have been drilled as of March 1988. Of these wells, 1,300 were active in May 1988 (BPOI, 1988c). The wells produce oil and gas from the four producing zones--Shallow Oil Zone (SOZ), Stevens Zone, Carneros Zone, and Dry Gas Zone as shown in Figure 2-5. A fifth zone, the Tulare Zone, is not



SIMPLIFIED GEOLOGIC CROSS-SECTION OF THE NPRC
SHOWING MAJOR PRODUCING ZONES

FIGURE 2-5

being produced. The Asphalto Pool is part of the Stevens Zone (BPOI, 1986c) and is being produced in 26Z Section.

Current production from NPR-1 includes approximately 110,000 BOPD, 345 million standard cubic feet per day (mmscfd) of gas, two-thirds of which is reinjected or otherwise used and one-third of which is sold. As of September 30, 1987, daily production of crude oil from NPR-1 was 109,076 barrels with the Government share being 85,256 barrels. The total crude oil production from NPR-1 for fiscal year (FY) 1987 was 39,812,627 barrels with the Government share being 31,118,363 barrels. Natural gas production reached 340 million cubic feet per day (mmcfd) for an FY 1987 cumulative total of 125,250 mmcf with the Government share being 275 mmcfd and 100,490 mmcf, respectively. Total propane production for FY1987 was 89,514,424 gallons with the Government share being 71,565,093 gallons and total butane production for FY 1987 was 69,852,117 gallons with the Government share being 55,804,521 gallons. Total natural gasoline production for FY 1987 was 71,028,620 gallons with the Government share being 56,678,328 gallons (DOE, 1987).

Propane, butane, and natural gasoline entrained in natural gas coming out of the well are called natural gas liquids (NGL). These natural gas liquids are separated from the natural gas at the gas plants, and then separated from each other, or fractionated, into liquefied petroleum gases and natural gasoline. This fractionation also occurs at the gas plants.

There are 211 active wells on DOE property on NPR-2 (BPOI, 1986). Production of oil from DOE lands on NPR-2 during FY 1987 was approximately 1,500 BOPD (DOE, 1987). Production from NPR-2 is generally classified as stripper production, denoting an oil field nearing the end of its productive life. Within the 10,446 acres of DOE property leased to the oil companies are eight identifiable pools or units, which are shown in Table 2-1 along with the current unit operators. As of September 30, 1987, the total cumulative production at NPR-2 was 642,592,120 barrels of oil representing 98.5 percent of ultimate recovery. It was estimated at this time that the remaining reserves were 9,619,249 barrels, of which 4,012,936 barrels were Government lease reserves. Government lease production for NPR-2 in FY 1987 was 552,031 barrels (DOE, 1987).

TABLE 2-1

PRODUCING POOLS OR UNITS ON NPR-2

Pool or Unit	Current Unit Operator
27-B Pool	Chevron U.S.A.
Antelope Shale Zone Unit	Texaco
Antelope Shale Pool Non-Unit	None
2-D Unit	Chevron U.S.A.
11-D Unit	Chevron U.S.A.
555 Stevens Unit	ARCO
Shallow Pool	None
Stevens Pool Non-Unit	None

Source: DOE, 1987

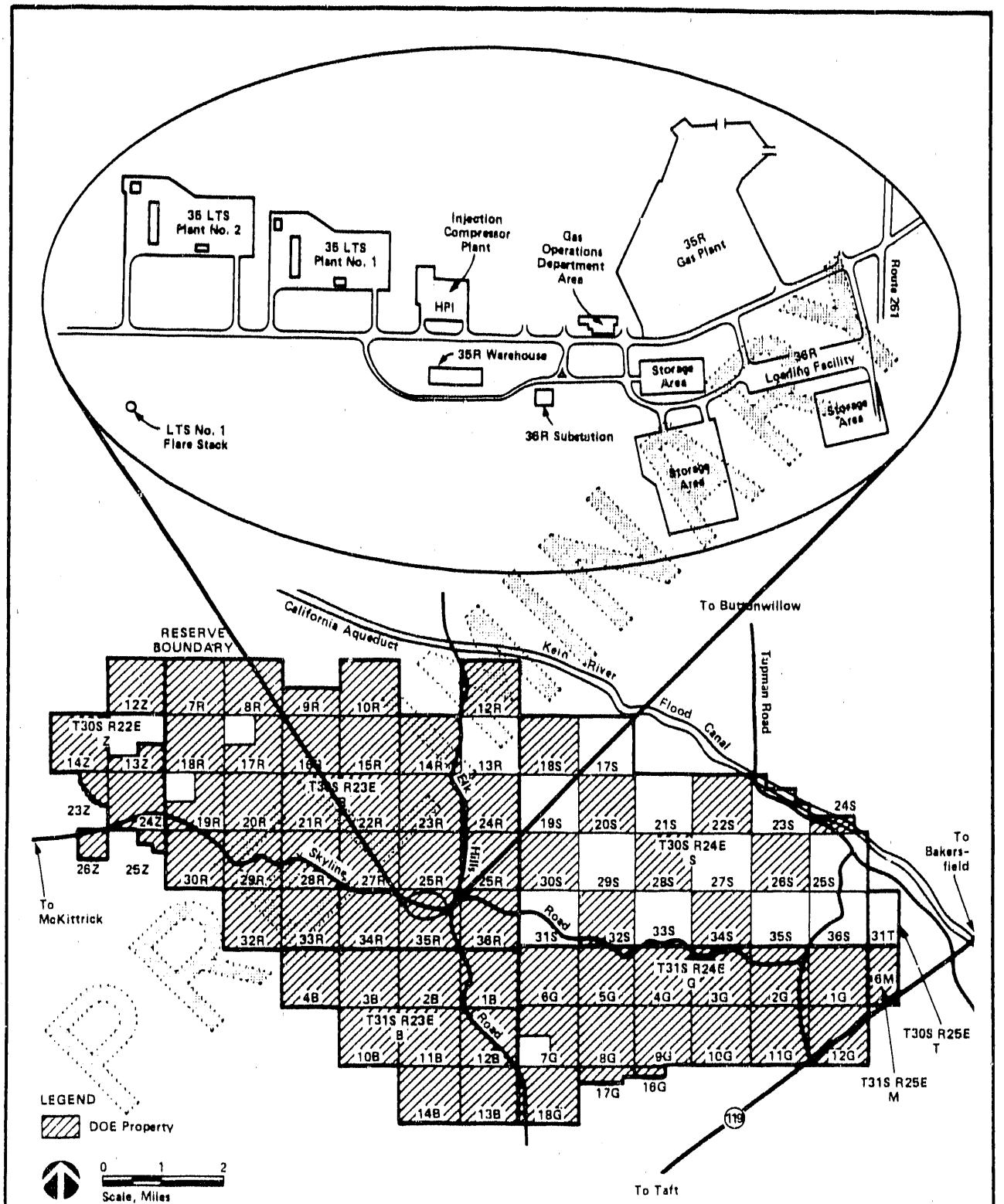
Production Facilities on NPR-1

Facilities at NPR-1 and NPR-2 are referred to by the section number and designated Township letter in which they are located and a generalized description of the facility. Examples are the 35R Gas Plant, which is a gas plant located in Section 35R, and the 36S warehouse, which is a supplies warehouse in Section 36S.

The major production facilities on NPR-1 are located in Section 35R and include the 35R Gas Plant, Low Temperature Separation (LTS) Plants 1 and 2, and the High Pressure Injection (HPI) Plant. The location of these plants is shown in Figure 2-6.

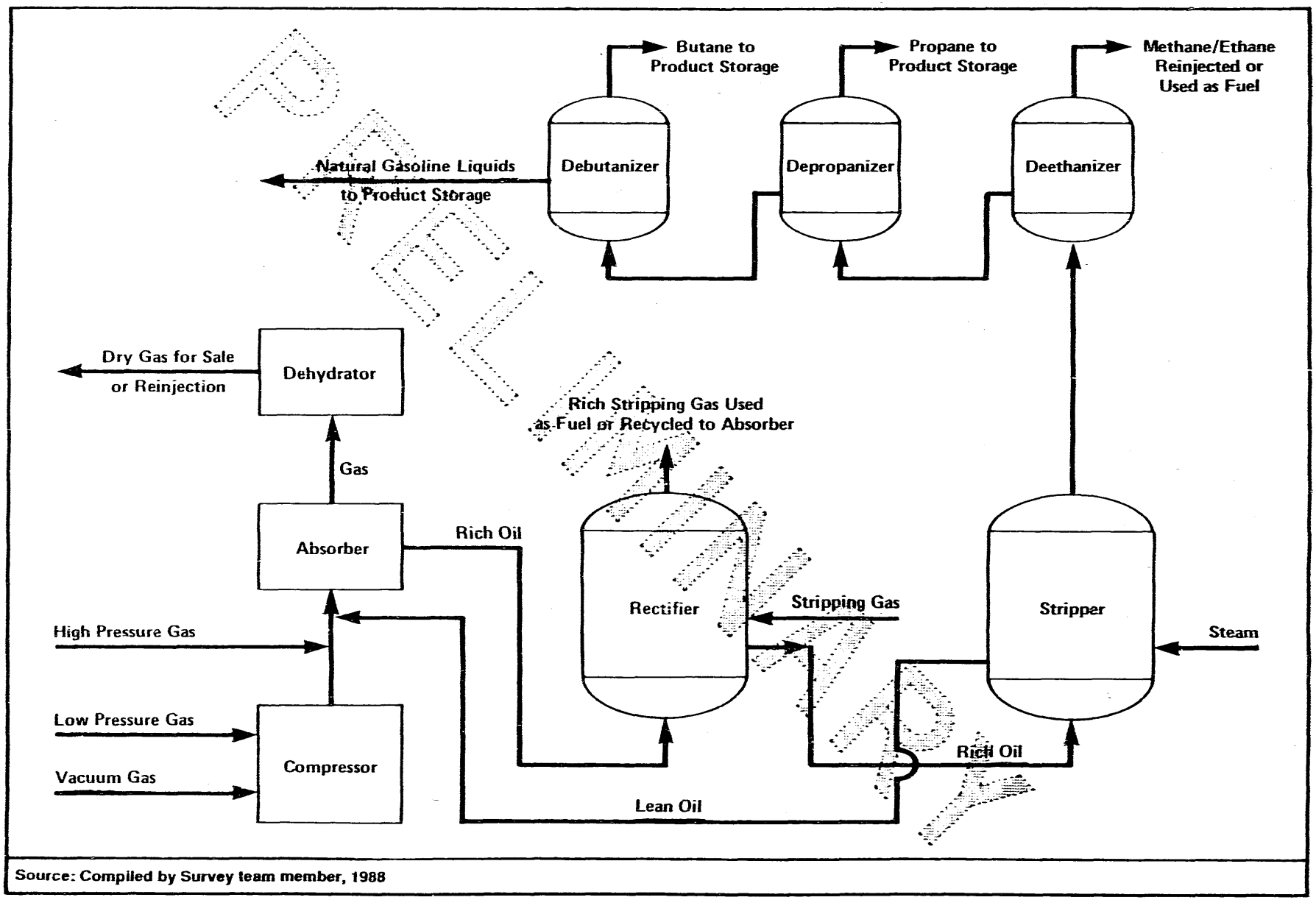
The 35R Gas Plant, built in the 1950s, employs absorption and fractionation processes to make Liquefied Petroleum Gas (LPG) and dry gas at a rate of approximately 90 mmcfd. Figure 2-7 presents a simplified flow schematic for the 35R Gas Plant. Wet or inlet gases are delivered to the plant through three different pipelines (vacuum, low pressure and high pressure). The vacuum and low-pressure gases are compressed to the same pressure as the high pressure gas. A combined pressurized gas stream and a lean oil are routed to an absorber. Within the absorber, the lean oil absorbs a slight amount of methane, some ethane, propane, butane, pentane, and heavier hydrocarbons. Gas from the absorber is dehydrated by solid bed dehydrators and/or a glycol contactor. Dehydrated gas is either injected into the reservoir by the HPI plant or sold (BPOI, 1986c).

The oil, now called rich oil due to the absorption of hydrocarbons, is routed from the absorber to a rectifier, a pressurized column. Stripping gas is added to the rectifier to remove methane and ethane. Stripping gas with methane and ethane is called rich stripping gas. The rich stripping gas is used as a fuel or recycled to the inlet gases (BPOI, 1986c). The rich oil from the rectifier is routed to a stripper. Steam is added to the stripper, which causes some methane, some ethane, propane, butane, pentane, and heavier hydrocarbons to leave the stripper as gases. The gases from the stripper are routed to the fractionation equipment (a series of distillation columns, reboilers, and condensers). The distillation columns (de-ethanizers, depropanizers, and debutanizers) vary temperature and pressure within a column to selectively separate hydrocarbon components. As a result, light hydrocarbon gases, such as methane and ethane, are either mixed with injection gas



Source: NPR, 1987

MAJOR PRODUCTION FACILITIES ON NPR-1 FIGURE 2-6



Source: Compiled by Survey team member, 1988

FLOW SCHEMATIC AT 35R GAS PLANT

FIGURE 2-7

or used as fuel, propane is recovered as a liquid and sent to product storage, and natural gasoline is condensed and sent to product storage.

The LTS plants, which were built in the 1970s, use compression, extraction, and fractionation processes to make LPG. Figure 2-8 presents a simplified flow schematic for the LTS 1 and 2 plants.

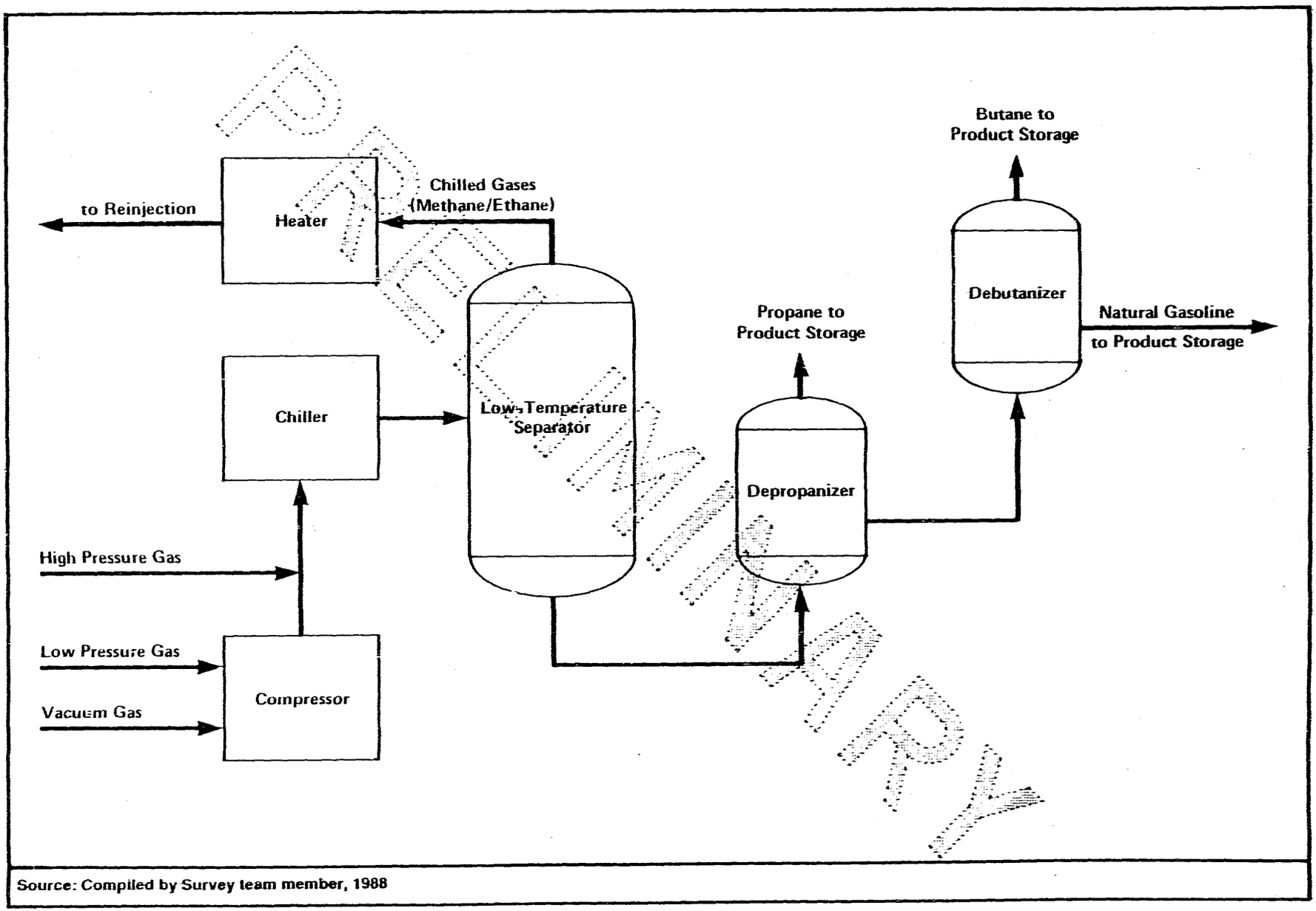
Vacuum and low-pressure gases are compressed to the same pressure as the high-pressure gases. The LTS extraction process chills inlet gases to -10°F to preferentially condense propane and heavier hydrocarbons. A low-temperature separator splits the chilled stream into two components, chilled gases and liquids (BPOI, 1986c).

Chilled gases from the low-temperature separator are heated and routed to the HPI plant. Liquids from the low-temperature separator are routed to the fractionation equipment. The fractionation process has been described earlier.

LTS Plants 1 and 2 function in the same manner. Each LTS plant processes 100 mmcfd. All three gas plants (35R Gas Plant, LTS 1 and LTS 2) are operated 24 hours a day, 7 days a week. The flow of all major streams into and out of each gas plant is metered and sampled for analysis. During abnormal operations, such as overpressure conditions and other process upsets, wet gases flowing into the gas plants are not processed, but instead are flared or vented to the atmosphere (BPOI, 1986c). There are five flare stacks at NPR-1.

Injection gas originates at the 35R Gas Plants and LTS Plants. Injection gas, primarily methane and ethane, is compressed at the LTS Plants and the HPI Plant. The discharge pressure at a compressor is normally 3,100 pounds per square inch (psi) and the maximum pressure is 3,500 psi. Injection gas is distributed by pipelines and metered prior to reinjection in Stevens Zone wells. The reinjected gas helps maintain field pressure and improve oil recovery (BPOI, 1986c).

Gas and oil are coproduced from oil producing zones. Gas-liquid separators at the tank settings separate gas, commonly referred to as "wet gas", from oil and water. All tank settings have one or more gas-liquid separators. Tank settings are equipped with facilities to periodically gauge (meter) oil, water, and gas production from individual wells in order to monitor well and reservoir performance. Tank



Source: Compiled by Survey team member, 1988

FLOW SCHEMATIC OF LTS 1 & 2

FIGURE 2-8

settings can include one to three fixed roof tanks for storage of liquids and pumps to send liquids on to a dehydration train (BPOI, 1986c).

Figure 2-9 diagrams tank settings for the major oil producing zones, the Shallow Oil Zone and the Stevens. Wet gases from tank settings are collected into separate pipeline systems according to the gas pressure leaving the tank settings Gas is transported to the gas plant or to compressors utilizing separate pipelines. Gas pressure classification is as follows:

- Vacuum gas - below atmospheric
- Low-pressure gas - 50 to 120 pounds per square inch gauge (psig)
- High-pressure gas - 400 psig and over.

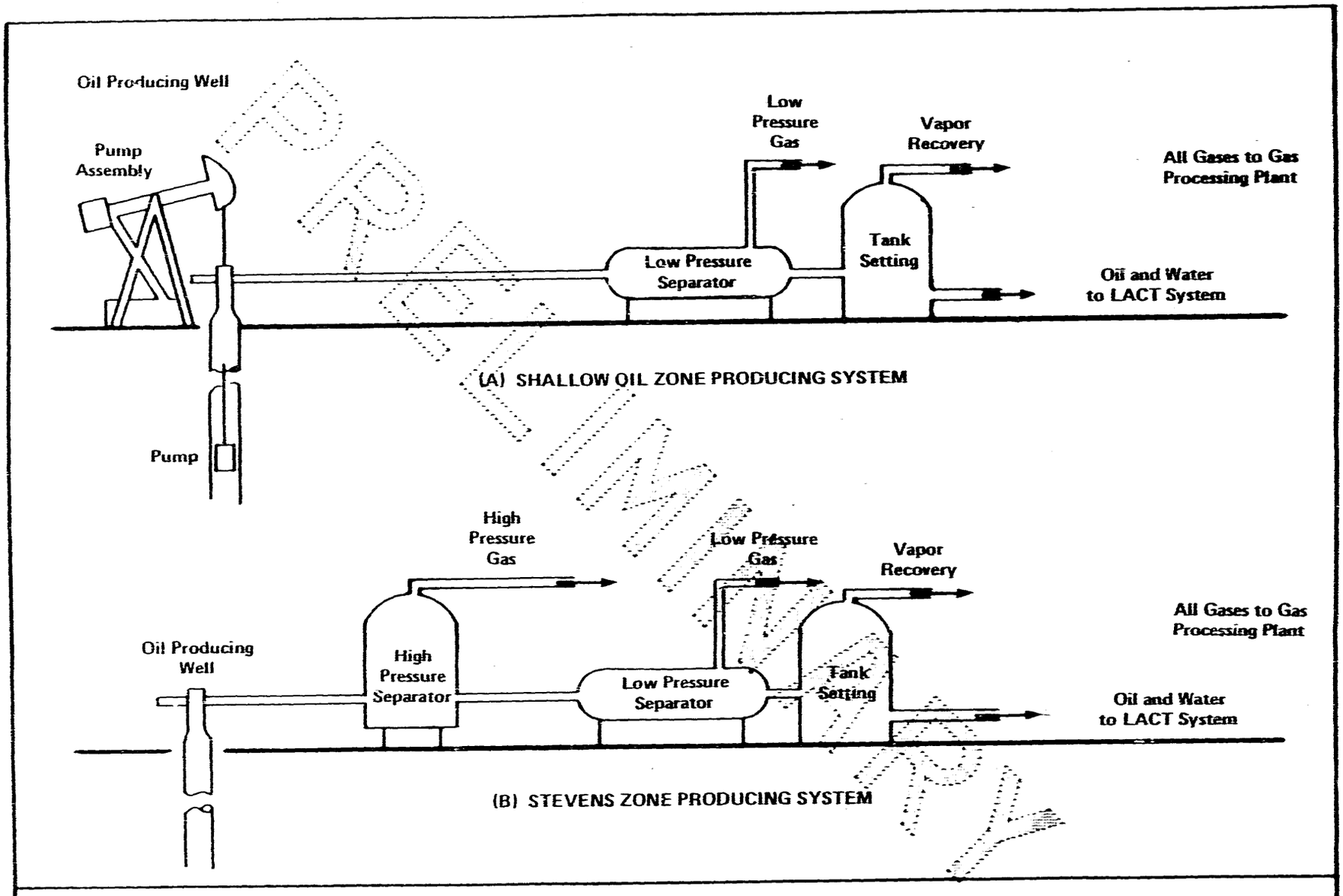
Wet gases that condense into a liquid are removed from the gas collection system and put into the condensate collection system. The condensate collection system is a network of piping that parallels the gas piping system. The condensate collection system is pressurized by the gas pipeline. Condensate can be processed into natural gasoline at the 35R Gas Plant and/or sold as part of the crude oil stream (BPOI, 1986c).

Oil and water are collected in pipelines that lead to the dehydration/Lease Automatic Custody Transfer (LACT) facilities. Dehydration/LACT facilities are normally located at a lower elevation than tank settings to minimize pumping.

There are 79 permitted tank settings throughout NPR-1. Tank settings are unmanned facilities that are inspected daily or regularly by an operator and serve the SOZ - 24 settings; Stevens Zone - 53 settings; and Carneros Zone - 2 settings (BPOI, 1986c). On NPR-2, there are 34 tank settings, of which 26 are active.

The dehydration facilities separate an oil and water mixture and store product oil. The dehydration process train for crude oil is normally a series of three tanks. The tanks, in order, are called wash, settling, and shipping, as shown in Figure 2-10.

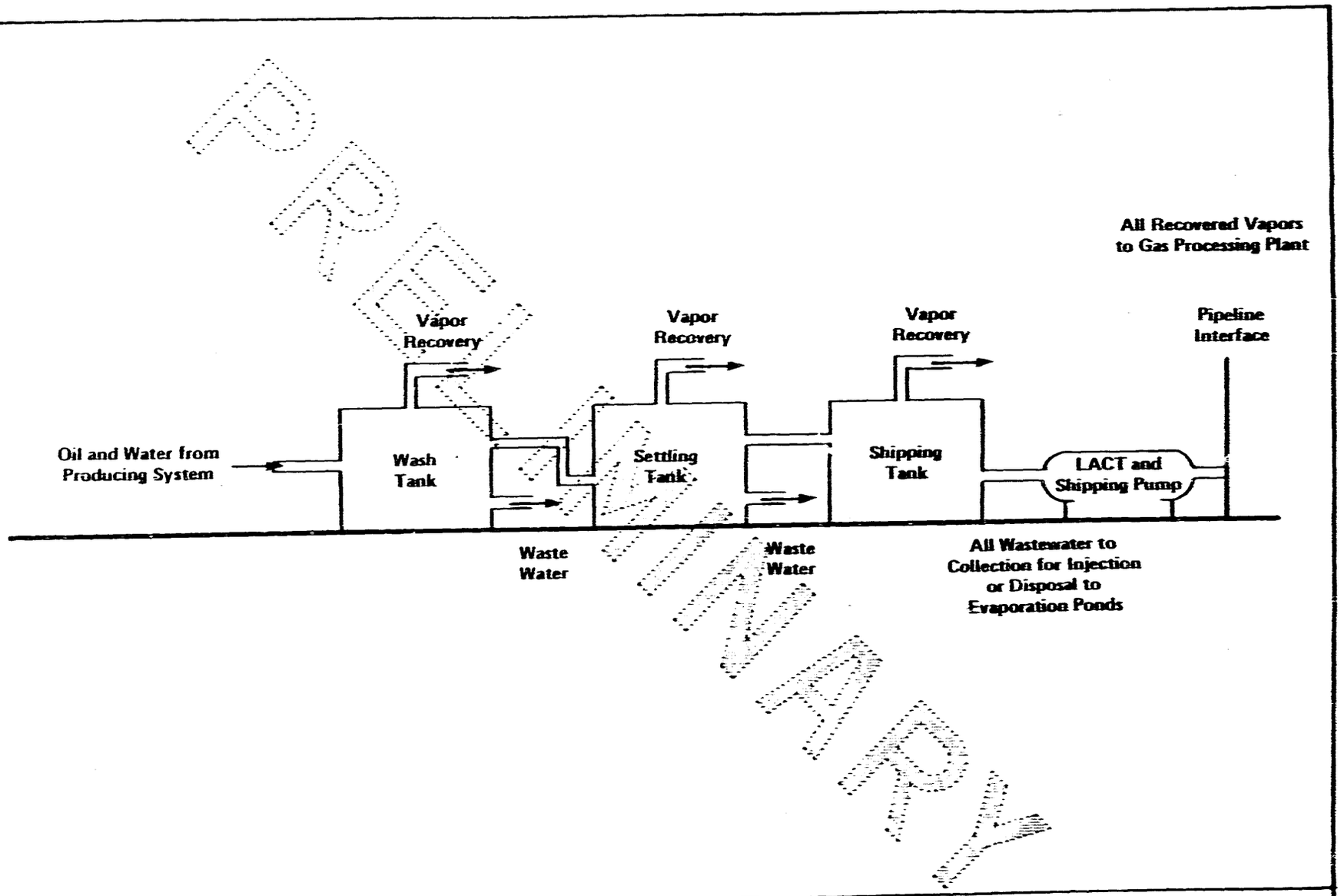
The wash and settling tanks provide for the gravitational separation of oil, water, and sediment. Oil floats to the top of the mixture due to its lower specific gravity, and sediment settles to the tank bottom due to its higher specific gravity. Product



Source: DOE, 1979

GAS/OIL SEPARATION SYSTEMS AND TANK SETTINGS

FIGURE 2-9



Source: DOE, 1979

DEHYDRATION PROCESS TRAIN AND LACT FACILITY

FIGURE 2–10

oil is stored in the shipping tank prior to sales. Wastewater is drained from the tank bottoms and returned to injection wells and evaporation/percolation sumps for disposal. Sediment is removed when tanks are taken out of service for cleaning.

The LACT units provide for unattended transfer of oil from the shipping tank to trucks and/or pipelines. The LACT unit takes samples, records temperatures, determines quality and net volume, recirculates non-specification oil to the dehydration tanks, and sounds an alarm when upset conditions occur (BPOI, 1986c).

The dehydration/LACT facilities are unmanned facilities that are checked by an operator daily or regularly. Dehydration/LACT facilities are located in Sections 10G, 18G, 25S, 24Z, and 26Z (BPOI, 1986c).

In addition to gas reinjection, the following are used to improve oil and gas well production:

- vacuum compression
- waterflood
- steamflood.

The SOZ reservoir pressure in 15 sections on the east side of the field has declined to a point that results in reduced production under normal conditions of 20-30 psig casing pressure at the surface of the well. In these areas, production rates were increased by installing pipelines and vacuum compressor facilities to reduce the well casing pressure to ± zero psig at the well's surface (BPOI, 1986c).

Waterflood facilities are in support of programs to waterflood the Stevens Zone. Primary facilities for high pressure pumping plants are located at Sections 3G, 17R, 33S, and 24Z. Source water for the pumping plants is cleaned, conditioned, and filtered for maintaining water quality needed to ensure maximum recovery of reserves. Source waters for the 24Z and 3G pumping plants are Stevens wastewater and SOZ wastewater, respectively. Source waters for the 33S Plant and the 17R Plant are from three Tulare Zone source water wells in Sections 18G, 13B, and 14B. Tulare source water from these wells is pumped to Section 33S using individual source well pumps, together with a booster pump plant located in Section 18G. At Section 33S a portion of the Tulare water is pumped to individual waterflood

injection wells using the 33S Pumping Plant. The remaining Tulare source water is transported by pipeline to the 7R Pumping Plant for distribution to Stevens Zone waterflood injection wells (BPOI, 1986c).

Support Facilities on NPR-1

The principal support facilities include road systems, freshwater and wastewater systems, sewage systems, landfills, buildings, fire water systems, and security.

The primary access roads within NPR-1 are Elk Hills Road and Skyline Road. A series of secondary and tertiary roads connect the primary access roads to wells, tank settings, and other facilities. Secondary roads are paved and tertiary roads are dirt. An order of magnitude mileage estimate of the secondary roads is 75 miles and tertiary roads is 900 miles (BPOI, 1986c).

NPR-1 receives its freshwater from a well field in the alluvial sediments of the Kern River operated by the West Kern Water District. The Water District is under contract to deliver up to 1.76 million gallons per day (mgd) at the 5M Pump Station or through a direct connection to Section 11G. Three pumps at the 5M Pump Station boost the water to a tank at an intermediate level in Section 35S. The level in the 35S tank controls the 5M pumps (BPOI, 1986c). The addition of chlorine to the fresh water system occurs at the 5M Pump Station. Similarly, the level in a higher tank at Section 32S controls booster pumps at Section 35S. Finally, the level in a 672,000-gallon tank at Section 28R, the highest point in the Reserve, controls the 32S pumps. Three large tanks are kept filled at Section 5M to provide additional storage. Field lines connected to the main lines are kept under pressure by gravity head from the three levels of storage tanks, at Sections 35S, 32S, and 28R. Freshwater demands are for potable, firefighting, and process needs. Process needs include process cooling at the 35R Gas Plant complex and support of field-wide drilling and production operations at individual well sites (BPOI, 1986c).

SOZ wastewaters generated at the 10G and 25S dehydration/LACT facilities are used as source water for waterflooding the Stevens Zone and/or injected into disposal wells on the east side of the field (BPOI, 1986c). Stevens wastewater generated at the 18G dehydration/LACT facility is injected into disposal wells in and around Section 18G. Stevens wastewater generated at the 24Z dehydration/LACT facility is

used as source water for waterflooding the Stevens Zone and/or (2) injected into disposal wells in Section 24Z (BPOI, 1986c).

Asphalto Zone wastewater generated at the 26Z dehydration/LACT facility is injected into a Tulare Zone disposal well. Carneros Zone wastewater generated at the 35R Carneros condensate sales facility and 35R Gas Plant complex wastewater are discharged to an evaporative sump located in Section 35R (BPOI, 1986c).

Sanitary sewage is disposed of through septic tanks and associated leach fields. Septic tanks are emptied by a subcontractor and the contents hauled off-site for disposal. Three 50-foot-deep sewage percolation wells are also utilized at the older support buildings in Section 36S. Leach lines discharge into the Tulare Zone (BPOI, 1986c).

NPR-1 operates two Class II-I liquid disposal sites, a 42-acre site in Section 27R and a 10-acre site in Section 10G. The sites employ landfarming-type operations and receive liquid waste generated during production, drilling, and related operations. Liquid wastes are landfarmed by spreading the waste over the ground's surface and mixing it into the ground by using a crawler tractor with bulldozer blade. The majority of the liquid waste is spent drilling mud (BPOI, 1986c).

Within the 27R Class II-I site is an oil recovery sump. This sump serves as the primary means of oil recovery from spills, oil/water mixtures, etc. Oil is skimmed from the sump and returned into the production system (BPOI, 1986c).

Construction-related and production-related solid wastes, as well as domestic trash, are hauled off the Reserve to the Taft Sanitary Landfill for disposal.

Numerous buildings and trailers have been provided for offices, maintenance and operations shops, storage, etc. Buildings provide office space for owner and contractor administrative and engineering staffs at the 11G Administration Building; office space for operating, engineering, and administrative staffs at Section 36S; office space for operating staffs at Section 35R; warehouses at Section 35R and Section 36S; a maintenance shop at Section 36S; and a storage yard at Section 2B. There are gasoline dispensing stations at Sections 36R and 36S (BPOI, 1986c).

Water for fire control is provided at all major facilities. The major facilities are gas plants, LPG facilities, dehydration/LACT facilities, compressor stations, and tankfarm and tank settings. The source of water is primarily the freshwater system. The water system is also tied into the wastewater system for backup (BPOI, 1986c).

All but approximately 2.5 miles of the perimeter of NPR-1 is fenced to restrict entry. A fireguard of disked ground about 20 feet wide is kept free of vegetation, inside the fence. Security guards are stationed at all entry road locations. Locked gates are located at various locations off public roads (BPOI, 1986c).

Production Facilities on NPR-2

Facilities on DOE leases for NPR-2 are shown in Table 2-2 along with the responsible lessee. There all 211 active oil and gas wells on DOE property on NPR-2 producing a combined 1,500 BOPD (BPOI, 1986d). There are 34 tank settings, 26 of which are active, on DOE land in NPR-2. These tank settings are similar in operation to the settings described previously. There are four major facilities on NPR-2, one in Section 8D, one in 32G, and two in 12D. Texaco operates the Buena Vista Gas Plant in 8D with a capacity of 17 mcfd, the West Kern County Water District (WKCWD) maintains a large pumping station on 32G (BPOI, 1986d) and the California Department of Water Resources maintains and operates the California Aqueduct and Buena Vista Pumping Plant in 12D. Atlantic Richfield Company (ARCO) maintains a small compressor station on Section 20B.

The current lessees of NPR-2 Government lands include: Mobil Oil Corporation, Atlantic Richfield Company (ARCO), Union Oil of California, Phillips Petroleum Company, Texaco Producing Company, and Chevron U.S.A. Numerous rights-of-way and easements have been granted to allow pipelines, transmission lines, and sewer lines to cross Government-owned land (BPOI, 1986d). The location of the leases on NPR-2 is shown in Figure 2-11.

Other Facilities on NPR-2

A fenced communication facility is located in Section 18D. This facility is owned by Warner-Amex cable television service. The facility includes two large and one small

TABLE 2-2

PROCESS FACILITY INVENTORY FOR DOE LEASES ON NPR-2

Section	Lessees	Active Wells	Active Tank Settings	Major Facilities
18B	Phillips Petroleum	0	0	0
20B	Texaco	3	1	0
	ARCO	26	2	0
28B	Phillips Petroleum	8	4	0
	Chevron	5	1	0
	Arco	0	0	0
	Texaco	0	0	0
22B	Texaco	0	0	0
	Chevron	5	1	0
26B	Texaco	0	1	0
	Chevron	22	2	0
34B	Texaco	0	0	0
	Union Oil	0	0	0
30G	Phillips Petroleum	1	1	0
32G	Phillips Petroleum	3	1	1[a]
	Mobil	2	1	0
	Union Oil	0	0	0
4D	Texaco	0	0	0
2D	Chevron	1	2	0
	Texaco	0	0	0
12D	Phillips	0	0	2[b]
14D	Texaco	35[c]	4	0
18D	Chevron	0	0	0
12C	Chevron	9	1	0
8D	Texaco	35[c]	1	1

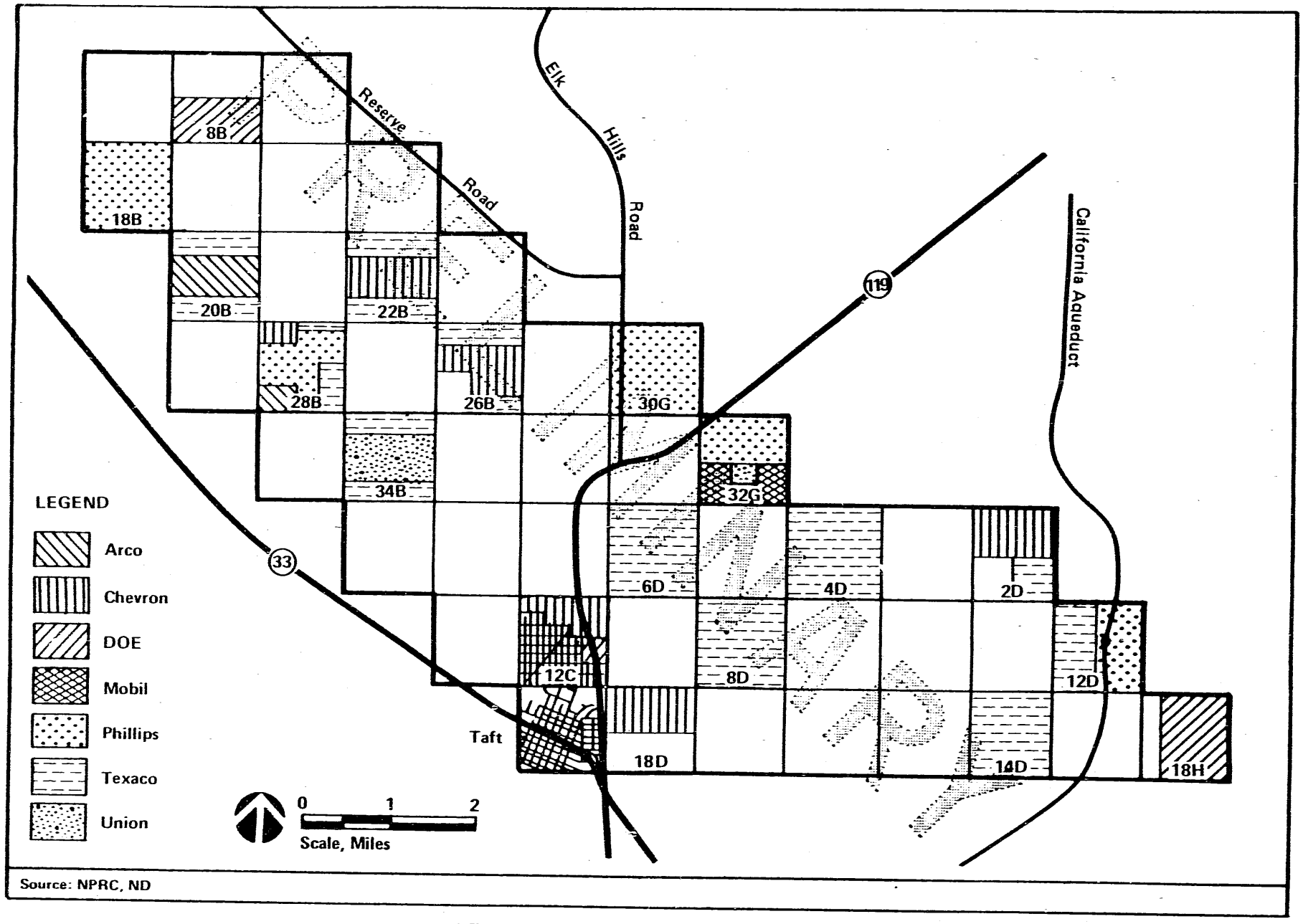
TABLE 2-2

PROCESS FACILITY INVENTORY FOR DOE LEASES ON NPR-2 (Continued)

Section	Lessees	Active Wells	Active Tank Settings	Major Facilities
	Chevron	0	0	0
6D	Texaco	90	3	0
	Chevron	1	0	0
TOTALS		211	26	4

Source: BPOI, 1986d

a - Major facility is West Kern County Water District Pumping Station
b - Major facilities are California Aqueduct and Buena Vista Pumping Plant
c - BPOI, 1986 sites combined total for wells in 14D and 8D



LEASES OF DOE PROPERTY ON NPR-2

FIGURE 2-11

dish satellite antennas bordered on three sides by a 20-foot-high earthen berm (BPOI, 1986d).

Valley Waste Disposal Company (Valley Waste) is a consortium of oil producing companies formed in 1932 to dispose of produced water. Prior to 1987, Valley Waste had operated two facilities on DOE land within NPR-2. The two facilities were Broad Creek No. 3 in Section 34B and part of Buena Vista No. 2 in Section 18B. In addition to these facilities, produced water from Buena Vista No. 1 crossed DOE land in Section 20B going to Buena Vista No. 4. Valley Waste facilities were primarily composed of several oil sumps or cleanup ponds followed by a series of percolation/evaporation sumps (BPOI, 1986d).

The Broad Creek No. 3 facility ceased operations around March 1986. Plans for restoration of the site by Valley Waste are in preparation. Buena Vista No. 2 had 23 percolation/evaporation wastewater sumps on DOE land and a transport channel such that two produced water streams were exiting the site. Buena Vista No. 2 ceased operations in late 1986 (BPOI, 1986d).

2.4 Site Natural Resources

Topography

NPR-1, which encompasses most of the Elk Hills, is characterized by a low, elongated swell about 20 miles long and 7 miles wide that protrudes about 1,000 feet above the surrounding valley floor. Elevations within NPR-1 range from 290 feet above sea level on the valley floor at the northeastern boundary to 1,551 feet along the main ridge in the western part (BPOI, 1986c).

In general, the terrain of NPR-1 is characterized by numerous, rounded divides and smooth slopes. A large number of ephemeral/intermittent streams draining the hills have created a highly dissected stream pattern of gullies and channels. Sediments eroded from the higher elevations have been deposited along the base of the hills, resulting in a smooth topographic transition into the adjacent valley lands (BPOI, 1986c).

The topography of NPR-2, which includes portions of the Buena Vista and Midway Valleys and the Buena Vista Hills, is quite similar to that of NPR-1. Elevations within NPR-2 range from 400 feet above sea level in the Buena Vista Valley to 1,288 feet in the southeasterly section of the Buena Vista Hills (BPOI, 1986d).

Major Water Bodies

NPR-1 and 2 are situated within the boundaries of the Tulare Lake Basin. Surface and groundwater flows within the basin converge toward the basin's central valley floor. In the past, this convergence resulted in the development of several large lakes (e.g., Tulare, Buena Vista, and Kern). However, upstream diversions, heavy groundwater pumping, and high evaporation rates have helped to reduce these lakes to dry lakebeds (BPOI, 1986c).

NPR-1 and 2 have relatively limited water resources. Less than 1 percent of the basin's total surface flow originates from the NPRC with Buena Vista Creek, in Buena Vista Valley, carrying most of it (DOE, 1979). This flow occurs entirely in the form of intermittent streams that have sustained flows only during and immediately after periods of heavy precipitation. These surface flows seldom reach the valley floor; instead, they tend to rapidly percolate into their stream beds (DOE, 1979). Buena Vista Creek flows into the Buena Vista lakebed, east of the NPRC.

Although stream flow is intermittent, certain surface water features of NPRC have been designated to be waters of the United States by the Environmental Protection Agency. Sand Creek on NPR-2 was declared a regulated waterway as was Buena Vista Creek and its tributaries and Broad Creek (Campbell, 1987). The California Aqueduct, a major conduit of freshwater for Los Angeles and southern California, borders NPRC to the north, east, and south and is located within the NPR-1 boundaries in Sections 23S, 24S, and 25S, and within the NPR-2 boundaries in Sections 12D and 13D.

Hydrology

The groundwater underlying the NPRC can be divided into three freshwater aquifer zones: (1) Lower Tulare, which is a confined aquifer, (2) Upper Tulare, which is an unconfined or water table aquifer, and (3) the alluvial zone, which contains perched

water in some areas. Because of the local geologic structure, the freshwater aquifers on-site are limited to 400-1,200 feet of strata, while the brackish waters of the oil zone extend several thousand feet in depth. The groundwater quality of these aquifers is poor. Water in the Tulare Formation is freshwater but with a high solids or mineral content, greater than 4,500 parts per million (ppm) total dissolved solids (TDS) (BPOI, 1986b). The water quality of the brackish waters is even poorer, with TDS levels averaging 30,000 ppm (DOE, 1979).

Climate

The surrounding physiography and established weather patterns direct the climatic conditions at NPRC. Since NPRC rises only about 1,000 feet from the valley floor, its climate differs little from that of the remainder of the southern San Joaquin Valley. Southern California experiences a mesic to aridic climate due to the effects of a semipermanent, high-pressure cell off the California coast. In summer, this cell is situated to the north, where it shields southern California from northwesterly storm fronts. In the winter, however, this high-pressure cell moves south, allowing storm fronts to track through the state, including the San Joaquin Valley. Most of the regional precipitation is associated with these winter storms occurring from October to April (BPOI, 1986b). Annual precipitation is about 5.7 inches per year in Bakersfield, 35 miles to the east. NPRC receives somewhat less rainfall due to its location on the east side of the Temblor Range (BPOI, 1986b).

The southern San Joaquin Valley is particularly susceptible to the accumulation of atmospheric components that create smog and haze (BPOI, 1986c). The climatic parameters that are important in determining photochemical pollution potential are winds, mixing depths, and sunshine. Summer winds in the San Joaquin Valley are dominated by a light, prevailing northwesterly flow caused by the semipermanent high-pressure cell described previously and by the flow of marine air from the ocean through the Sacramento-San Joaquin area. Mixing depth is the depth of the layer of air beneath the inversion level. During the summer, a persistent inversion exists in the San Joaquin Valley between 1,600 and 2,000 meters (5,200 to 6,600 feet) above sea level. Sunlight during the summer months is abundant due to the persistent high-pressure area (DOE, 1979).

Temperatures at NPRC are characteristic of the San Joaquin Valley's hot summers and mild foggy winters. Average July temperature for Bakersfield is 84°F with the average daily high at 99°F (BPOI, 1986b). In the winter months, night temperatures can reach the low thirties with daily highs in the upper fifties to low sixties. In addition, dense fogs often occur on the valley floors of the NPRC during the winter months (BPOI, 1986c).

Biological Resources

Four animal species that reside within the NPRC, the San Joaquin kit fox (Vulpes macrotis mutica), the blunt-nosed leopard lizard (Croataphytus silus), the giant kangaroo rat (Dipodomys ingens), and the Tipton kangaroo rat (Dipodomys nitratoides nitratoides), have been declared rare and endangered by the U.S. Fish and Wildlife Service (DOE, 1979). The State of California has included the San Joaquin antelope ground squirrel (Ammospermophilus nelsoni) on its threatened species list (DOE, 1988).

These five species inhabit, but are not restricted to, the flat, broad plains of NPRC where there is little plant cover. The kit fox and the leopard lizard are endangered, not because of excessive hunting or direct destruction by humans, but because their habitat is ideal for conversion to irrigated farmland and because oil production development has reduced vegetation cover (BPOI, 1986c). The most frequently observed wildlife on NPRC are the black-tailed hare, Botta pocket gopher, and San Joaquin antelope ground squirrel. Amphibians are rare on the NPRC due to the arid environment but reptiles, such as rattlesnakes, are fairly common (DOE, 1979). Bird life on the NPRC is neither exceptionally diverse nor abundant. The most frequently observed birds are the raven, blackbird, quail, and meadowlark. EG&G, one of the site contractors, is managing the endangered species program at the NPRC. The program consists of habitat studies for the endangered species, habitat restoration and revegetation, and determination of the impact of oil and gas production at the NPRC on the listed species.

Vegetation on the NPRC consists entirely of the Lower Sonoran grassland. This vegetational type is characterized by few or no trees, a scattered shrub stratum, and an herbaceous ground cover composed of annual plants. The density of the herbaceous layer depends upon yearly rainfall (DOE, 1979).

The dominant shrub on the NPRC is the common saltbush, with the dominant herb being the red-stemmed filaree and the dominant grass being red brome (BPOI, 1986c).

2.5 State and Federal Concerns

Numerous Federal, state, and county regulatory agencies were invited to a meeting on March 3, 1988, to discuss their environmental concerns relating to the NPRC in support of the Environmental Survey. The meeting was well attended and organized with nine regulatory agencies, the Kern County Fire Department, and Argonne National Laboratory providing input.

The following listing provides highlights of the various environmental concerns and issues as expressed by the various organizations.

U.S. Environmental Protection Agency, Region IX

- underground injection control program - concern over wells exceeding the maximum authorized injection pressure, resulting in potential fracturing of subsurface geologic structures.

- underground injection control program - concern over well failures as identified during mechanical integrity testing. One well failed its mechanical integrity test, which could possibly be causing groundwater contamination.

Kern County Health Department (KCHD)

- concern expressed over well integrity, especially old abandoned wells.

- concern that the KCHD is not being notified of various on-site spill incidences, thereby allowing the County emergency response team to respond.

- concern was expressed over compliance with the County underground tank ordinance, specifically requirements for removal of abandoned tanks.

- concern that the growing number of chromium spill sites be identified and removed.

- because the NPRC is a small water system user requiring water chlorination, the KCHD expressed concern that additional monitoring for trihalomethanes may be required.

California Department of Health Services (DHS)

- concern expressed that all on-site hazardous waste sites be identified.

- concern expressed that more groundwater monitoring be required, especially surrounding the 27R waste disposal site. DHS expressed the desire that the 27R site be closed.

Kern County Air Pollution Control District

- concern expressed that greater communication between the BPOI environmental services staff and the operators of air pollution control devices and equipment is needed to ensure proper installation and regular maintenance as approved in the permits so as not to cause regulatory exceedances of air pollution standards.

- stated that there may be further NOx limitations for NPRC if ambient ozone levels increase in the southern portion of the San Joaquin Valley.

California Regional Water Quality Control Board

- concern expressed over a lack of understanding of DOE's closure procedures related to the Valley Waste operations.

- concern expressed that the northeast portion of NPR-1 has had waste disposal problems which may result in downdip migration of pollutants.

- concern expressed that there are apparently 20 unlined sumps causing potential groundwater contamination.

- concern expressed that the disposal of produced brine water through 13 shallow injection wells (400-1,000-foot well depth) at the Valley Waste site might further adversely affect the Upper Tulare aquifer and other water-bearing zones.

California Division of Oil and Gas

- concern expressed over the use of "gully plugs" downdrainage from tank facilities as not being adequate to minimize environmental damage when the plug is placed far downstream from the tanks.

- concern expressed that water disposal and water injection projects are not in compliance with the Division of Oil and Gas (DOG) nor Federal underground injection control program regulations, causing the potential for subsurface formation damage and contamination of aquifers.

- concern expressed over proper well abandonment in accordance with DOG regulations.

U.S. Fish and Wildlife Service

- concern expressed that the rate of habitat restoration is not as rapid as surface disturbance from oil and gas activities, particularly with regard to endangered species habitat.

California Department of Fish and Game

- stated that the San Joaquin antelope ground squirrel is a State-listed threatened species.

USDI, Bureau of Land Management

- concern expressed over the Valley Waste disposal, specifically, ephemeral stream bottoms should not be used for infiltration of produced waters.

Kern County Fire Department

- concern expressed for proper review of the Material Safety Data Sheets contained in the SARA Title III submission to the County.

Argonne National Laboratory

- stated an EIS for future operations of NPR-1 and an Environmental Assessment (EA) for future operations of NPR-2 are being planned.

- EIS schedule: Draft Environmental Impact Statement (DEIS) due March 1989; Final Environmental Impact Statement (FEIS) due August 1989.*

* Note: As of January 1989, the schedule had been revised as follows: DEIS due June 1989; and FEIS due December 1989.

3.0 MEDIA-SPECIFIC SURVEY FINDINGS AND OBSERVATIONS

The discussions in this section pertain to existing or potential environmental problems in the air, soil, water, and groundwater media. The discussions include a summary of the available background environmental information related to each medium, a description of the sources of pollution and their control techniques, a review of the environmental monitoring program specific to each medium, and a categorization and explanation of the environmental problems found by the Survey team as they relate to each medium.

3.1 Air

3.1.1 Background Environmental Information

3.1.1.1 Regulatory Issues

The Naval Petroleum Reserves in California (NPRC) are located at the western edge of Kern County and within the San Joaquin Valley Air Quality Control Region (AQCR) 31. This region is administered by the U.S. Environmental Protection Agency (EPA) Region IX and the California Air Resources Board (CARB) for attainment and maintenance of the National Ambient Air Quality Standards (NAAQS) and California's air quality standards. The Federal standards establish limits for the protection of public health (Primary Standards) and welfare (Secondary Standards); California has adopted more restrictive standards for most of the pollutants included in the NAAQS, and has established standards for five other classes of pollutants. Table 3-1 lists the NAAQS and the California standards for the regulated pollutants.

The air quality in Kern County has been designated by EPA as either being better than the national standards or not classified for nitrogen dioxide, sulfur dioxide, and for carbon monoxide outside the Bakersfield metropolitan area (EPA, 1986). Kern County did not meet the Primary Standard for total suspended particulates prior to the change in the particulate standard. On July 1, 1987, EPA promulgated a new NAAQS for particulate matter with an aerodynamic diameter less than or equal to 10 micrometers (designated PM_{10}). Kern County is considered to have at least a 95 percent probability of not attaining the PM_{10} standard (EPA, 1987a).

TABLE 3-1

AMBIENT AIR QUALITY STANDARDS

Pollutant	Averaging Time	California Standards	National Standards	
		Concentration	Primary	Secondary
Ozone	1 hour	0.10 ppm (200 µg/m³)	0.12 ppm (235 µg/m³)	Same as Primary Standard
Carbon Monoxide	8 hour*	9.0 ppm (10 mg/m³)	10 mg/m³ (9 ppm)	Same as Primary Standard
	1 hour*	20 ppm (23 mg/m³)	40 mg/m³ (35 ppm)	
Nitrogen Dioxide	Annual Average	--	100 µg/m³ (0.05 ppm)	Same as Primary Standard
	1 hour	0.25 ppm (470 µg/m³)	--	
Sulfur Dioxide	Annual Average	--	80 µg/m³ (0.03 ppm)	--
	24 hour*	0.05 ppm (131 µg/m³)	365 µg/m³ (0.14 ppm)	--
	3 hour*	--	--	1300 µg/m³ (0.5 ppm)
	1 hour	0.25 ppm (655 µg/m³)	--	--
Suspended Particulate Matter (PM_{10})	Annual Mean	30 µg/m³	50	Same as Primary Standard
	24 hour	50 µg/m³	150	
Sulfates	24 hour	25 µg/m³	--	--
Lead	30-day average	1.5 µg/m³	--	--
	Calendar Quarter	--	1.5 µg/m³	Same as Primary Standard
Hydrogen Sulfide	1 hour	0.03 ppm (42 µg/m³)	--	--
Vinyl Chloride (Chloroethene)	24 hour	0.010 ppm (26 µg/m³)	--	--
Visibility Reducing Particles	1 observation	In sufficient amount to reduce the prevailing visibility to less than 10 miles when the relative humidity is less than 70 percent	--	--

Source: EPA, 1987b and California Air Pollution Control Regulations, 1987

* National standards are not to be exceeded more than once per year.

The San Joaquin Valley and Kern County have been classified as not attaining the NAAQS for ozone for several years. Nitrogen oxides and volatile hydrocarbons are precursors to the formation of ozone. Sources of air pollutants in Kern County are regulated by the Kern County Air Pollution Control District (KCAPCD). In order to achieve ozone reductions in future years, KCAPCD has adopted some stringent nitrogen oxide and hydrocarbon control strategies that have affected or will affect operations at NPRC. These requirements include (KCAPCD, 1987a):

- An increase in the control efficiency of steam drive well vents from 93 percent to 99 percent,
- Tighter emission limits on operating equipment such as pumps and compressors,
- Implementation of a motor vehicle inspection and maintenance program.

The California Air Resources Board adopted a plan in February 1987 to consider the western side of Kern County, in which NPRC resides, to be an attainment area for ozone unless the standard is exceeded four or more times between 1988 and 1990 (California APC Regulations, 1987). Should the standard be exceeded four or more times during this period, emission reductions of nitrogen oxides from internal combustion engines and from steam generators will be required within 15 months of the fourth exceedance. Implementation of the additional nitrogen oxide reduction requirements on engines will require NPRC to obtain operating permits from KCAPCD for small engines and steam generators and to reduce the nitrogen oxide emission rates for older engines. Additional information on these sources, the types of emission controls, and the allowed emission rates is presented in Section 3.1.2.

3.1.1.2 Air Quality

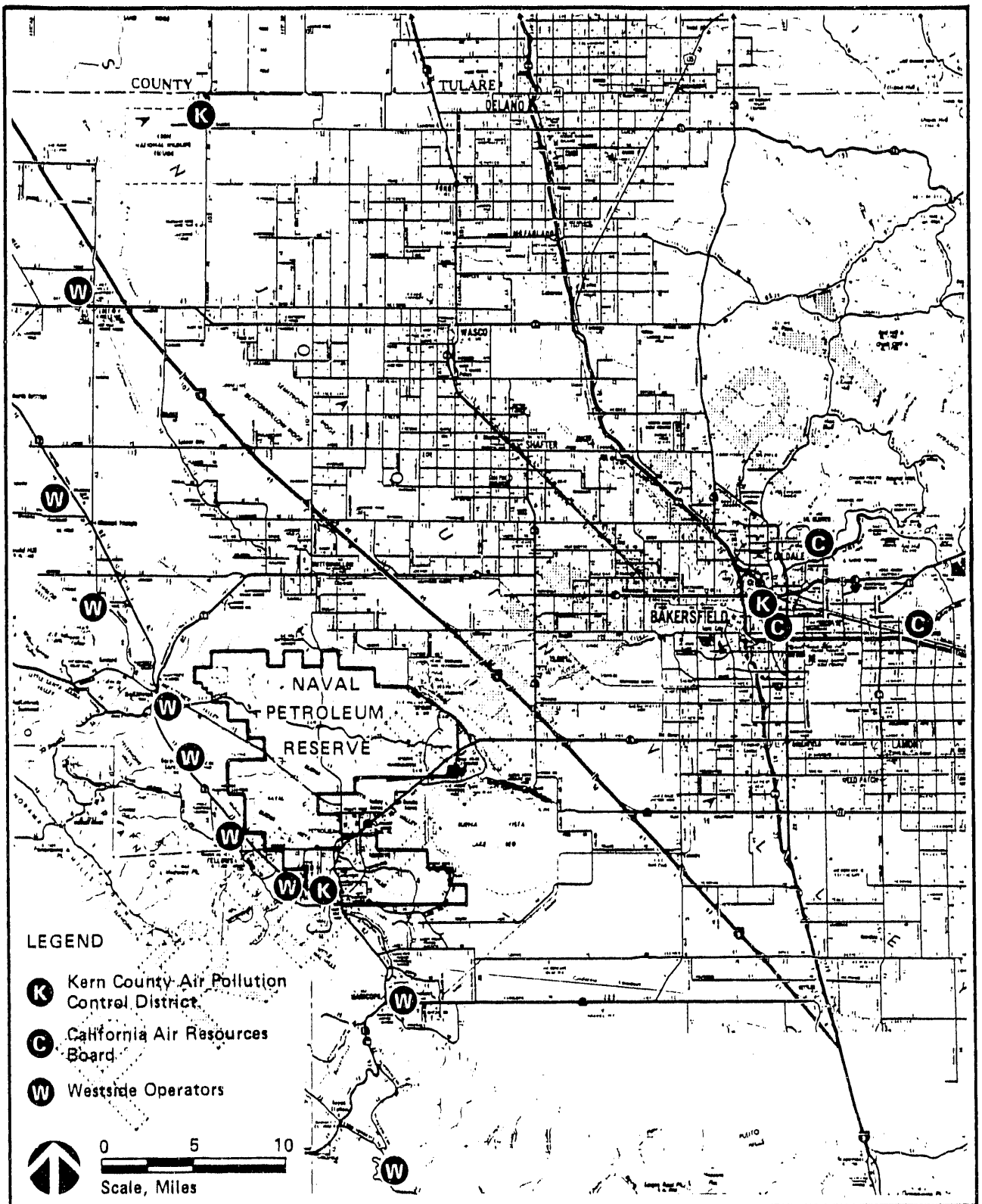
The KCAPCD operates high-volume (Hi-Vol) air samplers to measure total suspended particulates, which no longer have an applicable NAAQS. Three of the KCAPCD sampling locations are in the San Joaquin Valley AQCR at Bakersfield, Taft, and the

Kern Wildlife Refuge. Only the station at Taft also collects PM_{10} samples, which are applicable to the new standard. Samples collected at these locations are analyzed for particulates, lead, nitrates, and sulfates. The California Air Resources Board operates air monitoring stations in Bakersfield, Oildale, and Edison, but these three stations are approximately 23 miles northeast of NPRC. In addition to suspended particulate sampling, CARB monitors for the gaseous pollutants (sulfur dioxide, ozone, carbon monoxide, and nitrogen oxides) at the Bakersfield and Oildale stations. Closer to NPRC, an industrial association known as the Westside Operators had eight monitoring stations in the valley south and west of NPRC at Maricopa, Taft, Fellows, Derby Acres, McKittrick, Cymric, Kernridge, and Lost Hills. However, the stations at Taft, Cymric, Derby Acres, and Lost Hills were eliminated in the summer of 1988 (Powers, 1988). Figure 3-1 shows the location of the monitoring locations around NPRC. Data from the industrial monitoring locations are reported to KCAPCD, but the data are not reported or summarized in the county data reports. Summary descriptions provided below are from the KCAPCD and California Air Resources Board monitoring stations data. Table 3-2 presents a summary of the California Air Resources Board monitoring data for gaseous pollutants measured at Bakersfield, Edison, and Oildale during 1986. Table 3-3 presents a similar summary of particulate matter concentrations from Bakersfield, Oildale, and Taft.

Kern County had 99 days during 1986 during which the California ozone standard [0.010 part per million (ppm)] was exceeded (CARB, 1987), and Bakersfield recorded 8 hours in which the NAAQS (0.12 ppm) was exceeded (KCAPCD, 1987b). Nonattainment of the ozone standard reflects the complex interaction of hydrocarbons and nitrogen oxides within the restricted mixing area at the southern end of the San Joaquin Valley.

Nitrogen dioxide concentrations are well below the NAAQS, and the highest concentrations are approximately half the California hourly standard of 0.25 ppm. Nitrogen dioxide concentrations are monitored at seven air monitoring sites in Kern County. Data from two locations near NPRC, Maricopa and McKittrick, show a consistent range of hourly maximum values (0.02-0.08 ppm) and a consistent annual mean of 0.01 ppm for the period 1982 through 1986 (KCAPCD, 1987b).

Kern County has not exceeded the NAAQS for carbon monoxide since 1979, and redesignation of the Bakersfield area from nonattainment to attainment is



Source: Compiled by Survey team member, 1988

AMBIENT AIR MONITORING STATIONS
1987

FIGURE 3-1

TABLE 3-2

KERN COUNTY GASEOUS POLLUTANT CONCENTRATIONS (PPM), 1986

Pollutant	Location		
	Bakersfield	Edison	Oildale
Ozone			
Annual Mean	.031	.039	.036
Highest Hourly	.15	.16	.14
2nd Highest Hourly	.14	.16	.14
Carbon Monoxide			
Annual Mean	2.74	NA	1.33
Highest 8-Hour	8.8	NA	4.1
2nd Highest 8-hour	7.9	NA	3.1
Highest Hourly	14.0	NA	5.0
2nd Highest Hourly	12.0	NA	5.0
Nitrogen Dioxide			
Annual Mean	.030	NA	.023
Highest Hourly	.11	NA	.12
2nd Highest Hourly	.11	NA	.12
Sulfur Dioxide			
Annual Mean	.002	NA	.005
Highest 24-Hour Mean	.019	NA	.024
2nd Highest 24-Hour Mean	.015	NA	.020
Highest Hourly	.11	NA	.07
2nd Highest Hourly	.05	NA	.06

Source: CARB, 1987

NA = not applicable

TABLE 3-3

KERN COUNTY PARTICULATE MATTER CONCENTRATIONS (µg/m³), 1986

Pollutant	Location		
	Bakersfield	Oildale	Taft
PM_{10}			
Annual Mean	73	62	54
Highest Daily	181	165	131
2nd Highest Daily	162	142	124
Particulate Sulfate (SO_4)			
Annual Mean	4.19	5.68	4.33
Highest Daily	15.9	17.1	10.8
2nd Highest Daily	10.8	14.0	10.8
Lead			
1st quarter	0.15	0.06	0.11
2nd quarter	0.06	0.05	0.11
3rd quarter	0.05	0.05	0.12
4th quarter	0.11	0.06	0.12

Source: CARB, 1987

expected in the near future (KCAPCD, 1987b). Kern County did not have any exceedances during 1986 of either the 8-hour or 1-hour carbon monoxide standards for California (CARB, 1987).

The San Joaquin Valley portion of Kern County was a nonattainment area for sulfur dioxide from 1979 to 1983. Kern County adopted a control strategy in 1979 that required 80 percent reduction of sulfur emissions from oil field steam generators by July 1984. The combustion of oil field crude oil in the steam generators had been the chief source of sulfur dioxide emissions. Attainment of the sulfur dioxide standard was achieved in 1981 and has been maintained since then (KCAPCD, 1987b).

During 1986, particulate concentrations as measured by the PM_{10} method were above the NAAQS and California standards for both the annual and 24-hour averaging times. Measurements at Bakersfield exceeded the 24-hour NAAQS [150 micrograms per cubic meter ($\mu g/m^3$)] three times, Oildale had one exceedance, and Taft had none. The California 24-hour standard of 50 $\mu g/m^3$ was exceeded 46 times at Bakersfield, 36 times in Oildale, and 30 times in Taft (CARB, 1987). Sulfate measurements from the PM_{10} samples at the three sampling locations were all less than the California 24-hour standard of 25 $\mu g/m^3$ during 1986. Particulate lead samples were also less than both the monthly California standard and the quarterly NAAQS of 1.5 $\mu g/m^3$.

3.1.1.3 Meteorology

The Elk Hills area is situated in the extreme south end of the San Joaquin Valley and is partially surrounded by mountainous terrain on three sides. The NPRC is located in the foothills of the Temblor Range, and the peaks of the Tehachapi mountains lie about 30 miles south and southeast. The relatively flat plains of the southern San Joaquin Valley separate the Elk Hills area from the Sierra Nevada mountains which lie to the northeast. The broad plains of the great Central Valley extend north from Elk Hills.

The surrounding topography has a significant influence on the regional climate. The Sierra Nevadas insulate the central valley from blasts of cold polar air that propagate southward over the continent during the winter. The Tehachapi

mountains, forming the southern boundary, force moist air emanating from the northwest and north to rise, thus promoting heavier precipitation on the windward slopes, as well as a higher frequency of cloudiness over the foothill areas. The coastal ranges, situated due west of the Elk Hills area, tend to shield the local region from the true marine environment that dominates 50 to 70 miles to the west (DOE, 1979).

The general climate of the Elk Hills area is warm and semi-arid. Nearly 90 percent of all precipitation falls during the annual "wet season," which occurs from October through April. Snow in the southern valley region is infrequent, with only a trace occurring in about 1 year in 7. Thunderstorm and severe weather activity is seldom experienced. Elk Hills receives about 6 inches of precipitation annually (DOE, 1979).

Monthly average temperatures range from the mid-40s in January to the mid-80s during July. Record temperatures have been observed to exceed 110°F during the summer months and drop to less than 22°F during the winter season (DOE, 1979).

The mixing layer defines the extent of vertical circulation in the lower atmosphere. Convection at the surface due to solar heating decreases with altitude due to a persistent inversion in the Bakersfield area. The inversion is a stable layer of air aloft that acts as a ceiling and limits the dilution of pollutants within the mixing layer below. Afternoon mixing heights are approximately 1,200 meters, or 4,000 feet (DOE, 1979). When the ceiling moves to within 1,500 feet of the ground with the wind speed at less than 15 miles per hour (mph), pollutant concentrations increase to produce visible smog. In the winter months, the contributing pollutants are carbon monoxide, sulfur dioxide, nitrogen oxides, and particulate matter; during the summer months, May through October, ozone is the primary pollutant (KCAPCD, 1987b).

The daily wind direction distribution for western Kern County is bimodal with primary wind directions corresponding to flow from the southwest and north. At Elk Hills, winds come from the southwest during the evening and night due to the colder drainage winds originating in the higher terrain to the west and southwest. From approximately 8 AM to 10 AM, wind flow typically changes from a southwesterly to a northerly flow. Afternoon air flow is typically from the north

with wind speeds of 4 to 5 mph (DOE, 1979). During the early evening hours, the wind conditions return to a southwesterly flow.

3.1.2 General Description of Pollution Sources and Controls

Pollutants are emitted to the atmosphere at NPRC from the operational equipment for extracting, pumping, refining, and storing oil and gas. The major groupings of equipment (based on their potential for emissions) include the four gas processing plants, gas compressor engines at the gas plants and at 10 other locations within NPRC, oil tank settings throughout the reserve, and miscellaneous sources. Three gas plants are located near the center of NPR-1; the fourth plant is operated by Texaco in NPR-2. The gas plants are potential sources of fugitive hydrocarbons that can escape though a multitude of small leaks throughout each of the plants. Each gas plant also contains some boilers and heaters that emit the combustion products from burning natural gas. When operating, the flares for each of the NPR-1 plants are the most noticeable air pollution sources since the flames are visible for many miles. However, the flares emit relatively small amounts of pollutants compared to the other groups of equipment. Table 3-4 summarizes the annual baseline or permitted emission rates for each of the major source categories at NPR-1. Except for emissions from the flares determined by the Survey, actual emissions are less than the permitted values presented in Table 3-4. Actual emissions are not quantified by NPRC. The gas compressors pump field gas from the wells to the processing plants, and from the plants to either a sales terminal or to an injection well. The compressor engines run on residual gas from the gas plants. Although the largest engines at NPR-1 have been modified to limit the emission of pollutants, the engines are still the largest source of nitrogen oxides at NPRC as well as a major source of hydrocarbons and carbon monoxide. The tanks storing oil are also a minor source of hydrocarbon emissions. The many well heads, small engines, and heaters, plus a few other types of equipment, make up the class of miscellaneous sources that have no emission controls and, with some exceptions, are not regulated. These sources account for approximately half of the hydrocarbons on the emissions inventory for NPR-1. A description of each of the source categories and any associated control equipment is provided below.

TABLE 3-4

ESTIMATED EMISSION RATES FROM NPR-1 OPERATIONS

Source Category	Emissions (tons/year)				
	Part.	SO_2	NO_x	HC	CO
Gas Processing Plants	13.3	0.8	147	797	22.4
Flares	Negligible	10[a]	13[a]	277[a]	124[a]
Gas Compressor Engines	12.7	1.8	4,400	3,366	3,935
Tank Settings	NA	NA	NA	425	NA
Miscellaneous	4.0[b]	0.4[b]	1,025[b]	7,814[b]	138[b]
Total	30	13	5,585	12,679	4,219

Sources: [a] Compiled by Survey team member; [b] BPO [1986]; otherwise Gough, 1988

NA = Not applicable

3.1.2.1 Gas Processing Plants

NPR-1

The 35R Gas Plant complex consists of two Low Temperature Separation (LTS) gas plants, LTS-1 and LTS-2 (built in the late 1970s), and an older gas absorption plant, also known as 35R plant (built in the 1950s). The gas plants process wet gases from tank settings and gas wells into Liquefied Petroleum Gas (LPG) and dry gas. Then the LPG is fractionated into propane, butane, and natural gasoline. The major difference between the 35R gas plant and the LTS plants is the type of extraction process for removing propane and heavier hydrocarbons from the field gas. The LTS extraction process chills inlet gases to -30°F to preferentially condense propane and heavier hydrocarbons. The 35R plant uses an absorption process, rather than a refrigeration process, to remove the heavier gases from the field gas mixture. Each LTS plant processes approximately 120 million cubic feet per day (mmcfd), and the 35R plant processes approximately 80 mmcfd. All three gas plants are operated 24 hours a day, 7 days a week. See Section 2.3 and Figures 2-7 and 2-8 for additional information.

Emissions from the processing equipment consists of hydrocarbon vapors that escape intermittently from flanges and packing seals around valves. Emissions from the three plants have been estimated at 3,636 pounds per day (lb/day) of hydrocarbons (Gough, 1988). Continuous sources of process emissions at the plants are limited to the boilers and heaters at each plant. Each of the two LTS plants have gas-fired glycol regeneration systems and two process heaters. The liquid glycol absorbs water from the processed gas. When the glycol is heated in the regenerator, the water vapor and some of the glycol evaporate to the atmosphere. The evaporated water produces a short white plume, which is the only visible emission from the process equipment. The two gas-fired heaters, each rated at 27.5 million British thermal units per hour (MMBtu/hr), heat Therminol; a high molecular weight heat transfer medium. The hot Therminol is circulated to the reboilers associated with the three distillation columns for ethane, propane, and butane separation.

The 35R Gas Plant has three boilers and two rich oil heaters. Steam is supplied to the reboilers, the rich oil stripper, and steam pumps. The plant used to have many

steam pumps, but most have been replaced with electric pumps. Consequently, only one boiler is operated at a time. One boiler is rated at 24 MMBtu/hr, and the other two are rated at 49 MMBtu/hr. The rich oil heaters heat the absorbing oil to a temperature of approximately 460°F to drive off the absorbed gases in the stripper section (BPOI, 1982). Each heater has a capacity of 19 MMBtu/hr.

NPR-2

The Texaco gas plant is located in the middle of Section 8D and has been operating since the early 1920s. An oil absorption process removes propane and raw gasoline from the wet gas. The capacity of the plant is 15 mmcfd, but recent production rates are approximately 7 mmcfd. Gasoline production is approximately 10,000 gallons per day (gpd). The field gas contains between 10 and 12 percent carbon dioxide that is removed from the gas stream by absorption in a potassium carbonate solution. Compressors at the plant have a combined power of 3,500 brake horsepower (bhp), and they draw the field gas to the plant and compress the gas to 400 psi for the fractionating columns. Each of the compressors rated at more than 500 bhp has an air permit from the KCAPCD. The permitting of the compressors is the responsibility of Texaco as owner and operator of the plant. DOE has no control or responsibility for any air emissions by the leaseholders at NPR-2. Additional sources of combustion product emissions include the steam boiler for providing steam to old pumps and the glycol reheating unit for evaporation of water removed from the gas stream.

3.1.2.2 Gas Plant Flares

During abnormal operations at the gas plants such as overpressure conditions, failure of compressor engines, or other process upsets, gases flowing into or out of the gas plants are burned at a flare rather than being processed, pumped to sales, or reinjected at NPR-1. At NPR-1 there are five flares on the south side of the 35R Gas Plant complex: a high-pressure flare and a low-pressure flare for each of the two LTS plants, and one flare designed to serve both the gas absorption plant (35R) and the High Pressure Injection (HPI) plant. However, the 35R/HPI flare was incorrectly designed, and it cannot be operated under the original permit conditions without producing smoke. The 35R/HPI flare is permitted to burn only 50 million standard cubic feet per day (mmscfd), but the 35R plant and the HPI have a

combined capacity of 140 mmscfd (Williams Brothers, ND). Consequently, the gas flared from 35R plant and HPI is diverted to the LTS plant flares. The combined capacity of the four LTS flares is 246 mmscfd. The normal incoming feed rate to the three gas plants is 315 mmscfd. Should all three plants be required to flare at the same time, the LTS flares are overloaded and burn with considerable smoking (Williams Brothers, ND). At the time of the Survey, the Bechtel Petroleum Operations, Incorporated (BPOI) staff were preparing to submit another application to KCAPCD for a modified permit to operate the 35R/HPI flare.

The inventory of emissions prepared by BPOI for NPRC operations does not include emissions from flaring of gas since flaring is considered an emergency situation. Only routine emissions are tabulated for KCAPCD. During 1987, 266 mmscf of gas were burned at the four operational flares (Ash, 1988). During the 10-day Survey, the flares were observed operating on six days. Emission estimates for the flare presented in Table 3-4 are based on published emission rates for burning of natural gas (Brunner, 1985; EPA, 1985; Engineering Science, 1983).

3.1.2.3 Compressor Engines

Approximately 60 gas engines at NPRC power compressors that gather field gas from the wells and tank settings, or compress the gas for processing at the gas plants, for sale, or for reinjection into the well field. Additionally, six temporary units were being rented at the time of the Survey. The engines are at 13 locations across NPR-1 with the largest concentration of 27 at the 35R Plant complex. The six largest engines are rated at 5,500 horsepower (hp) each, and all but one of the engines have power ratings in excess of 500 hp. Engines in excess of 500 hp within NPRC are subject to KCAPCD permitting and inspection requirements. Additionally, the Prevention of Significant Deterioration (PSD) permit issued by EPA Region IX to NPR-1 in 1982 specified maximum emission rates for 34 engines by manufacturer (EPA, 1982). Engines built by Ingersoll-Rand Corporation were limited to 11 grams per horsepower hour (g/hp-hr), and engines made by Waukesha Corporation were limited to 10 g/hp-hr. Ten engines installed prior to 1976 were not subject to the PSD regulations, which became effective in 1977. EPA also excluded two engines at 7R which have a more restrictive emission limit of 4 g/hp-hr on the construction permit issued by KCAPCD (BPOI, 1986j). Two new permanent engines (K59 and K60) have been installed since the PSD permit was issued.

In November 1982, NPRC was inspected by EPA Region IX and found to be out of compliance with the emission limits of the PSD permit. Modifications of the engines were planned with the manufacturers, and engineering studies of the modifications were conducted on selected engines from 1983 through 1986. EPA issued a notice of violation to DOE in May 1986 for exceedance of the nitrogen oxide emission rates, and DOE submitted an updated compliance plan in October 1986. Negotiations between DOE and EPA resulted in a revised compliance schedule and the application of specific modifications to the engines. The resulting Federal facility compliance agreement, which was formally approved by EPA in November 1987, specifies a schedule for installation and testing of the modifications for each type of engine with all 34 engines being modified and tested by March 22, 1989 (EPA, 1987c).

The agreement specified the installation of precombustion chamber (PCC) modifications on the 15 Ingersoll-Rand engines, and the installation of pre-stratified charge (PSC) controls on the 19 Waukesha engines. Additionally, the allowable nitrogen oxide emissions from the Ingersoll-Rand engines were reduced from 11 g/hp-hr to 7 g/hp-hr based on previous performance tests. The emission limit for the Waukesha engines remained at 10 g/hp-hr. The PCC modification converts the engines to a lean burn configuration by replacing major engine parts including cylinder heads, turbochargers, and power pistons. Nitrogen oxide emission levels as low as 2 g/hp-hr are achievable with this modification (BPOI, 1986j). The PSC emission controls charge the cylinders with stratified layers of recirculated exhaust gas, dilution air, and a fuel charge via a modified inlet manifold. The rich-burning engine is effectively converted to a lean-burning engine with the PSC modification (BPOI, 1986j).

At the time of the Survey, all the Waukesha engines had been modified with the PSC controls, and all but 12 of the Ingersoll-Rand engines had been modified with the PCC controls. Testing of the modified engines was in progress during the Survey, and the modification program was ahead of the schedule stipulated in the compliance agreement. Nitrogen oxide emission rates for the modified engines are 8 g/hp-hr for the Waukesha engines and 2 g/hp-hr for the Ingersoll-Rand engines. Annual emission rates presented in Table 3-4 for the compressor engines represent expected emissions after all engines have been modified. As a group, the

compressor engines are the largest source of nitrogen oxides and carbon monoxide at NPR-1, emitting 4,400 tons of nitrogen oxide and almost 3,400 tons of carbon monoxide per year.

Should western Kern County be declared a nonattainment area for ozone, KCAPCD Rule 427 requires that the 14 older engines at the 35R gas plant with ratings greater than 200 hp reduce nitrogen oxide emissions by at least 80 percent. Additionally, the concentration of nitrogen oxides shall be no greater than 150 ppm. The 19 Waukesha engines recently modified with PSC control will also require additional modifications to further reduce nitrogen oxide emissions to 2 g/hp-hr. These emission limitations are to be met within 15 months after the effective date of the rule (i.e., after four exceedances of the ozone standard). Other engines that are rated between 50 and 200 hp must reduce emissions by December 31, 1995 (KCAPCD, 1987a).

3.1.2.4 Tank Settings and Dehydration Tanks

Gas and oil are coproduced from four oil-producing zones, and the gas and oil are separated at 79 tank settings across NPR-1 and 34 tank settings across NPR-2 (of which 8 are inactive). All tank settings include one or more gas-liquid separators; equipment for gauging oil, water, and gas production from each well; one to seven fixed roof tanks for storage of an oil/water mixture; and pumps to deliver the oil to dehydration trains (oil-water separator tanks). (See Figure 2-9.) Wet gases from the separators are collected into one of three pipeline systems (vacuum, low pressure, or high pressure) according to the gas pressure at the tank setting for transfer to the gas plants (BPOI, 1986j). Should the gas gathering compressors fail, the pressure in the separator may continue to build due to continued pumping at the wells. In such cases, the gas is vented to a short stack approximately 100 feet from the tank setting.

Gas that separates from the oil while in the holding tanks is pumped into the gas pipelines by a vapor recovery system at each tank setting. Each of 271 oil storage tanks on NPR-1 is equipped with a Varec breather valve for limiting the internal pressure or vacuum that can develop inside the tanks with changes in the air temperature and pressure if the vapor recovery system breaks down. The breathing of the tanks accounts for a minor portion of the fugitive hydrocarbon emissions at

the tank settings. The other potential sources of emissions at the tanks include the entry hatch, gauge hatch, and the cable seal for the oil level indicator. However, any leaks from these points are stopped within a few weeks due to the tank inspection and maintenance program (see Section 3.1.3). Permitted emission rates filed with the KCAPCD show an aggregate rate of 328 tons/yr from all the NPR-1 tank settings out of an NPR-1 total of over 12,000 tons/year (Gough, 1988).

The dehydration facilities separate the oil and water mixture and store product oil. The dehydration process train is a series of three tanks called wash, settling, and shipping, respectively. See Figure 2-10 and Section 2.3. The wash and settling tanks provide time for the separation of oil, water, and sediment due to different specific gravities. Product oil is stored in the shipping tanks prior to sale. NPR-1 dehydration tanks are located in 10G, 18G, 25S, 24Z, and 26Z. Gas evolving from the oil in the 35 dehydration tanks is collected by a vapor recovery system at each location. Fugitive losses from these dehydration tanks are estimated at 97 tons/yr, with the majority of the emissions coming from the six trains in 18G (Gough, 1988).

3.1.2.5 Miscellaneous Sources

There are many small sources of air pollutants at NPR-1 that are not included in the categories of major sources discussed above. These sources include the numerous wells and associated pumps, several small oil heaters and glycol drying heaters, a boiler for underground steam injection and associated tanks, a vapor recovery system for gas from well casings, gasoline pumps, and product loading racks. Additional information on these sources is provided below:

- The total power rating of all the well pumps and other small internal combustion engines was estimated at 9,467 hp. Hydrocarbon emissions from the wells have been estimated at approximately 34,400 lb/day (BPOI, 1986j).

- The 18G dehydration tank trains had six gas-fired heaters for warming the oil during the winter. Each heater has a capacity of 12 MMBtu/hr. Emissions from the heaters have not been estimated because the firing time is dependent upon the wintertime temperatures and because their size is below the KCAPCD criteria level for obtaining a permit.

- Gas is dehydrated in the field at the 30R and 36R compressor stations using a glycol absorption process. The glycol is regenerated by evaporating the water in a heater at both compressor stations.

- The Shallow Oil Zone Steam Injection Project is a pilot study for increasing production and recoverable reserves in Section 3G. The project began injecting steam in July 1987. Emission sources associated with the project include a 62.5 MMBtu steam generator, a steam flood drain tank, and a tank setting. KCAPCD Rule 425 limits the nitrogen oxide emission rate from the steam generator to no more than 0.14 pound per million Btu (lb/MMBtu) (KCAPCD, 1987a).

- The reservoir pressure in 15 sections on the east side of NPR-1 has declined to a point that production is reduced under normal conditions of 20 to 30 pounds per square inch gauge (psig) inside the well casing. Production rates were increased by installing a system of pipelines and vacuum compressors to reduce the well casing pressure to approximately zero. Electrically powered pumps for the vacuum system are installed in Section 3G (BPOI, 1986j).

- Gasoline is stored and dispensed at the vehicle maintenance area in Section 36S. The gas loading facility at 35R transfers liquefied butane and propane into pressurized tanker trucks. Natural gasoline from the gas processing plants is also loaded into tank trucks at the gas loading facility. A crude oil loading rack at the 24Z dehydration/LACT facility is used to transfer light product oil to tanker trucks.

Table 3-4 lists the total emissions from all the miscellaneous sources at NPR-1. Approximately half the hydrocarbon emissions from NPR-1 come from the oil and gas wells (6,276 tons/yr). Almost all the nitrogen oxide emissions from the miscellaneous sources come from the small pump engines at the wells. The small engines contribute 996 tons/yr of nitrogen oxide emissions while the other miscellaneous sources emit 29 tons/yr (BPOI, 1986j).

3.1.3 Environmental Monitoring Program

There is no program at NPRC for measuring the ambient air concentrations of any pollutants. The closest air monitoring stations are south and west of NPR-2 (see Section 3.1.1.2, Air Quality). Air emissions from three classes of air pollution sources are monitored to ensure compliance with regulatory emission limits. The emission monitoring programs for the compressor engines, fugitive hydrocarbons, and vehicle emissions are described below.

3.1.3.1 Compressor Engines Exhaust Monitoring for Nitrogen Oxides

The PSD permit issued to NPRC by EPA in 1982 requires the demonstration of continuous compliance with the specified nitrogen oxide emission limits for the 34 engines at NPR-1 identified in the permit. Testing is to be conducted each month on at least one engine in each of the five classes of engines identified in the permit, and all engines will be tested at least once during each calendar half. Testing methods are to be in accordance with those described in 40 CFR 60 Appendix A using EPA Method 7 (EPA, 1982). During the emission testing, engine power output is measured by installing two pressure sensors on each compressor cylinder during the test. Preprogrammed instrumentation then calculates the horsepower rating of the engine from the pressure and vacuum readings and engine speed. A written report is to be sent to EPA Region IX each calendar quarter containing nitrogen oxide emissions in grams/horsepower-hour and all other relevant information. Information on the applicable emission limits for the engines is provided in Section 3.1.2.3.

3.1.3.2 Fugitive Hydrocarbon Emission Inspection and Maintenance Program

Hydrocarbon emission control is required by the KCAPCD for light oil storage tanks with vapor recovery systems (Rule 411) and for components at light oil and gas production facilities and natural gas processing facilities (Rule 414.7). "Components" means any valves, pressure relief valves, flanges, threaded connections, hatches, seals, packing, sealing mechanism, sight glass, or meter. For oil tanks of 40,000 gallons or greater capacity, the tanks are to be maintained in a "gas tight" condition. "Gas tight" is defined (KCAPCD Rule 414.7) as leakage at a concentration of not greater than 20,000 ppm measured as methane by a

hydrocarbon detection instrument within 1 centimeter of the leak source (KCAPCD, 1987a). The NPRC tank inspection program inspects all applicable tanks at least quarterly to ensure compliance. Tanks having emissions exceeding 5,000 ppm are repaired (BPOI, 1987c). Applicable tanks are permitted by KCAPCD, and are inspected by the District annually before reissuance of the operating permit. During 1987, 1,236 separate tank inspections were made, and 164 tanks (or approximately 13 percent) had measurable leaks at concentrations greater than 10,000 ppm (BPOI, 1988b).

On June 1, 1987, the KCAPCD adopted Rule 414.7: Components Serving Light Crude Oil or Gases at Oil and Gas Processing Facilities and Components at Natural Gas Production and Processing Facilities. This rule is designed to limit fugitive emissions from oil and gas handling equipment and from gas processing plants. Leaks are defined as either:

- A drip rate greater than three drops per minute of a liquid containing volatile organic compounds (VOCs), or
- An emission of gaseous VOCs which causes an appropriate analyzer sampling 1 centimeter from a source to register in excess of 20,000 ppm as methane (KCAPCD, 1987a).

Leaks in excess of 20,000 ppm must be repaired within 20 working days, and leaks in excess of 75,000 ppm must be repaired within 15 working days. An Operator Management Plan was submitted to KCAPCD on September 29, 1987, outlining the program to maintain compliance with Rule 414.7. A contractor has been hired to perform the fugitive emission inspection and repair services at NPR-1.

3.1.3.3 Vehicle Emissions

All motor vehicles registered in NAAQs nonattainment areas within California must be inspected every 2 years (Health and Safety Code 44011). The inspections are to determine whether the vehicle meets emission standards set by the Air Resources Board. If an inspected vehicle fails to comply, it must be repaired at a licensed repair station. NPRC vehicles are inspected and maintained at the garage in Section 36S, which has station license number DC880109. Before any vehicle is tested, the test

instrumentation is calibrated with certified zero and span gases. A visual check is made of emission control components including the positive crankcase vent, air cleaner, air injection system, fuel evaporation system, fill pipe restrictor, catalyst, exhaust gas recirculation valve, and carburetor. The emission standards for vehicles at NPRC are 1.2 percent carbon monoxide, 150 ppm hydrocarbons at idle, and 220 ppm hydrocarbons at high engine speeds.

3.1.4 Findings and Observations

3.1.4.1 Category I

None

3.1.4.2 Category II

None

3.1.4.3 Category III

None

3.1.4.4 Category IV

1. Emissions of pollutants to the atmosphere and an assessment of the effects of these emissions are not reported in the annual report as required by DOE Order 5484.1. DOE Order 5484.1 requires DOE sites to summarize effluent monitoring data and to determine the environmental impacts from routine and accidental releases of pollutants. The NPRC annual report for 1987 follows the format described in Chapter III d.4., Annual Site Environmental Report, of Order 5484.1. Under section (f) 5 of Environmental Program Information, a summary is to be provided describing the nonradioactive effluent monitoring results, reasons for monitoring, the parameters measured, to whom the data are reported, and any results that are out of compliance. However, the Annual Site Environmental Report contains only one statement in part 5 of the Environmental Program Information that says NPR-1 does not discharge to surface waters.

Even though NPR-1 has an emission testing program for some of the gas compressors, and has an emission inventory listing the majority of air pollution sources and emissions of over 20,000 tons/yr at NPR-1, atmospheric emissions are not quantified, considered, or evaluated in the annual environmental monitoring report.

3.2 Soils

3.2.1 Background Environmental Information

3.2.1.1 Surface Soils

Soils at the Naval Petroleum Reserves in California (NPRC) are primarily composed of two series. The Panoche Series is closely equivalent to the Quaternary alluvium on the geologic map. This series occurs in the valley areas surrounding Elk Hills and Buena Vista Hills. This soil is derived from mixed sources of transported and weathered sedimentary and granitic rocks. It is described as light brownish gray, massive sandy loam surface and subsoils. The substrata are brownish yellow sandy loam, stratified with loam or loamy sand. These soils are moderately alkaline and calcareous. Permeability is described as 2 to 6 inches per hour (in./hr).

The Kettleman Association, which covers Elk Hills and Buena Vista Hills, consists of soils on the topographically hilly areas. They are derived from sedimentary rocks weathered in place. These soils are described as pale brown, granular, loam surface soils and pale brown, blocky, loam subsoils. Substrata are light yellowish brown, blocky loam. These soils are also moderately alkaline and calcareous. Permeability is described as 0.6 to 2 in./hr.

The loose soils and sediments on the surface of Naval Petroleum Reserve No. 1 (NPR-1) and NPR-2 are easily erodible. Natural vegetation consisting of forbs and grasses, moss and lichen is sparse (<30 percent) although it helps reduce erosion during winter rains.

3.2.2 General Description of Pollution Sources and Controls

Sources of releases to the soil at NPRC include waste disposal operations at Section 27R and Section 10G, releases of fluids to sumps, leaks and spills of various materials, and leaks of chemicals stored in drums. These sources are all discussed in other sections of this report. Discussions of 27R and 10G waste disposal facilities are included in Section 4.1. Releases to sumps are discussed in Section 3.3. Leaks and spills are discussed in Section 3.3 where they affect drainageways, in Section 4.2

where they relate to tanks, and on an overall basis in Section 4.5. Leaks from drum storage are addressed in Section 4.1 and Section 4.2.

3.2.3 Environmental Monitoring Program

NPRC does not conduct a soil monitoring program. Soil sampling has been conducted for various special programs and these programs are discussed in Section 4.5.

3.2.4 Findings and Observations

3.2.4.1 Category I

None

3.2.4.2 Category II

None

3.2.4.3 Category III

None

3.2.4.4 Category IV

None

3.3 Surface Water

3.3.1 Background Environmental Information

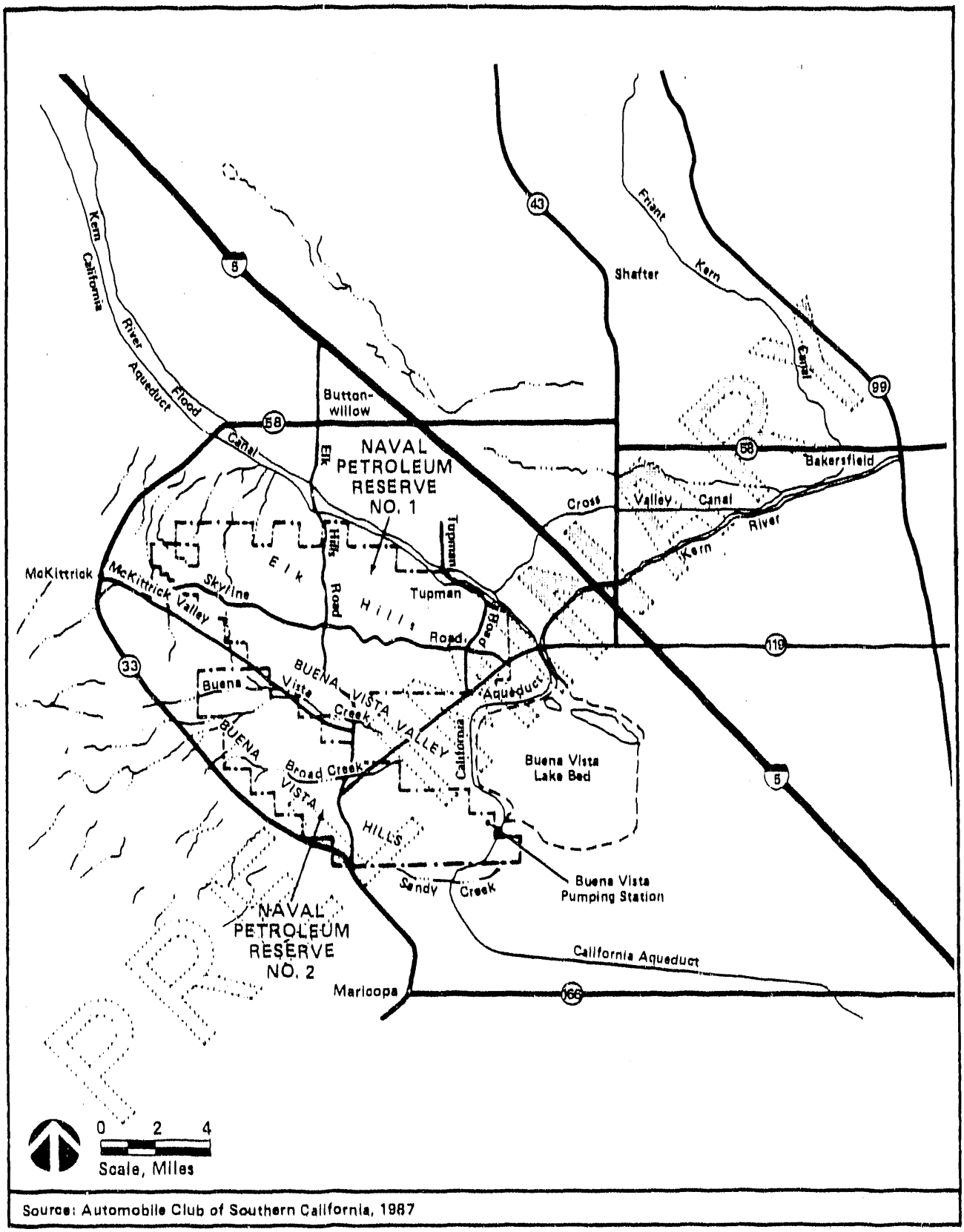
3.3.1.1 Regional and Local Setting

The NPRC is located within the boundaries of the Tulare Lake Basin. The basin is a closed hydrologic system within the southern half of the San Joaquin Valley. Surface and groundwater flows within the basin converge toward the central valley floor.

Surface water features include intermittent streams that have sustained flows during and immediately after periods of heavy precipitation. These surface water flows tend to percolate rapidly into their streambeds (DOE, 1986). Drainage patterns within the hilly topography of the petroleum reserves generally consist of numerous deeply trenched gullies. The gullies subsequently flatten out as they reach the alluvial deposits of the valley floor.

The major surface water bodies of interest include Buena Vista Creek, Broad Creek, Sandy Creek, Kern River, and the California Aqueduct (see Figure 3-2). Buena Vista Creek, Broad Creek, and Sandy Creek have been designated by the U.S. Environmental Protection Agency (EPA) to be waters of the United States. Consequently these waterways are regulated under the Clean Water Act. Buena Vista Creek is an intermittent stream located within the Buena Vista Valley, near the boundary between NPR-1 and NPR-2. Drainageways along the southern slope of Elk Hills are tributaries of Buena Vista Creek. Broad Creek and Sandy Creek are intermittent streams that drain portions of Buena Vista Hills within NPR-2. The Kern River is also an intermittent surface water body that flows in a southwesterly direction from Bakersfield to the Buena Vista lakebed. The California Aqueduct transports freshwater from northern California to agricultural, industrial, and domestic users in southern California. The aqueduct is adjacent to the northeastern boundary of NPR-1 and flows through the eastern portion of NPR-2. A aqueduct pumping station (Buena Vista Pumping Station) is located within NPR-2.

It is reported that the water quality of these intermittent streams is generally poor. Although no water quality data exist for the unnamed ephemeral streams found on



Source: Automobile Club of Southern California, 1987

MAJOR SURFACE WATER FEATURES
IN THE VICINITY OF NPRC

FIGURE 3-2

Elk Hills, Buena Vista Creek, to the south, had an average total dissolved solids (TDS) level of 3,400 milligrams per liter (mg/L) in 1975 (DOE, 1985). These measurements were collected when the creek received discharges from the Valley Waste Facilities on NPR-2.

3.3.1.2 Utilities

Water Supply Systems

The West Kern Water District provides water from the Tulare aquifer to two NPR-1 water supply systems. The NPR-1 main water supply system is operated by the NPRC and consists of a main pump station, chlorinator, two booster pump stations, and several water storage facilities. Water is chlorinated at the main pump station to ensure that a residual chlorine level is maintained throughout the length of the supply pipelines at NPR-1. The water supply system is used primarily for facilities fire protection, for process cooling, and for support of field-wide drilling and production operations at the individual well sites and tank settings. The system also supplies bathrooms, ice-making machines (Section 36S and 35R Laboratory), and a water fountain (35R Laboratory) that is reported to no longer be used for drinking. The second water supply system supplies potable water to facilities in Section 11G. Water is not chlorinated and supplies at least three water fountains and an ice machine. Drinking water is generally provided by a supplier of bottled water because backflow prevention devices were not necessarily installed at all locations where contamination, as a result of backflows, may occur (Thomas, 1988).

There is no water supply system operated by NPRC at NPR-2. Instead, lessees are responsible for providing water to sites at NPR-2. Most of these lessees have arranged for water supply from the West Kern Water District; however they also provide bottled water for employee drinking water.

Sewage Treatment Systems

Sewage treatment systems at both NPR-1 and NPR-2 consist of septic tanks with leach fields (see Table 3-5). In addition, portable sewage holding tanks (port-a-potties) are provided by a subcontractor at drilling rigs. NPRC operates 12 sewage treatment systems at NPR-1. There are no sewage treatment systems operated by

TABLE 3-5

SEPTIC TANK SYSTEMS

NPR-1 Facilities Served by a Septic Tank System	
11G	Complex
36S	Administration, drafting, finance, accounting
36S	QA
36S	Garage
36S	Warehouses
36R	
35R	Gas Plant/Laboratory
HPI	
LTS	I
LTS	II
35R	Warehouse
Building 13 (EG&G)	

NPR-2 Facilities Served by a Septic Tank System
Texaco Gas Plant
Buena Vista Pumping Station
ARCO Compressor Plant

Source: Compiled by Survey team member, 1988

NPRC at NPR-2. Instead, lessees are responsible for providing sewage treatment systems for facilities located on NPR-2. Three septic tank systems are operated by lessees at NPR-2.

Stormwater Systems

Stormwater runoff is generally directed to ditches and gullies at both NPR-1 and NPR-2. There are no stormwater sewer systems. Many gullies throughout NPR-1 have small earthen dams, known as "gully plugs" or catch basins. Some gully plugs are provided with water legs to maintain floating oil and release water (BPOI, 1986k). There are 50 gully plugs located on NPR-1. Most gully plugs are located 1/4 to 8/10 mile downstream of potential spill sites (BPOI, 1987h), such as pipelines and tank settings. It was reported that some gully plugs are/had been on NPR-2.

3.3.2 General Description of Pollution Sources and Controls

The NPRC potentially discharges contaminants to surface waters from several sources. These sources include oil processing facilities, gas processing facilities, sewage treatment facilities, laboratory facilities, washrack wastewater, and stormwater runoff. These pollution sources and associated collection and/or treatment systems are described in the following subsections.

3.3.2.1 Oil Processing Facilities

Oil processing facilities consist of tank settings and Lease Automatic Custody Transfer (LACT) stations. At tank settings, oil, gas, and water are separated. The wastewater produced is known as "produced water". Produced water is saline, with TDS content ranging from 25,000 to 33,000 mg/L. At LACT stations, additional water is separated from the oil. Produced water from both tank settings and LACT stations is reinjected into the groundwater, discharged to surface water drainageways, or discharged to wastewater sumps where it percolates into the ground or evaporates into the atmosphere. Biocides, de-emulsifiers, and corrosion inhibitors are usually added to the produced water prior to pumping.

Subsurface wastewater disposal into Tulare Zone injection wells has been in effect at NPR-1 since 1981. Prior to that time, produced water was disposed of in large

surface sumps. Approximately 93,400 barrels of water per day (BWPD) are disposed of in injection wells or reused at NPR-1 (see Section 3.4.2 for further details). In total, approximately 83 percent of the injected/reused water is from the Stevens Oil Zone, with 13 percent from the Shallow Oil Zone and 4 percent from the Asphalto Pool.

Sumps are usually constructed at tank settings and LACT stations. The sumps receive produced water and/or oil during upset conditions. Title 1770(a), California Code of Regulations (CCR), requires hazardous sumps to be designed for protection of wildlife. Sumps are not considered to be hazardous by the state unless according to Part 740, they are 100 ft^2 or 10 percent of the surface area has an oil film.

NPR-1

At NPR-1, there are five LACT stations located in Sections 25S, 10G, 18G, 26Z, and 24Z. Produced water from these facilities is pumped to injection wells during normal operations. During upsets, produced water is discharged to sumps. Approximately 85,000 barrels per day (bbl/day) are injected.

At NPR-1, there are six major wastewater sumps located in Sections 14Z, 24Z, 26Z, 8G, 10G, and 18G. In addition, there are numerous containment basins that collect oil or oily wastewater during upset conditions at tank settings and LACT stations. Overflow collected in containment basins is returned to the system for processing.

At the 24Z LACT wastewater sump, two sumps are connected in series. The lower sump had an overflow pipeline that discharged to a natural drainageway. Evidence of past overflows included erosion of the natural drainageway and high water marks along the banks of the sump.

At NPR-1, there are 79 active tank settings located throughout Elk Hills (BPOI, 1988). At the 4-24Z tank setting, it was observed that oil had escaped through a gas release vent stack and had flowed into a swale that drains into a natural drainageway below the access road to the tank setting. At the 24Z LACT station, oily water overflowed from the slop tank to a containment basin without any netting. At the 3-8R tank setting, oily water from a skim tank was discharged to a containment

basin without any netting. It is reported that overflows and spills collected in the containment basin are cleaned up within 24 hours. Consequently, netting is not required under Title 14, CCR.

NPR-2

At NPR-2, there are three LACT stations located in Section 6D, one in Section 14D, and two in Section 20D. Produced water from these facilities is discharged to covered sumps, with a potential to release to natural drainageways during upset conditions or produced water is pumped to injection wells during normal operations.

At NPR-2, there are approximately 14 major wastewater sumps (BPOI, 1986d). In addition, there are numerous sumps that collect oil or oily wastewater during upset conditions at tank settings and LACT stations.

At the 14D LACT station, wastewater from a Baker tank (460N) and a wastewater sump had overflow pipelines that discharged to a natural drainageway.

At NPR-2, there are 26 active tank settings located throughout Buena Vista Hills (BPOI,1988c).

At the 28B Phillips Tank Setting 2, produced water is discharged to a natural drainageway and enters a sump constructed within the drainageway. The drainageway is a tributary of Broad Creek. The wastewater sump had a significant amount of oil on the surface and was covered with netting. A containment basin that lacked any netting contained oil.

At the 28B Phillips Tank Setting 3, produced water is discharged to a natural drainageway that is a tributary to Broad Creek. The produced water had an oily surface sheen. In addition, oil was present in two containment basins that lacked any netting.

At the 28B Phillips Tank Setting 4, produced water from an oil/water separator is discharged to a natural drainageway. In addition, a sump overflow pipeline discharges to a natural drainageway.

3.3.2.2 Gas Processing Facilities

Gas processing facilities are located at both NPR-1 and NPR-2. Wastewaters and other contaminants handled at each facility are described below.

NPR-1

Although NPR-1 has four gas processing plants, only three are operated. These include the 35R Gas Plant, Low Temperature Separation (LTS)-1, and LTS-2. The 3G Gas Plant has not operated for several years.

At LTS-1 and 2, several chemicals and lubricating oils are used. Glycol and Therminol leaks were observed at numerous locations throughout the plants. Therminol contains benzene, C_{14-30} alkyl derivatives, CAS Reg. No. 68855-24-3, which is identified as a hazardous chemical under the criteria of OSHA Hazard Communication Standard (29 CFR 1910.1200). Betz Inhibitor 30K and Betz Slimicide 508 are added to cooling water. Cooling water blowdown is discharged to a tile drain system. Both plants have a diked utility storage area where engine lube oil, injection lube oil, refrigerant lube oil, dirty engine lube oil, coolant, glycol, and diesel fuel are stored. Black oily stained soil was observed west of the diked utility storage areas. The stains were also present within the diked areas and indicated that material from the storage areas had escaped the diked areas. The drainageway west of the diked utility storage area at LTS-1 and LTS-2 consists of a concrete-lined spillway for secondary containment, and leads to a concrete sump for oil recovery. It was installed to prevent spills from contaminating natural drainageways. The observed oily stained soil is between the diked area and the concrete-lined spillway. Chemical and lube oil spills/leaks are collected from the compressor buildings and discharged into a hydrocarbon pipeline. The hydrocarbon pipeline is routed to a heated separator to recover gas and the remaining oily water is added to an oil production pipeline.

At the 35R Gas Plant, condensate, oil, lubricants, and cooling water all flow to plant drains. The plant drains discharge to the 35R sump. Slimicides and other chemicals are added to cooling water.

The 35R sump receives wastewaters from the LTS-1, LTS-2, and 35R Gas Plants. Oil and condensate are recovered from an oil water separator before water enters the sump. If oil reaches the sump, it is recovered by vacuum truck. Wastewater either percolates to the ground or evaporates to the atmosphere.

The 30R Compressor Plant had two facilities that were discharging materials to natural drainageways. The shipping pump for the condensate drain was leaking oil during the site visit. The oil entered a natural drainageway. In addition, UNX 13479 Tank was discharging oil over a hillside that entered a drainageway.

NPR-2

The only gas process facility at NPR-2 was the Texaco Gas Plant located on Section 8D. All process wastewaters and cooling water blowdown are reinjected into the Tulare Zone. Waste oils, steam condensate, and hydrocarbon condensate are collected in a Baker tank. The contents of the Baker tank are pumped out and hauled off-site for disposal. Sewage and laboratory wastewater disposal is described in Sections 3.3.2.3 and 3.3.2.4, respectively.

3.3.2.3 Sewage Treatment Facilities

Sewage is treated and discharged at several facilities throughout NPR-1 and NPR-2. These facilities include septic tank systems and treated wastewater from a municipal wastewater treatment plant (WWTP).

NPR-1

Table 3-5 lists the facilities served by 12 septic tank systems located on NPR-1. Generally, the septic tank systems are pumped out by a subcontractor (Knight's Pumping Service) once a month and hauled off-site for disposal at the Crescent Moon Lagoon in the Bear Mountain area, several miles east of Bakersfield. Except for the 11G septic tank system, no operating problems have been reported.

The Section 11G septic tank system serves the entire 11G complex, which houses approximately 500 fulltime employees plus daily visitors. The system is hydraulically overloaded; consequently the system is pumped out every 4 to 5 days when

overflows are observed near the septic tanks (Miles, 1988). The overflows occur in an area generally avoided by site personnel due to the potential presence of rattlesnakes. No sewage backups into the 11G facilities have been reported. Current plans include expansion of the hydraulic capacity of the existing system and construction of an additional septic tank system to serve approximately 70 people in the eastern portion of the 11G complex (Rhoden, 1988).

The 35R septic tank system receives wastewater from the 35R Laboratory. It was reported that diluted acids are the only laboratory wastewaters discharged to the septic tank.

NPR-2

Table 3-5 lists facilities served by three septic tank systems located on NPR-2. Each system is operated by a lessee.

The Texaco Gas Plant is currently served by two septic tank systems. One system located north of the plant serves the gas measurement building and change room. The plant operator could not locate the system during the site tour. Another system west of the plant serves a lounge area with toilet and shower facilities. The plant operator reported that neither system had ever been pumped out. In addition, an abandoned septic tank system was reported to be located near lease houses that are no longer in use.

The Buena Vista Pumping Station is served by a septic tank system. The system serves 5 or 6 people who work at the pumping station. Only sewage is discharged to the system. The septic tank was reported to have been pumped out in 1979 or 1980. No problems with the system have been reported.

The ARCO Compressor Plant is served by a septic tank system. The system collects sewage, laboratory wastewater, and leaks/spills that flow into plant drains. A small laboratory is currently used to test basic sediment and water (BS&W) and in the past was used to test gravities. Although the operator did not know which solvents may have been used in the past, petroleum-based solvents are currently used in the laboratory. Oils and liquid chromate solutions, used as a cooling water corrosion inhibitor in the compressors, are collected from compressor leaks on a concrete pad.

The pad has drains connected to the septic tank. During the site visit, a small continuous leak was observed. A concrete pad under the cooling water tower also had drains connected to the septic tank. It was reported that the cooling tower had not been in service for 5 years. Green and yellow stains on the soil near the cooling tower were observed. It was believed that chromates were used in the cooling water tower. During the site visit, black oily stains were observed on the surface soil near the septic tank. The operator reported that the septic tank had overflowed once as a result of a sink faucet being left open for an extended period. It was also reported that the septic tank had not been pumped out in at least 3 years.

Treated wastewater from the City of Taft-Ford City-Taft Heights Sanitation District Joint Wastewater Treatment Plant is used to spray-irrigate 167 acres on NPR-2. Since 1985, wastewater effluent has been applied to the farm during the period April 1 through October 31. Wastewater effluent must be chlorinated and meet water quality standards of 40 mg/L biological oxygen demand (BOD) and 0.2 mg/L settlable solids. Alfalfa is the only crop produced at the farm and it is used as fodder for animals. No problems have been reported for the spray irrigation facilities.

3.3.2.4 Laboratory Facilities

NPR-1

Laboratory wastewater from the 35R Laboratory is discharged to either a holding tank, sump, or septic tank system. Two drains within the laboratory discharge to a holding tank, which is designed to collect chromic acid discharges. Drains in the old laboratory discharged into the 35R sump. Currently, gasoline used during laboratory testing may be discharged from these drains. The remaining sink and floor drains in the 35R Laboratory discharge into a septic tank system. It was reported that only diluted acids are washed down these drains.

Laboratory wastewater from the 36S Laboratory was reported to discharge to the 25S LACT station. Wastewater from the LACT station is discharged to injection wells. The laboratory facilities are used to conduct cuts and gravity testing, to clean tools, and to clean down-hole instrument clocks. Wastewater discharges include kerosene, de-emulsifier, oil, trichloroethene, and samples used for cuts and gravity testing. It was reported that the pipeline that drains the laboratory had

experienced backups due to backpressures in the downstream pipelines. Dark stains in soil near an air vent on the drain pipeline probably resulted from previous backup(s). No problems have been reported since a check valve was installed on the downstream pipeline.

NPR-2

Laboratory wastewater from the ARCO Compressor Plant was reported to be discharged to the septic tank system. See Section 3.3.2.3 for a description of the septic tank system.

The Texaco Gas Plant has a laboratory that has been inactive for approximately 4 years. In the past, laboratory wastewater from the Texaco Gas Plant was reported to be discharged to injection wells.

3.3.2.5 Washrack Wastewater

A washrack in the Section 36S area at NPR-1 is used to wash vehicles and other equipment. It was reported that a degreaser agent is used to clean some equipment at the washrack. Runoff from the washrack either flows overland down a slope or enters a drain system. It was reported that the drains discharge into a leach field located in the same drainageway as overland flow. However, during the site visit, it was observed that washwater from the washrack area was flowing into a natural drainageway.

3.3.2.6 Stormwater Runoff

Contaminants that may be spilled or leaked on the ground are potentially transported by stormwater runoff. Since there are no stormwater sewer systems, runoff is directed to ditches, gullies, and/or natural drainageways. Drainageways and surface soils that are potentially contaminated and would be susceptible to transport via runoff are described below. Although a spill prevention, control, and countermeasures plan (BPOI, 1986k) for NPR-1 has been prepared, it is outdated.

NPR-1

At both LTS-1 and LTS-2, glycol, thermanol, engine lube oil, injection lube oil, refrigerant lube oil, dirty engine lube oil, coolant, and diesel fuel are used. Evidence of spills and leaks deposited on surface soils was observed throughout the plant facilities. In several cases, these spills and leaks had occurred near drainageways (see Section 3.3.2.2).

At the 4-24Z tank setting, it was observed that oil had escaped through a gas release vent stack and had flowed into a swale. The oil covered the surface soil within and adjacent to the swale. The swale discharges into a natural drainageway below the access road to the tank setting.

NPR-2

At the 28B Phillips Tank Setting 2, produced water is discharged to a natural drainageway and enters a sump constructed within the drainageway. The wastewater sump had a significant amount of oil on the surface. Stormwater runoff could potentially cause materials within the sump to be washed out and transported downstream. The drainageway is a tributary of Broad Creek.

At the Kern County Water District Pumping Station, used crankcase oil, which is a listed hazardous waste in California, had been spread on the ground to control dust and vegetative growth. As a result, soil contaminated with used crankcase oil around the perimeter of the West Kern Pumping Station could potentially enter natural drainageways. It was reported that approximately 150 gallons of used crankcase oil had been applied over a period of time. It is uncertain at this time as to whether this practice is continuing.

At the ARCO Compressor Plant, black oily stains observed on the surface soil near the septic tank indicated that the tank had overflowed. Potential septic tank contents include solvents, oil, and chromates (see Section 3.3.2.3). The stained soils were located near a drainageway.

3.3.3 Environmental Monitoring Program

As part of the NPRC environmental monitoring program, the water supply system is sampled and analyzed regularly. No surface water discharges are included in the environmental monitoring program.

Sampling and analysis of the water supply system is performed in accordance with the CCR, Title 22, Chapter 15, "Domestic Water Quality and Monitoring Requirements," based on the National Interim Primary Drinking Water Regulations, 40 CFR Part 141. Water samples are taken biweekly from eight locations in the water supply system. Residual chlorine and coliform bacteria analyses are performed for each biweekly sample. Physical, chemical, and radiological property analyses (summarized in Table 3-6) are performed at less frequent intervals.

As indicated in Table 3-7, zero residual chlorine levels have frequently been reported for samples taken from the 36S change room and EG&G facility. Zero residual chlorine levels have also been recorded for samples taken from the Building 51A, 36S Garage, 5M Pump Station, 32S Storage Tank, and 35R Laboratory.

In 1987, positive tests for bacterial contamination of the water supply system at the 36S change room were reported on February 11, February 14, and October 26. In response to the bacterial contamination reported in February 1987, a monthly water pipeline flushing program was initiated at the 36S change room area. However, one positive test for coliform has occurred since this effort began.

Physical, chemical, and radiological analyses are performed at least twice a year. To date, reported concentrations have been within allowable limits.

3.3.4 Findings and Observations

3.3.4.1 Category I

None

TABLE 3-6

POTABLE WATER SYSTEM: PHYSICAL, CHEMICAL, AND RADIOLOGICAL ANALYSES PERFORMED

Physical	Chemical - Inorganic
turbidity	arsenic
color	barium
threshold odor	cadmium
	chromium
Chemical - General Mineral Analyses	fluoride
bicarbonate	lead
carbonate	selenium
hydroxide alkalinity	silver
calcium	mercury
chloride	nitrate
copper	
foaming agents (MBAS)	Chemical - Organic
iron	endrin
magnesium	lindane
manganese	methoxychlor
pH	toxaphene
sodium	2,4-D
sulfate	2,4,5-TP Silvex
specific conductance	trihalomethanes
total dissolved solids	
total hardness	Radiological
zinc	gross alpha particle measurement or both radium-226 and 228

Source: BPOI, 1987k

TABLE 3-7

1987 RESIDUAL CHLORINE LEVELS FOR THE NPR-1 WATER SUPPLY SYSTEM

SAMPLE LOCATION	JAN-12	JAN-26	FEB-9	FEB-23	MAR-9	MAR-23	APR-6	APR-20	MAY-4	MAY-18	JUN-1	JUN-15
5M Pump Station	N.S.	0.5	0.5	0	0.75	1	1.1	0.8	1.1	1.1	1	1.1
36S Change Room	0	0	0	0	0	0	0	0	0	0	0	0
35S Storage Tank	N.S.	0.5	0.2	0	0.6	0.6	0.6	0.4	0.75	0.6	0.7	1
32S Storage Tank	N.S.	0.5	0.4	0	0.6	0.6	0.4	0.6	0.8	0.7	0.6	1
EG&G	N.S.	0.1	0.2	0	0	0.2	0.3	0.3	0	0.1	0.4	0.8
35R Laboratory	N.S.	0.2	0.1	0	0.4	0.4	0.4	0.6	0.4	0.7	0.5	0.8
28R Storage Tank	N.S.	0.3	trace	0.1	0.6	0.4	0.6	0.6	0.5	0.6	0.5	0.8
11G Administration	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

SAMPLE LOCATION	JUN-29	JUL-13	JUL-27	SEP-8	SEP-21	OCT-5	OCT-19	NOV-2	NOV-16	NOV-30	DEC-14	DEC-28
5M Pump Station	1.1	1.1	1	1.2	1.2	1.1	1	0.75	1.1	1.1	1.1	1.2
36S Change Room	0	0	0	0	0	0	0	0	0	0	0	0
35S Storage Tank	1	0.7	1	0.7	0.7	0.8	0.8	0.6	0.8	1.1	1.1	1.1
32S Storage Tank	1	0.7	1	1	0.5	0.8	0.6	0.6	1	1	1	1.1
EG&G	0.6	0.3	0.4	0.2	0.1	0.1	0.1	trace	trace	trace	trace	trace
35R Laboratory	1	0.4	0.4	1	0.7	0.6	0.4	0.6	1	1	1	0.8
28R Storage Tank	1	0.7	0.6	1	0.7	0.6	0.7	0.75	0.8	1.1	0.75	0.8
11G Administration	N.S.	N.S.	N.S.	N.S.	0	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

Source: Compiled by Survey team member, 1988
N.S. - not sampled

3.3.4.2 Category II

1. Ineffective chlorination of the NPR-1 potable water system. Ineffective chlorination of the NPR-1 potable water system has resulted in bacterial contamination at the 36S change room. In addition, zero residual chlorine levels have been recorded at NPR-1. Zero residual chlorine levels increase the likelihood of bacterial contamination of the potable water system since the disinfectant chlorine prevents the growth of bacteria. Although most drinking water is provided by bottled water, four drinking water fountains and ice machines utilize the potable water systems at NPR-1. Consequently, users may contract water-borne diseases by consuming contaminated water. During 1987, frequent zero residual chlorine levels have been reported for samples taken from the 36S change room and EG&G facility. Zero chlorine residuals have also been recorded for samples taken from Building 51A, 36S Garage, 5M Pump Station, 32S Storage Tank, and 35R Laboratory.

   During 1987, positive tests for total coliform bacteria have been reported on three occasions for samples taken from the 36S change room. In response to the bacterial contamination identified in February 1987, a monthly water pipeline flushing program was initiated at the 36S change room area. However, one positive test for coliform has occurred since this effort began.

2. Potential entrapment of wildlife in containment basins at NPR-1 and NPR-2. Oil and oily produced water are discharged to open containment basins that lack any netting to prevent wildlife from entering the containment basin. As a result, wildlife may become trapped in the containment basins. Open containment basins of primary concern were observed at the following sites:

   NPR-1 Sites:

   24Z LACT Station - oily water was present in an open containment basin that has received overflow from the slop tank.

   3-8R Tank Setting - oily water was present in an open containment basin that received overflow from a skim tank.

Pipeline blowdown sump - during the pre-site Survey tour of NPRC, conducted during March 1-3, 1988, a small animal carcass was observed floating in the open containment basin.

NPR-2 Sites:

Phillips Tank Setting 2 (Section 28B) - oil was present in an open containment basin.

Phillips Tank Setting 3 (Section 28B) - oil was present in two open containment basins.

3. Contaminated soil may enter natural drainageways. Used crankcase oil from gas engines, which is a listed hazardous waste in California, was spread on the ground to control dust and vegetative growth around the perimeter of the West Kern Pumping Station, located on NPR-2. Used crankcase oil may contain contaminants such as benzene, toluene, xylene, and lead, as well as chlorinated hydrocarbons. Soil contaminated with used crankcase oil could potentially enter natural drainageways. It was reported that approximately 150 gallons of used crankcase oil had been applied over a period of time. It is uncertain at this time whether this practice is continuing.

3.3.4.3 Category III

1. Chemicals, oil, and oil products released into natural drainageways at NPR-1. Chemicals, oil, and oil products from NPR-1 have been released into natural drainageways from wastewater discharges as well as past leaks and spills. As a result, wildlife and vegetation may be adversely impacted due to the potential alteration of habitats and contamination of the food chain. Of primary concern are releases entering natural drainageways at the following sites:

4-24Z Tank Setting - oil was released from the gas vent stack and had flowed into a swale.

36S Washrack - Degreasing agent was reported to be used at the washrack. Drainage from the washrack either flows overland and down an adjacent

hillside or enters a drain. The drain is reported to discharge into a leach field located in the same drainageway as overland flow.

2. Tank settings discharge oily water and produced water into natural drainageways at NPR-2. Oily water and produced water are discharged to natural drainageways from tank settings on NPR-2. As a result, wildlife and vegetation may be adversely impacted due to the potential alteration of habitats and contamination of the food chain. Of primary concern are discharges at the following sites:

   Phillips Tank Setting 2 (Section 28B) - Produced water is continuously discharged to a natural drainageway and enters a sump within the drainageway. The sump had a significant amount of oil on the surface.

   Phillips Tank Setting 3 (Section 28B) - Produced water is continuously discharged to a natural drainageway. The produced water had an oily surface sheen.

   Phillips Tank Setting 4 (Section 28B) - Produced water from an oil/water separator continuously discharges into a natural drainageway.

3. Sump overflow pipelines released oily water and produced water into natural drainageways at NPR-1 and NPR-2. Oily water and produced water from sump overflow pipelines have been released into natural drainageways in the past and could potentially be released in the future. As a result, wildlife and vegetation may be adversely impacted due to the potential alteration of habitats and contamination of the food chain. Of primary concern are overflow pipelines identified at the following NPR-1 sites:

   24Z LACT Station Wastewater Sump - An overflow pipe discharges to a natural drainageway. Evidence of past overflows included erosion at the outfall pipe and immediately downstream of the pipe, as well as high water marks within the sump walls, which indicated that produced water had reached the overflow pipe.

Of primary concern are overflow pipes at the following NPR-2 sites:

14D LACT Station - Overflow pipes from Baker Tank #460n and wastewater sump discharge into a natural drainageway.

Phillips Tank Setting 4 (Section 28B) - A sump overflow pipe discharges into a natural drainageway.

4. Potential soil contamination due to improper disposal to a septic tank system. Improper disposal to the septic tank/leach field at the ARCO Compressor Plant on NPR-2 (Section 20B) has resulted in potential soil contamination. Subsurface and surface discharges from a septic tank/leach field system may contain chromate, oil, and solvents. These contaminants may alter wildlife habitats and enter the food chain.

Evidence of past surface discharges consisted of a black oily stained area near the septic tank. Past practices at the plant included using chromates in a water cooling tower. The water cooling tower was located on a concrete pad that has drains that discharge to the septic tank. Current practice includes draining laboratory wastewater, as well as spills and leaks at the compressor pad to the septic tank. A slow leak from a compressor consisting of oil and water was observed during the site visit. Chromates are used as a corrosion inhibitor in cooling water added to the compressors. Laboratory wastewater consisting of petroleum-based solvents is discharged to a sink that drains to the septic tank. Other solvents may have been used in the past. The last time the septic tank was pumped out is unknown. However, it was reported that the tank had not been pumped out within the last 3 years.

3.3.4.4. Category IV

1. Potential contamination of the NPR-1 water supply system due to a lack of backflow preventers. There is a potential for contamination of the site potable water supply system due to a lack of backflow preventers. Backflow preventers would deter sanitary or process wastewaters from entering and contaminating the potable water system.

2. Improper handling of domestic water supply samples at NPR-1. Samples acquired from the freshwater system on May 16, 1988, were improperly handled according to the procedures included in BC Laboratories, Inc., Laboratory Quality Control Manual. The samples, which were to be analyzed for coliforms, were not chilled or refrigerated during transport from NPR-1 to BC Laboratories.

The "Bacteriological Water Analysis" procedure in the BC Laboratories QA Manual includes the statement, "Sample should be kept cool and preferably ice-packed until submitted to the laboratory." Chilling the samples reduces microbiological activity which, at ambient temperatures, would produce erroneously high coliform counts.

Additionally, the travel blank for volatile organics contained air bubbles or headspace. Volatile organics in the travel blank can volatilize into the headspace and thus not be detected in the water phase of the sample.

3.4 Hydrogeology

3.4.1 Background Information

3.4.1.1 Geology

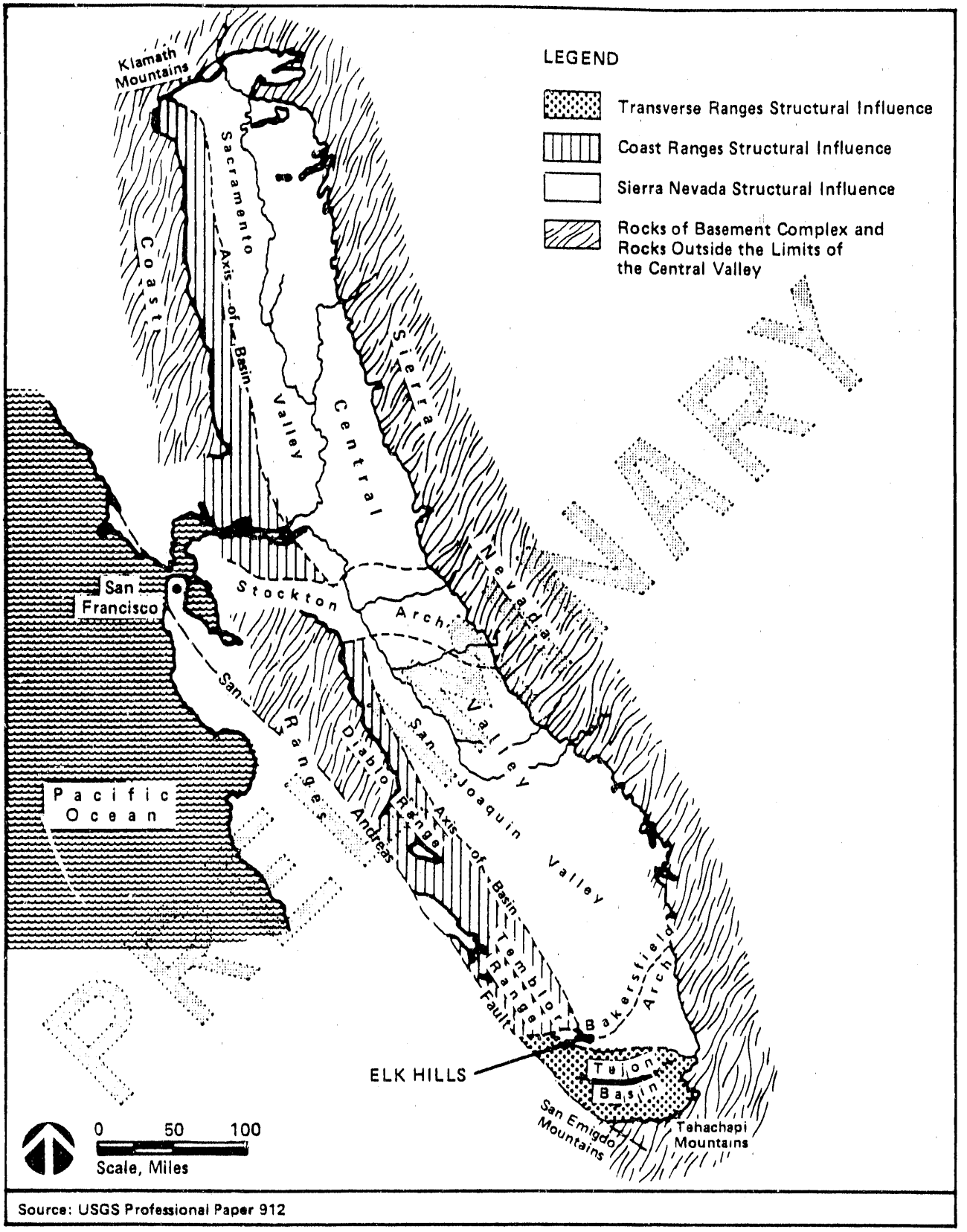
The Naval Petroleum Reserves in California (NPRC) are located in the southern portion of the San Joaquin Valley, an elongate structural trough bordered on the east by the Sierra Nevada and on the west by the Coast Ranges. The San Joaquin Valley is an asymmetric basin with the axis near and parallel to its west border. The gently sloping eastern floor of the basin is a continuation of the Sierra Nevada granitic surface. The more abrupt west flank of the basin has been complexly folded and faulted as a result of movement in the adjoining Coast Ranges and along the San Andreas Fault. These features are shown in Figure 3-3.

As the basement block beneath the San Joaquin Valley tilted down to the West, sediments were eroded from the highlands to the east and were deposited during Cretaceous and Cenozoic time. The San Joaquin Valley now has a nearly flat alluvial floor broken by scattered hills and ridges that commonly reflect local anticlines. The Elk Hills and Buena Vista Hills are formed by such anticlines.

3.4.1.2 Stratigraphy

The stratigraphic sequence of rocks in the vicinity of the NPRC consists of sedimentary deposits from the infilling of the basin by material eroded from the surrounding highlands. Basement rocks were not encountered in the deepest well in California, which was drilled to about 25,000 feet in depth at the Elk Hills oil field (Kaman Tempo, 1987a). Metamorphic rocks believed to be of Jurassic age were reported in the nearby North Coles Levee oil field at a depth of 17,860 feet (USGS, 1975).

The oldest sediments in the area are the sands and shales of the Eocene age Kreyenhagen Formation. This formation has been measured in the Elk Hills field at thicknesses ranging from 2,300 to 2,900 feet. The formation is composed of the interfingering of two distinct facies that represent the equivalent of the sandy



Source: USGS Professional Paper 912

REGIONAL TECTONIC ELEMENTS, NPRC

FIGURE 3-3

Tejon Formation to the south and the clay shale facies to the north that is called the Kreyenhagen Shale.

The Wagonwheel Formation of Oligocene age is described as lying conformably on the Kreyenhagen Formation and is believed to consist of a basal sand unit and clayey shale. In the Asphalto field west of NPR-1, wells encountered 265 feet of Wagonwheel Formation. The unit is believed to thicken to the east, where as much as 700 feet were measured in the North Coles Levee field.

The boundary between Oligocene and Miocene time is placed within the Temblor Formation, which lies unconformably on the Wagonwheel Formation. The Temblor is a sequence of sandstones and shales that ranges in thickness from approximately 2,900 to 4,100 feet. Included within the Temblor Formation are two petroleum-producing zones, the Santos Shale Member and the Carneros Sandstone Member. Production from the Carneros Zone included over 100,000 barrels per year (bbl/yr) of oil and approximately 90,000 bbl/yr of natural gas liquids. Production also included approximately 5 billion cubic feet per year (ft^3/yr) of gas (DOE, 1986).

The most important stratigraphic interval in the Elk Hills area from a production perspective is the Miocene age Monterey Shale. The three lower members of this formation, the Gould, Devilwater, and McDonald Shales, are difficult to distinguish on electric logs or in weathered outcrops. They consist of approximately 800 feet of shale with some silty zones. The upper part of the Monterey Shale is the Elk Hills Shale member. The thickness of the Elk Hills Shale ranges from 1,780 to 3,280 feet in NPR-1 and consists primarily of gray siliceous shale and siltstone. This member also contains several thick oil-bearing sandstone lenses that are collectively referred to as the Stevens Oil Zone. This zone produced approximately 33,000,000 barrels of oil in 1987 (DOE, 1987).

Overlying the Monterey Shale is another Miocene age formation, the Reef Ridge Shale, consisting primarily of gray-blue shales with minor amounts of sandy shale. The thickness of the Reef Ridge Shale is related to the geologic structure, with thicknesses of 200 to 500 feet on the crests of anticlines increasing to thicknesses of 1,000 to 1,300 feet in synclinal areas.

Overlying the Reef Ridge is the Etchegoin Formation of Pliocene age. This formation consists of sands, silts, and shales and ranges from 1,700 to 3,500 feet in thickness. Several of the sand zones within the Etchegoin contain oil and gas and are collectively referred to as the Shallow Oil Zone. During fiscal year (FY) 1987, this zone produced 6.5 million barrels of oil as well as natural gas and gas liquids (DOE, 1987).

Also included in the Shallow Oil Zone is the lower portion of the San Joaquin Formation. This Pliocene age formation overlies the Etchegoin and ranges in thickness from 1,200 to 2,100 feet. The lower 180 feet are called the Scaley Sand Zone and consist of a sequence of sandstone lenses interbedded with shales. The upper part of the San Joaquin Formation is called the Mya Sand Zone due to the abundance of the pelecypod Mya in the zone. This zone is also known as the Dry Gas Zone and, in FY 1987, over 7 billion cubic feet of gas were produced from this zone (DOE, 1987). This zone is the shallowest producing zone within Elk Hills.

A thick succession of interbedded sandstone, conglomerate, and claystone blankets Elk Hills and vicinity. These beds are called the Tulare Formation and are exposed at the surface on the flanks of the Elk Hills Anticline. This formation is classified as late Pliocene and Pleistocene in age (Woodring et al., 1940). The Tulare ranges in thickness from 600 to 2,150 feet in the vicinity of Elk Hills. The Tulare Formation in many wells at Elk Hills can be divided into a lower sandstone and conglomerate member, an overlying claystone member, and an upper sandstone and conglomerate member. While the claystone is well defined in well logs in the western part of Elk Hills, it becomes indistinct in the east and the upper and lower sandstone and conglomerate members cannot be consistently separated. The lower member is believed to be finer grained than the upper member. To the east of Elk Hills in the San Joaquin Valley, the Tulare is separated into lower and upper units by the Corcoran Clay member. According to Bean and Logan (1983)

> *...the areal extent of the Corcoran Clay is a matter of some disagreement at this time. Brown (1968) shows a westward extent that is beyond the line of the California Aqueduct in most places, and is generally farther west than the limit shown by Croft (1972). However, there is some indication that the Corcoran may extend even farther west, and its relation to a widespread claystone within the Tulare*

Formation in Elk Hills awaits the results of further drilling, sampling, and correlation.

The Tulare Formation is covered by Quaternary alluvium along the perimeter of Elk Hills and Buena Vista Hills. The alluvium consists of poorly sorted sand, silt, clay, and pebbles and is virtually indistinguishable from the Tulare. These deposits are usually coarsest near the mountains and grade to finer materials in the valleys.

3.4.1.3 Hydrogeology

The San Joaquin Valley portion of Kern County ovelies a major groundwater basin, known as the Tulare Lake Groundwater Basin. The basin supplies drinking water to municipal and private systems as well as providing much of the irrigation water supply. The Elk Hills and the Buena Vista Hills are on the western edge of the basin. Between these two sets of hills is the Buena Vista Valley, which acts as a separate small basin.

Three aquifer zones are identified in the San Joaquin Valley. These include the Lower Tulare, which is confined beneath the Corcoran Clay; the Upper Tulare, which is an unconfined or water-table aquifer; and the alluvial zone, which contains perched water in some areas. The confined aquifer is described by Bean and Logan (1983) as extending from the base of the Corcoran Clay to the base of fresh water [defined as water with total dissolved solids (TDS) of less than 2,000 milligrams per liter (mg/L)]. The depth of the fresh water varies considerably throughout the area but is believed to be deepest beneath the Buena Vista lakebed (Kern County Water Authority, 1977). Groundwater levels in the confined aquifer are lower than the levels in the overlying unconfined aquifer, indicating that there is a downward gradient between the two aquifers. This gradient is in part due to heavy pumping of the lower aquifer. Average hydraulic conductivity in the confined aquifer, as reported in Bean and Logan (1983), is 1×10^{-2} centimeter per second (cm/sec).

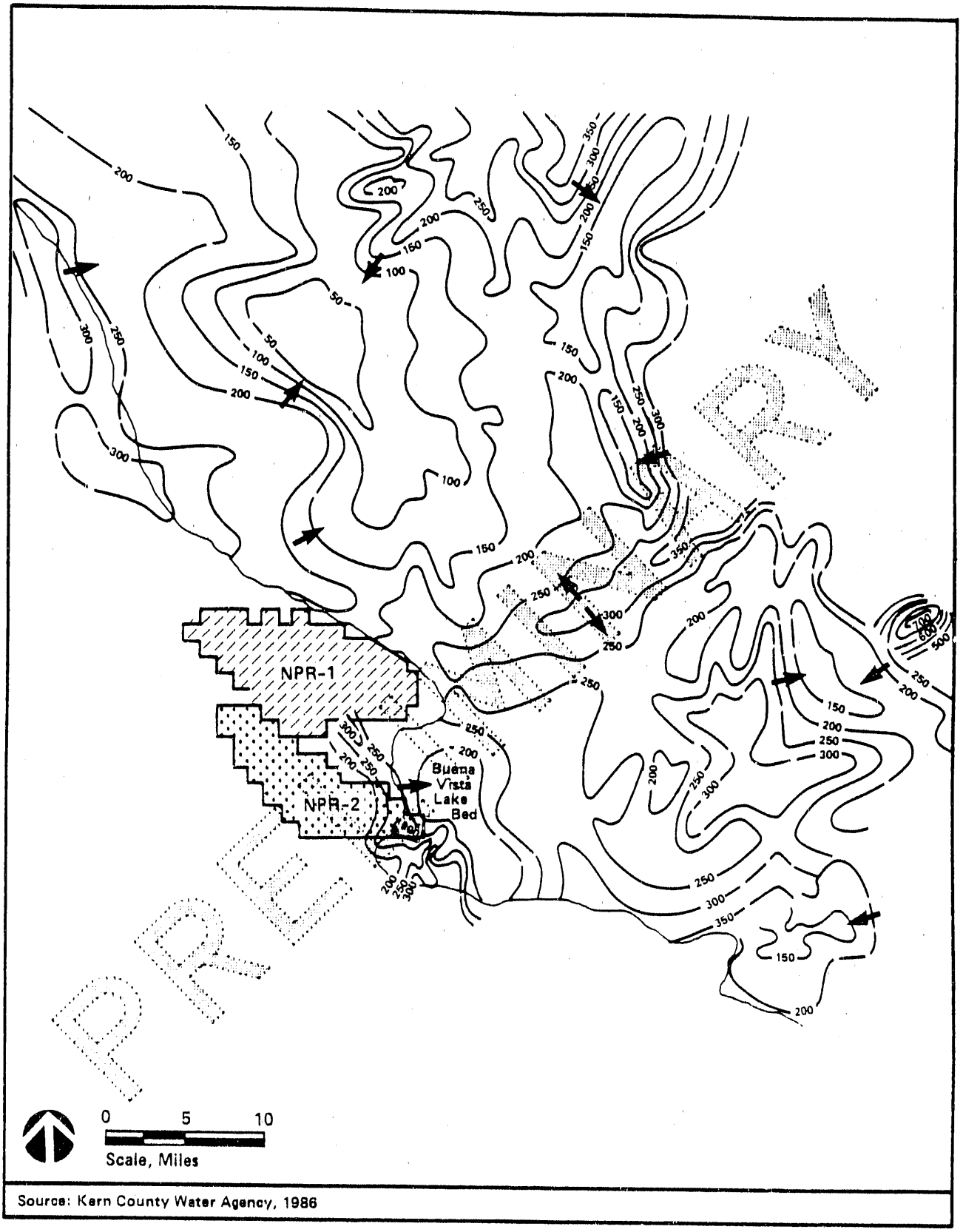
The unconfined aquifer in the Upper Tulare is composed of alluvial sands, gravels, silts, and clays. Most of these sediments were deposited by the ancestral Kern River. As a result, the coarser material tends to be closer to the river channel, while the finer silts and clays are more common to the northeast and southwest. Permeability

for the unconfined aquifer, as reported by Bean and Logan (1983), averages 1.7 x 10^{-2} cm/sec.

The alluvial aquifer, which contains perched water in some portions of the San Joaquin Valley, has some saturated portions in the Buena Vista Valley. This unit has more significance for NPRC where it occurs in the Buena Vista Valley because it represents a potential migration pathway for contaminants from NPRC to areas where groundwater is used. The alluvium is a source of irrigation water at the mouth of the Buena Vista Valley (Wilson and Zublin, 1988).

Groundwater movement in the vicinity of NPRC is difficult to evaluate for several reasons. The available data are limited in spatial distribution, with no wells in some areas. The data are also limited in the vertical dimension. Most of the existing wells are used for irrigation or municipal supplies. As a result, rapid fluctuations in water levels in the vicinity of the wells make it difficult to measure true aquifer water levels. In addition, many of the wells are poorly documented with regard to what aquifer zone they are completed in. Measurements of water levels are further complicated by variations within the aquifer zones, with some sand lenses acting as isolated aquifers. The Kern County Water Agency records water levels throughout the County and has mapped groundwater contours. Figure 3-4 is derived from their 1986 map and shows groundwater flow directions in the vicinity of NPR-1 and NPR-2. Due to the limitations noted above, this map should be used only to provide a general indication of groundwater conditions.

Groundwater quality in the region varies with the source of recharge and the subsequent effects of human activities. Groundwater that is recharged from sources to the east tends to have low TDS and to be of good quality. Recharge sources to the west are more highly mineralized, with high TDS levels, and are of poor quality. In addition to the natural variability in water quality, man-made influences have degraded water quality in some areas. These influences include irrigation return flow which flushes salts from the soil into the groundwater, and disposal in the basin of produced brines from oil fields.



Source: Kern County Water Agency, 1986

GROUNDWATER SURFACE ELEVATION MAP FIGURE 3-4

3.4.1.4 Groundwater Uses

Groundwater uses in the vicinity of the NPRC include domestic and municipal supplies, irrigation, and waterflooding to enhance oil production. According to the U.S. Geological Survey, over 100 wells have been drilled into the Tulare Formation around the southeast, northeast, and north sides of Elk Hills. The majority of these wells are used for irrigation. On-site at NPR-1, four wells are used to supply water for waterflooding operations. On the south flank of Elk Hills, three of these source wells (13B-84W, 14B-82W, and 18G-86W) supply approximately 100,000 barrels per day (bbl/day) of Tulare water to the 33S waterflood pump station. Typically, only two wells are on line at any given time with the third well serving as backup. The fourth source well (8R-61WS) was completed shortly before the Environmental Survey and is intended to supply the 17R waterflood pumping station.

3.4.2 General Description of Pollution Sources and Controls

Operations at NPRC result in releases from several sources that could affect groundwater quality. By far, the most significant source of releases to groundwater is the disposal of produced water or oil field brine. Significant amounts of water are coproduced with oil at both NPR-1 and NPR-2. According to Stuart (1987), 85,000 barrels of water per day (BWPD) are produced at NPR-1. Stuart's discussion of wastewater disposal is as follows:

> *Presently, Stevens Zone wastewater is disposed of at the 24Z and 18G LACT Facilities. After dehydration at the 24Z LACT Facility, four disposal wells (13WD, 22WD, 23WD, and 24WD-24Z) handle 15,000 BWPD, and three south flank 24Z Pool waterflood injectors (317, 338, and 348X-24Z) take 9000 BWPD (Subtotal = 24,000 BWPD). The remainder of Stevens Zone wastewater is gathered in the 18G area and 40,000 BWPD is disposed of in six nearby disposal wells (48WD-7G, 68WD-7G, 18WD-8G, 61WD-18G, and 71WD-18G). The total Stevens Zone wastewater volume being disposed of at Elk Hills is averaging 64,000 BWPD. Shallow Oil Zone wastewater at Elk Hills is disposed of in the south flank area where three disposal wells (88WD-7G, 42-16G a SS-1 zone injector, and 81WD-18G) handle 21,000 BWPD.*

Subsequent to the on-site portion of the Survey, the site provided revised information which indicates that presently, Stevens Zone wastewater is disposed of in the following manner:

(1) Of 25,000 BWPD Stevens Zone wastewater processed through the 24Z LACT, 5,500 BWPD is reinjected to the Stevens Zone in 3 waterflood wells (317, 338, and 348X-24Z) and 19,500 BWPD is injected into the Tulare Zone in 4 disposal wells (13WD, 22WD, 23WD, and 24WD-24Z).

(2) All of the 52,600 BWPD Stevens Zone wastewater gathered in the 18G area is injected into the Tulare Zone in 6 disposal wells (48WD-7G, 68WD-7G, 78WD-7G, 18WD-8G, 61WD-18G and 71WD-18G).

The total Stevens Zone wastewater volume being disposed of at Elk Hills is averaging 77,600 BWPD.

Approximately 18,400 BWPD Shallow Oil Zone wastewater is disposed of in the south flank area as follows:

(1) 11,400 BWPD is injected into the Tulare Zone in 2 wells (88WD-7G and 81WD-18G).

(2) 700 BWPD is reinjected into the Shallow Oil Zone in one well in 16G (42-16G).

In addition, one injection well is located in Section 26Z and handles approximately 4,000 bbl/day of water from Asphalto Zone wells in Sections 14Z and 26Z. At the time of the Survey, wastewater from the 10G Lease Automatic Custody Transfer (LACT) station was being discharged to a series of sumps. A disposal well at Section 10G has been shut-in since February 1985 and requires subsurface mechanical repairs. As a result of the well failure, Section 10G wastewater was routed through pipelines to Section 18G for disposal in wells at that location. The same pipeline also conveys wastewater from Sections 25S to 18G. The pumps at Section 10G have difficulty in overcoming the line pressure from Section 25S and cannot consistently force Section 10G wastewater into the Section 18G line. Pipeline leaks are also a

significant problem in this line. Until these problems are overcome, Section 10G wastewater will continue to be sumped at Section 10G. The volume of water discharged to these sumps is estimated at 9,000 bbl/day. Although evaporation may remove some of this water, it is apparent that the vast majority infiltrates into the subsurface. The quality of the wastewater is measured at each of the LACT stations. In general, the water has high sodium, chloride, and TDS. Table 3-8 lists typical values for the four major LACT stations at NPR-1.

Produced water on NPR-2 is also disposed of in wells and surface sumps. No data were available to the Survey to estimate the volumes of water that are handled on NPR-2, but it is believed to be substantially less than NPR-1 due to the lower production on NPR-2. Wilson and Zublin (1988) estimated the volume of wastewater from the Buena Vista field at approximately 30,000 bbl/day. No water quality data are available for NPR-2 but it is believed to be similar to the produced water on NPR-1 (see Table 3-8). Additional wastewater disposal occurred on NPR-2 at the Valley Waste Disposal Company Buena Vista 2 facility. This facility receives wastewater from the Midway Sunset field and currently disposes of the brine in injection wells. In the past, the produced water was collected in sumps and allowed to infiltrate. The sumps that were within the boundaries of NPR-2 were closed in 1986. This facility currently handles approximately 70,000 bbl/day of produced water. Wilson and Zublin (1988) indicate that this produced water contains 1,890 parts per million (ppm) sodium, 2,166 ppm chloride, and 6,000 ppm TDS. Current plans call for an expansion of this facility with the addition of 10 more injection wells. The capacity of the expanded facility is intended to be 140,000 barrels per day.

Other potential sources of groundwater contamination at NPRC include the Class II (23 CA. Admin. Code §2520) disposal facility at 10G, the Class II disposal facility at 27R, the 27R oil recovery sump, the 27R truck washout sumps, the 27R hazardous waste pits, and various leaks and spills throughout the NPRC properties.

3.4.3 Environmental Monitoring Program

At present, no environmental monitoring of groundwater quality is conducted at NPRC. Data are available from several regional studies but these generally focus on the main San Joaquin Basin and have limited implications for the NPRC. Samples of

TABLE 3-8

PRODUCED WATER QUALITY - NPR-1 - TYPICAL VALUES

LACT Station	Sodium (ppm)	Chlorides (ppm)	TDS (ppm)
10G	10,760	19,302	33,900
18G	8,480	11,964	25,900
24Z	10,120	12,390	28,500
25S	10,380	18,504	33,900

Source: BPOI, 1988b

water produced from source wells at NPR-1 for use in waterflood operations provide an indication of current groundwater quality in the vicinity of the site. An example of a typical analysis is provided in Table 3-9. A comparison of these data to the values for disposed wastewater indicates that the water injected in wells or infiltrated through sumps has significantly higher values of TDS than the natural water.

No data on groundwater quality in Section 27R area are available. Studies conducted in 1987 (Kaman Tempo, 1987) indicate that contaminants from that area have migrated in the vadose (unsaturated) zone but the clay dividing the Upper and Lower Tulare may act as a barrier to migration and prevent contamination of the groundwater.

3.4.4 Findings and Observations

3.4.4.1 Category I

None

3.4.4.2 Category II

None

3.4.4.3 Category III

1. Potential degradation of groundwater quality in off-site areas in stratigraphic zones of higher quality as a result of disposal of produced water. The potential exists for degrading the existing groundwater quality in some aquifer zones near the NPRC by disposal of large volumes of produced water in injection wells. The produced water has high salinity with TDS values of 25,000 to 30,000 ppm. Normally, water is considered potable if it contains less than 2,000 ppm TDS. The natural groundwater has TDS values ranging from 5,000 to 6,000 ppm. By injecting thousands of barrels of produced water per day into the aquifer, some degradation is likely. This may result in a loss of available water for irrigation and consumption. The lack of detailed characterization of the hydrogeology of the site precludes evaluation of those

TABLE 3-9

EXAMPLE SOURCE WELL WATER QUALITY - NPR-1
(Well No. 61WS-8R)

Constituent		ppm
TDS Measured		5,600
TDS Calculated		5,348
Cations		
Sodium	Na	1,588
Potassium	K	7.0
Calcium	Ca	232
Magnesium	Mg	71.2
Barium	Ba	10.0
Strontium	Sr	6.6
Iron	Fe	0.12
Silicon	Si	11
as Silica	SiO_2	23.4
Anions		
Chloride	Cl	2,185
Bicarbonate	HCO_3	132
Sulfate	SO_4	983
Boron	B	20
as Borate	BO_3	109
Phosphate	PO_4	1.2
pH		7.2

Source: BPOI, 1988b

Note: Data in table represent a single sample event but are believed to be representative.

impacts. A number of regional studies have been conducted concerning groundwater quality and flow. However, these studies lack the site-specific details of the impacts of specific disposal activities at NPR-1 and 2.

2. Disposal of excess produced water in sumps and Tulare Zone disposal wells degrades groundwater quality in both the Upper and Lower Tulare on-site. Existing groundwater TDS levels are approximately 5,500 ppm, while the produced waters have TDS levels of 25,000 to 30,000 ppm. More than 90,000 bbl/day of produced water are disposed of at NPR-1, primarily in disposal wells. An unknown volume of produced water is disposed of on NPR-2, primarily in sumps.

   As a result of these disposal practices, less usable groundwater will be available for irrigation or consumption.

3.4.4.4 Category IV

None

4.0 NON-MEDIA-SPECIFIC FINDINGS AND OBSERVATIONS

This section discusses findings and observations pertaining to waste management, toxic and chemical materials, radiation, quality assurance, and inactive waste sites and releases. These discussions do not include a background environmental information section because the areas addressed are not necessarily tied to one medium as was the case with the discussions in Section 3.0.

4.1 Waste Management

The Naval Petroleum Reserves in California (NPRC) generate limited types of hazardous and nonhazardous wastes. Most of these wastes are associated with oil exploration, well drilling, and oil reserve recovery and are disposed of on-site. NPRC utilizes a limited range of chemical substances due to the nature of its operations; therefore, waste characteristics are relatively constant. Mixed and radioactive wastes are not generated at the NPRC.

4.1.1 General Description of Pollution Sources and Controls

4.1.1.1 Hazardous Waste

NPRC generates listed wastes and characteristic corrosive hazardous wastes as categorized according to the California Code of Regulations (CCR) and the Resource Conservation and Recovery Act (RCRA). California waste regulations differ from those in most states. Substances that are hazarous wastes in California may not be considered such in other states. Some of these wastes include crushed drums, unrecycled oils (lubricant, motor, etc.), and oil and water mixtures.

NPR-1 currently possesses a California Hazardous Waste Generator Identification number. The State of California does not have primacy under RCRA; however, its regulations in most cases are equally stringent or more stringent than are Federal waste regulations. The California State Department of Health Services (DHS) and the U S. Environmental Protection Agency (EPA) share enforcement authority.

A waste management program with written procedures does not exist at NPR -1 nor are there specific written policies and procedures for waste collection and storage,

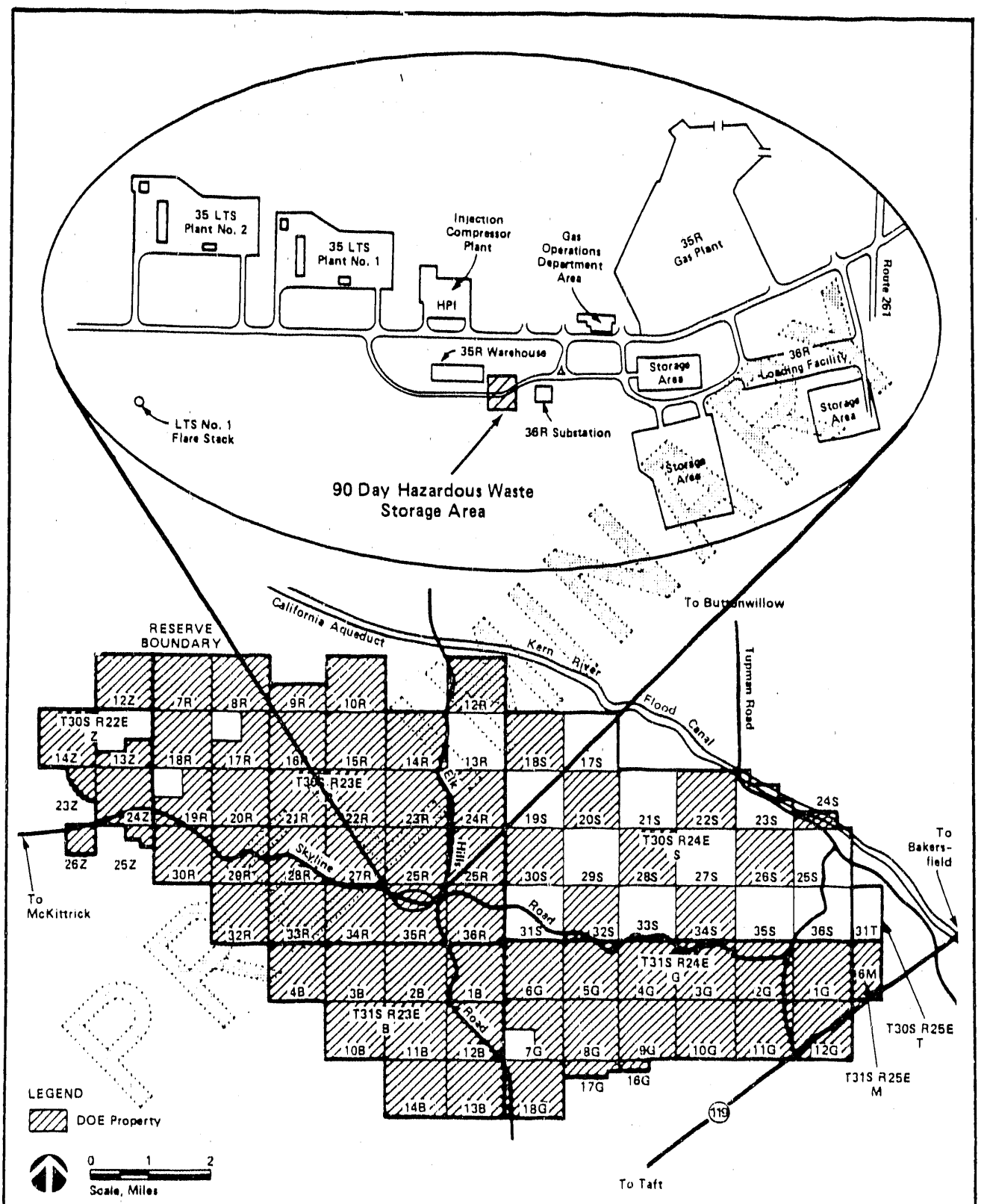
transportation, segregation, or disposal. The Environmental Protection and Compliance Plan, however, is the generic guiding document for waste programs on NPR-1. In addition, several Policies & Procedures are in effect which are applicable on a safety basis for handling of NPR-1 hazardous wastes. Hazardous waste is handled at NPR-1 by Services and Relief (S&R)-the NPR-1 maintenance group, and the Environmental Services group. Currently, wastes at NPR-1 are largely managed through verbal instructions based on individual judgments.

The six companies leasing DOE lands on NPR-2 (Chevron, ARCO, Phillips, Exxon, Texaco, and Union) implement their own waste programs. Little information was available to the Survey on these programs.

Waste Storage Area and Waste Handling

The 90-day hazardous waste storage area at NPR-1 was constructed in 1987. It is located near the warehouse area in Section 35R; see Figure 4-1 for its approximate location. Storage in this area cannot exceed 90 days as NPR-1 does not have interim status as a storage facility under RCRA. Recent shipping manifests show shipments off-site within 90 days of each other. The 90-day hazardous waste storage area is approximately 550 square feet and consists of three concrete bays with 4-inch curbing whose floors slant to central drains. Each of the three central drains has a collection system with one tank associated with it. When the three collection tanks (500 gallons each) have liquid in them, each tank is sampled and analyzed to characterize its contents for disposal. Prior to the Survey, all tank contents were sampled and resulted in an off-site hazardous waste shipment of approximately 75 gallons of oily water. The earthen collection tank area is bermed with about 2 feet of soil. The open-air hazardous waste storage area has outside railings on three sides with two on the inside to separate the bays and one hazardous waste sign in English only. It does not have a roof, the bays are not differentiated for segregation by waste type, and the area is readily accessible to site workers. There are no phones, fire extinguishers, or other emergency equipment. Waste logs to document internal receipt at the storage area were implemented approximately 2 weeks before the Survey.

This hazardous waste storage area is operated by warehouse personnel without formal waste management training (waste requirements, compatibility,



Source: NPR, 1987

NPR-1 90 DAY HAZARDOUS WASTE STORAGE FACILITY

FIGURE 4-1

segregation, handling, disposal, etc.). Limited guidance is provided by the Environmental Services group. Specific written policies and procedures for identification, segregation, and handling of hazardous wastes did not exist at NPR-1. Safety and Environmental Policies and Procedures are in existence that relate to handling of hazardous materials in general, however, those procedures that do exist are vague or based on individual judgments. This is especially evident with regard to the waste storage area and to waste drum and container handling.

Drums at the 90-day hazardous waste storage area are those which have been brought in off the fields or plants of NPR-1. Abandoned drums exposed to the environment will eventually degrade and may leak their contents, thereby contaminating the environment. Drums and containers such as these were observed on NPR-1 and NPR-2 by Survey team members (see Table 4-1). NPR-1 is not routinely surveyed for abandoned drums by S&R or Environmental Services. No sampling and analysis is performed prior to handling to characterize the waste, and S&R personnel do not have formal hazardous waste management training (as above) for handling, segregation, and disposal. The typical waste handling can be described as follows: after abandoned drums and containers in the fields have been located, a work order is issued for their pickup by S&R. S&R uses a pickup truck to transport drums and containers. If a drum is too heavy to pick up manually and it is assumed to contain oil, the drum is referred to Material Control which dispatches a hydrolift truck to retrieve the drum and its contents. Lube oils may be combined at the pad or removed to the gravity line. Those drums that can be transported are taken to the 90-day hazardous waste storage area. Empty drums and containers that can be identified as returnable are separated from others upon reaching the hazardous waste storage area. These are placed in a separate storage area south of the hazardous waste storage area by specific supplier. These drums may or may not be marked as to contents, and if they are unmarked, segregation is solely dependent on the storage area operator's knowledge of drum coloring or pattern. Crushed and damaged drums and containers will not be accepted for deposit return by the suppliers. Therefore, they are shipped off-site as California Hazardous Waste. Sampling and analysis is not performed on drum contents upon their receipt at the waste storage area. If containers exhibit any markings, drum contents are assumed to be consistent with the markings. Drums remaining on the pads are labeled with the standard hazardous waste sticker. Approximately 40 of 88 drums and containers in the bays at the time of the Survey were unmarked or did not have

TABLE 4-1

ABANDONED DRUMS AND CONTAINERS OBSERVED AT NPRC

	Location	Number & Size	Contents	
NPR-1	Near Well 35G & 36R Abandoned Gas Plant	2 55-Gallon Drums	Lubricant oil, Tretolite/Petrolite chemicals	Partially full
	Admissions Control Area of 35R Gas Plant	2 5-Gallon Containers	Unknown	Full-one without bung
	Northern Internal Perimeter of 35R Gas Plant	2 55-Gallon Drums	Unknown but labeled as "2-27-STV Waste"	Full
	Northwest Corner of LTS-1 Pumping Hut	2 55-Gallon Drums	Unknown	Full
	LTS-2 Pumping Hut	2 55-Gallon Drums	May contain oil	Partially full
	Northwest Corner of LTS-2 Compressor Facility	1 55-Gallon Drum	Unknown	Partially full
	36S Truck Washout Area Loading Dock	3 55-Gallon Drums	Gear lubricant, motor oil, turbine oil	Full or partially full
	2B Storage Yard East Annex	150-200 35-Gallon Drums	Lubricant oil	Full or partially full
	2B Storage Yard	1 500-Gallon Poly Tank	Sulfuric Acid	Partially full
	LTS-2 South Cooling Tower Area	1 55-Gallon Drum 1 110-Gallon Poly Tank	Sulfuric Acid	Full
NPR-2	28B Phillips Tanks Setting 3	1 55-Gallon Drum	Unknown	Full
	20B ARCO Compressor Plant Laboratory	1 5-Gallon Drum	Unknown	Full

Source: Compiled by Survey team members

their contents or accumulation date identified. When pad capacity is reached or the 90-day storage time may be elapsing, waste storage area personnel contact Environmental Services personnel for waste subcontractor disposal services. NPR-1 subcontracts to EPA-registered firms for waste characterization, treatment, transportation, storage and disposal. Some of these subcontractors include: Envirosafe Services of Idaho, Inc., of Mountain Home, Idaho; U.S. Pollution Control, Inc. (USPCI), of Murray, Utah; Cold Canyon Landfill in Arroyo Grande, California; Casmalia Resources of Santa Barbara, California; Chemical Waste Management (Kettleman Hills Facility) of Coalinga, California; and Kern Environmental Services of Taft, California (NPRC, 1988c). Upon the disposal company's arrival, the wastes in the 90-day area will be sampled and identified, treated/stabilized, and consolidated by the disposal subcontractor. Drums will be crushed as well. When this is completed, the subcontractor will manifest the waste for off-site shipment. Manifests are retained by the Environmental Services group.

Waste storage and handling policies, procedures, and practices for NPR-2 are unknown by the Survey team. However, Texaco does accumulate and ship hazardous and toxic wastes to EPA-registered waste disposal sites such as the Cold Canyon Landfill in Arroyo Grande, California; Casmalia Resources in Casmalia, California; and Petroleum Waste, Inc. (PWI) in Buttonwillow, California (Texaco USA, 1986).

Chemical waste management at NPR-1 was not practiced until Bechtel Petroleum Operations, Incorporated (BPOI), became unit operator of NPR-1 in 1985. Between 1985 and 1987, when the 90-day hazardous waste storage facility was constructed, drums were accumulated in the 28 storage yard of NPR-1. Three large documented shipments of hazardous wastes were made during this time. Section 4.5 contains further information on past waste management and disposal practices.

Waste Management Facilities

Waste management facilities at NPR-1 consist primarily of two areas: the 27R Waste Management Facility and the 10G Landfarm area. The 27R Waste Management Facility contains a landfarm area, oil recovery sumps, a truck washout impoundment area, and a waste disposal trench area. Both the 27R and 10G facilities are permitted Class II-1 Liquid Disposal Sites. Class II-1 sites are areas overlying usable

groundwater and geologic conditions that either are naturally capable of preventing lateral and vertical hydraulic continuity between liquids and gases emanating from the waste in the site and usable surface or groundwaters, or are disposal areas that have been modified to achieve such capability. During the Survey, the 27R facility was active and the 10G facility was on standby. Both areas operate under waste discharge requirement orders. These areas do not have security to prohibit access and illegal dumping of wastes. Vacuum truck drivers are required to log in their loads upon entering the facility; however, this activity is not monitored. The lack of site security has resulted in unauthorized substances entering the units in the past (Komin, 1980; and Survey team observation).

As previously mentioned, the 42-acre 27R Waste Management Facility consists of a landfarm area, two oil recovery sumps, a truck washout area, and disposal trenches. All areas, with the exception of the trenches, are active. These units are not lined. NPR-1 and the DHS are currently negotiating closure requirements for the waste disposal trenches. DHS considers the 27R Waste Management Facility to be a California interim status hazardous waste disposal area (BPOI, 1986c). A subsurface soil investigation of this area was conducted in 1987 to determine waste constituent migration from the units (Mark Group, 1987). Other sampling has been conducted as well (BC Laboratories, Inc., 1987). Results show maximum migration of contaminants (metals and organics) into the soil to be 30 feet.

The landfarm area, which is part of the 27R Waste Management Facility, receives liquid waste generated during drilling, production, and related operations. Wastes are spread on the soil by vacuum trucks and incorporated with a bulldozer. The majority of the waste is drilling muds and fluids. In the past, this area also received tank bottoms and neutralized acid salt solutions, which are California Hazardous Wastes if they contain elevated levels of certain hazardous constituents (Donahoe, 1986).

The oil recovery sumps at this site are the primary means through which oil is recycled at NPR-1. These sumps are bermed earthen pits. Oil and water mixtures from sumps and well cellars, waste oils from abandoned drums and the waste oil tank, oil samples, etc., are reintroduced into the field lines and LACT settings through these sumps. As oil is lighter than water, it floats on top. When the liquid volume in the sumps reaches a certain level, a pump is automatically activated to

siphon the oil from the top of the sump back into the production lines. The area around the unloading pipes to the sump was saturated with oil and a strong odor was present. These sumps have received acids (reported by the site to be neutralized) and tank bottom sediments in the past (Donahoe, 1986). The sumps are covered with netting to prevent birds and other animals from being trapped in the oil.

The truck washout area is utilized to clean truck interiors and exteriors before changing loads (i.e., from oil to water) or before leaving the installation. Drivers hose their vehicles down with water on a concrete pad which has drains. These drains funnel to a pipe which discharges to two unlined earthen pits or surface impoundments. The water portion of the discharge seeps into the soil. Contaminants (oil or other substances present on the trucks) remain on the soil surface and, to some extent, percolate with the water into the soil. The original surface impoundment was taken out of service due to leakage and collapsing walls. At the time of the Survey, residual oil sludge was present on the bottom of the original surface impoundment. The current impoundment services the washout area via a diversion pipe. While Survey team members were at the washout area, a small truck was being cleaned by its driver. This resulted in a large oil slick on top of the impoundment water. Reportedly, this amount of oil in the impoundment is unusual. No netting was in place. In such instances, a vacuum truck is used to take the floating oil off the water; the oil will be taken to the oil recovery sumps in the area. Analyses of a soil sample taken from this sump area in May 1987 showed levels of 1,1,1-trichloroethane (1,800 micrograms per kilogram [µg/kg]), ethyl benzene (4,100 µg/kg), toluene (3,600 µg/kg), and xylene (28,000 µg/kg) (BC Laboratories, Inc., 1987). While the last three substances occur naturally in crude oil, chlorinated organics do not. This solvent probably entered the impoundments through washout activities. BPOI documentation also states that acids (reported by the site to have been neutralized) were disposed of in the washout area as well (Donahoe, 1986). Because this area is not secure or monitored and routine waste site inspections are not conducted, other hazardous wastes may enter the environment through this pathway.

The waste disposal trenches at this facility are considered a California Hazardous Waste site and are scheduled to undergo closure this year per a DHS order. The closure date is currently under negotiation. This unit is no longer receiving wastes.

Prior to November, 1985, however, it received neutralized acid salt solutions containing fluoride and tank bottom sediments, both of which may be California hazardous wastes if contaminant concentrations exceed specified levels. These wastes are presently being shipped off-site as hazardous. The area is safety/emergency equipped. During the Survey visit, a crushed, half-empty, half-buried drum was observed in one of the trenches. Subsequent to November, 1985, tank bottom sediments have been disposed of by landfarming at the 27R Waste Management Facility, after having been tested and confirmed to be non-hazardous.

The 10G disposal site is a 10-acre landfarm which receives drilling muds and oil/water mixtures. This area was on standby for economic reasons during the Survey team visit. Disposal procedures are the same as at the 27R landfarm area. The 10G site currently is not permitted by the Kern County Health Department.

It is unknown by Survey team members if any waste management facilities exist at NPR-2.

Waste Generation

Hazardous wastes generated at NPR-1 include acids (sulfuric, hydrochloric, and hydrofluoric) and neutralized acid salts (sodium fluoride salts); bases (sodium hydroxide, potassium hydroxide); corrosives (algicides, corrosion inhibitors, proprietary chemicals); solvents (1,1,1-trichloroethane, 1,1,2-trichloroethane, carbon disulfide, chloroform, toluene, and xylene); metals (chromium and arsenic); waste hydraulic, motor, and lubricant oils; waste paint, cans, and thinners; tank bottoms; crushed drums; PCB-contaminated oil, transformers, and capacitors; and asbestos. PCB-related wastes and asbestos wastes are discussed in Section 4.2.

Waste acids at NPR-1 are generated through well stimulation and scale inhibition. Hydrochloric (HCl) and hydrofluoric (HF) acids are used for well stimulation of new and work-over wells. These acids are neutralized immediately upon retrieval from the wells in large tanks, called Baker Tanks, at each well location by the subcontractor. Lime is used for the neutralization of these acids although soda ash was previously used. Soda ash produces sodium chloride when mixed with the hydrochloric acid and sodium fluoride when combined with the hydrofluoric acid. Sodium chloride is currently disposed of at the landfarm area of the 27R Waste

Management Facility or in production lines (Morgan, 1988). Sodium fluoride, however, may be a California Hazardous Waste and is currently being shipped off-site as such. Before November 1985, however, the sodium fluoride salts were disposed of in the waste trenches of the 27R Waste Management Facility. After this date, well stimulation fluids using hydrogen fluoride were taken to the PWI disposal site in Buttonwillow, California (Morgan, 1988). Accurate and current inventories for acid utilization at NPR-1 were not available. However, approximate data from 1984 and 1985 are presented in Table 4-2. Final fate of the acids is unknown.

At NPR-2, Chevron ". . . pulls spent acid from [their wells] and [transports] it unneutralized to a hazardous waste disposal site" (Morgan, 1988). It is unknown if other lessees at NPR-2 handle their acids in a similar manner.

Sulfuric acid has been used as a scale inhibitor in the cooling towers at the NPR-1 gas plants. Some of the towers, however, are currently being converted to Betz proprietary products for scale inhibition. A 1988 chemical inventory states that 200 gallons per year of sulfuric acid is used at NPR-1 (BPOI, 1988f). During the Survey, a 110-gallon poly tank of sulfuric acid was observed by the LTS-2 Gas Plant northwest cooling tower. This tank was considered waste by the operator and had reportedly been there approximately 2 months.

Soda ash or lime is utilized to neutralize acids from well stimulations, as discussed above. This material converts the acids to salts and is disposed of as such. Potassium hydroxide is used on-site in a propane treater at the 35R Gas Plant at NPR-1. This system requires servicing by an outside subcontractor. NPRC is then considered to be the generator of this hazardous waste.

Corrosives such as algicides and corrosion inhibitors are used in well work, production lines, and cooling towers. These substances are utilized in wells to protect the casings from harsh downhole conditions. They are also fed into production lines at LACT tank settings to keep lines open and free of scale, and in cooling towers to inhibit scale and algae growth. There is typically no waste generated from their use and they are usually supplied in bulk (110- to 500-gallon poly tanks) with only the amount needed being used or are totally used in the production lines or cooling towers. Waste that does result is usually from damaged containers.

TABLE 4-2

WELL ACID STIMULATION VOLUMES

	HCl[a] (gal)	HCl/HF[b] (gal)
1984[c]	109,845	61,030
1985	166,159	152,696

Source: Compiled by Survey team member

a HCL In 15, 7½, 5, 2 % weight/volume
b 12% HCL/3% HF
c data from 5/1/84 - 12/31/84 only

Laboratory operations at Sections 35R and 36S of NPR-1 generate solvent waste from crude oil distillations, petroleum product testing, and water flood/water quality analysis. Solvents used here mainly include 1,1,1-trichloroethane, 1,1,2-trichloroethane, carbon disulfide, chloroform, toluene, xylene, and "Sullivan's Degreaser". Kerosene and gasoline are also utilized at the laboratories. The waste generation rate at the 35R laboratory is approximately 4.5 liters/month. Wastes are stored under a sink in one of the rooms in brown 1-liter bottles. When these bottles are full, they are emptied into one 55-gallon container outside the laboratory building. At the time of the Survey, this drum did not have a logbook associated with it and had no hazardous waste label on it. Its only marking was "1,1,2-trichloroethane" stenciled on its back side. The drum was sitting on a concrete sidewalk protected by the roof overhang. This drum had been in use for 5 months. Drums were not used previous to this. Waste samples that contain solvents are also put into the drum. Most oil samples are returned to the production lines, however, after analysis has been performed. From 1983 when this laboratory was constructed until the time the drum was provided, all liquid waste went down the drains. From 1975 to 1983, an associated laboratory performed analyses of natural and liquefied gas using acetone, isooctane, and other solvents. These laboratory wastes also went down the drains. The Survey could not determine where the drains discharge.

At the 36S laboratory, cut and gravity tests are performed. At the time of the Survey the main solvents used were 1,1,1-trichloroethane, kerosene, emulsion breaker called treatolite C-10, and "Sullivan's Degreaser". No waste drum or other containers were observed and it could not be ascertained where these solvents were disposed of.

Maintenance operations such as equipment cleaning also used solvents. Primarily a biodegradable nonhazardous solvent "Oil Flo" is currently in widespread use, however, 1,1,1-trichloroethane is also used at LTS-2 (as observed by Survey team personnel). No waste containers are provided for maintenance/cleaning activities. At the time of the Survey, it could not be ascertained where these solvents are disposed of.

Drilling muds and fluids historically contained chromium. Drill pads used when these metals were contained in the muds now show signs of contamination. Excavation of these contaminated areas by BPOI is currently underway. Soil containing chromium and arsenic from well corrosion inhibitor is being shipped off-

site to USPCI in Utah as hazardous waste. From January to April 1988, approximately 550 tons of soil were shipped. Section 4.5 contains further information on this activity.

Waste oil liquids such as hydraulic, motor, and lubricant oils; waste oil solids such as sludge from maintenance and well operations; and oily water that is or may be contaminated with solvents, metals, acids, or bases and cannot be returned to the production lines for those reasons are shipped off-site to Gibson Oil and Refinery Company of Bakersfield, California, as a California hazardous waste. From January to April 1988, 1,750 gallons of waste oil and mixed oil, 17.2 cubic yards of waste oil and mixed oil solids, 13,445 gallons of crankcase oil and water, and oily water were shipped off-site as hazardous waste. Gibson is a DHS approved recycler for motor oils that are not Federal hazardous wastes. California controls waste oils by a special law which restricts their use and disposal if they contain certain levels of contaminants. NPR-1 used compressor oils have been tested and do contain levels of contaminants below these levels of restriction.

Waste paint, paint cans, and paint thinners, are generated through maintenance operations. These wastes are collected by S&R and brought to the 90-Day Hazardous Waste Storage Area. Two hundred seventy-five gallons were disposed of off-site to Solvent Services, Inc., of San Jose, California, between January and April 1988. During the time of the Survey, however, three 1-gallon cans; partially containing paint, and 12 saturated brushes were observed in a solid waste receptacle in Section 36S. Waste paint and paint cans are California hazardous wastes if they are flammable or exceed hazardous waste levels of metals. Empty paint cans, brushes and water based paints are not considered hazardous unless they contain hazardous waste levels of metals.

Damaged or crushed drums which cannot be returned to their suppliers are also a California Hazardous Waste. In the first 4 months of 1988, 20 cubic yards of crushed metal and poly drums were disposed of off-site to Casmalia Resources of Casmalia, California, as hazardous waste.

Occasionally, off-specification drilling muds and off-specification or aged chemicals will not meet the required standards for use or on-site disposal. These substances will be taken off-site and disposed of as hazardous waste (BPOI, 1986p).

Tank bottoms at NPR-1 consist of sediments from crude-oil storage tanks associated with production, dehydration, and shipping. Every few years the tanks are drained of oil, opened, and the accum lated sediment is vacuumed out. There is no set schedule for tank bottom removal. In the past, these tank bottoms were disposed of in the trenches, oil recovery sumps, and the truck washout areas of the 27R Waste Management Facility as discussed above. In 1987, four tanks were cleaned. This waste has not been generated yet in 1988 for NPR-1. These tank bottoms may be flammable wastes and therefore are required to be shipped and disposed of as a hazardous waste. The site has reported that in their present procedure, the bottoms are allowed to age to remove volatile lighter hydrocarbons to the atmosphere through several tank openings. Tank bottoms may then be tested for hazardous waste levels of metals and if determined to be non-hazardous, disposed of at the 27R landfarm. If any tank bottoms were found to be hazardous, disposal off-site at a permitted hazardous waste disposal site would occur.

Federally Exempt/California Nonexempt Waste

Exempt wastes are those wastes associated with the exploration, development, or production of crude oil and natural gas. Due to their large volume and relatively low environmental hazard, th e wastes have been classified as "special wastes" under Section 3001(b)(2)(A) o RCRA. The Federal Government has determined that NPRC does not require RCRA permits for their waste activities due to the fact that NPRC wastes are oil field production related, thus temporarily excluding their wastes as hazardous. DHS does not recognize this exemption and, therefore, requires California facilities such as NPRC to comply with state regulations of these wastes. Such wastes include drilling fluids, cuttings, produced water, and wastes from gathering lines. A partial list of these other federally exempt wastes and California nonexempt wastes appears in Table 4-3. California State regulations in some cases may be more stringent than Federal regulations. Nonexempt wastes are those wastes not directly generated through oil and gas exploration and production and may be considered nonhazardous. However, they may also be California Hazardous Wastes. See Table 4-4 for a partial list of these wastes. Examples could include off-specification drilling muds which may contain leachable metals, or tank bottoms which are flammable.

TABLE 4-3

FEDERALLY EXEMPT WASTES/CALIFORNIA NONEXEMPT WASTES

Drill cuttings[a]	Basic sediment and water and other tank bottoms from storage facilities and separators[a]	Appropriate fluids injected downhole for secondary and tertiary recovery operations
Drilling fluids[a]	Produced water	Liquid hydrocarbons removed from the production stream but not from oil refining
Well completion, treatment, and stimulation fluids	Constituents removed from produced water before it is injected or otherwise disposed of	Gases removed from the production stream, such as hydrogen sulfide, carbon dioxide, and volatilized hydrocarbons
Packing fluids	Accumulated materials (such as hydrocarbons, solids, sand, and emulsion) from production separators, fluid-treating vessels, and production impoundments that are not mixed with separation or treatment media	Materials ejected from a production well during the process known as blowing down a well
Sand, hydrocarbon solids, and other deposits removed from production wells	Drilling muds from offshore operations[a]	Waste crude oil from primary field operations[a]
Pipe scale, hydrocarbon solids, hydrates, and other deposits removed from piping and equipment		Light organics volatilized from recovered hydrocarbons or from solvents or other chemicals used for cleaning, fracturing, or well completion
Hydrocarbon-bearing soil		
Pigging wastes from gathering lines		
Wastes from subsurface gas storage and retrieval		

Source: EPA, 1987d; State of California, 1985

[a] Considered a California Hazardous Waste if contaminant levels exceed California hazardous waste level restrictions.

TABLE 4-4

FEDERAL AND CALIFORNIA NONEXEMPT WASTES

Waste lubricants, hydraulic fluids, motor oil, and paint[a]	Sanitary wastes, trash, and gray water	Filters
Waste solvents from clean-up operations[a]	Gases, such as SO_x, NO_x, and particulates from gas turbines or other machinery	Spent catalysts
Off-specification and unused materials intended for disposal[a]	Drums (filled, partially filled, or cleaned) whose contents are not intended for use[a]	Wastes from truck- and drum-cleaning operations
Incinerator ash[a]	Oil and water[a]	Waste solvents from equipment maintenance
Pigging wastes from transportation pipelines	Waste iron sponge, glycol, and other separation media	Spills from pipelines or other transport methods

Source: EPA, 1987d; State of California, 1985

[a] Considered a California Hazardous Waste if contaminant levels exceed California hazardous waste level restrictions.

Hazardous wastes generated by Texaco at NPR-2 include oxidizers, corrosives, waste crude oil, crushed drums, and asbestos (Texaco USA, 1986, 1987). Texaco has an EPA Generator Identification Number. These wastes are shipped as hazardous wastes to EPA-registered treatment, storage, disposal (TSD) facilities in California, specifically Petroleum Waste, Inc., Buttonwillow; Casmalia Resources of Casmalia, and Cold Canyon Landfill of Arroyo Grande. Chevron also ships hazardous waste off-site; however, details of their program could not be ascertained during the Survey. Hazardous waste program details of other NPR-2 lessees are not known by the Survey team.

Some waste streams at NPR-1 have not been characterized prior to disposal to determine the nature of the waste in accordance with appropriate California Waste Regulations or periodically sampled to ensure waste consistency. Examples of this include glycol filters, waste oils, and oil and water mixtures. In some instances such as the glycol filters and compressor engine oil filters, the state has yet to specifically determine the nature of the waste (hazardous, non-hazardous, or exempt).

NPR-2 Federally Exempt/California Nonexempt waste activities are not known by the Survey team with the exception of Chevron U.S.A. glycol filters as previously mentioned.

Oil filters from NPR-1 compressor engines have been classified by the Environmental Services group staff as nonhazardous. A laboratory analysis was performed in 1987 to characterize oil filters with respect to the Total Threshold Limit Concentrations (TTLC) standards (Morgan, 1987). At the time of the on-site Survey visit, the California DHS had not yet made a determination as to the nature (hazardous or nonhazardous) of the oil filters. However, the site has reported subsequently that the Kern County Health Department has reviewed and approved disposal of drained oil filter elements at the Taft Landfill. Currently, oil filters are drained into 55-gallon drums until the dripping has stopped. The drained oil is then returned to the field production lines via the 27R oil recovery sump. The drained oil filters are placed in heavy-duty plastic bags and disposed of as solid waste. At the time of the Survey, 150 to 200 55-gallon drums of oil filters were sitting in an open area on the south-southeast side of the 35R Gas Plant near the glycol unit. Three of the 150-200 drums were marked on hazardous waste labels as oil filters. The remainder were unmarked and unlabeled. Of those three marked, two were dated (February and

March 1987). These drums were reportedly the responsibility of S&R; however, the site was uncertain with regard to this, at the time of the Survey on-site visit.

Also classified as solid waste by NPR-1 are triethylene glycol filters from the glycol units of the gas plants. The glycol is used as a heat exchanger and filters are used for keeping the glycol free of carbon buildup. No formal waste characterization (sampling and analytical determination of hazardous constituents) has been conducted on these filters to establish the disposal requirements. These filters are disposed of as a hazardous waste by the Chevron U.S.A. on NPR-2. On the average, each NPR-1 gas plant uses about 19 filters a week, totaling approximately 2,964 filters per year. Glycol filters are currently being disposed of in the solid waste dumpsters owned by the Westside Waste Company and hauled to the Taft County Landfill. In the past, they were disposed of in on-site landfills. See Section 4.5 for more information on past landfill usage.

Recyclable Material

Hazardous materials at NPR-1 include solvent and parts degreasing fluids, lead acid batteries, and oil.

The vehicle maintenance garage has been located in Section 36S for 6 years and services approximately 260 cars, trucks, and other equipment. This area has two parts washers/degreasers and two choke and carburetor cleaners which are serviced and owned by Safety Kleen, an outside contractor. Safety Kleen 105 Solvent, utilized in the parts washer/degreaser, consists mainly of mineral spirits. The solvent used in the choke and carburetor cleaner, Immersion Cleaner and Carburetor Parts Cleaner 609, contains triethylamine, methylene chloride, acids, and ortho-dichlorobenzene. These solvents are recycled off-site.

Lead acid batteries are also stored at the garage and are recycled off-site through a local contractor in Bakersfield. Approximately 30 to 40 batteries are picked up every 2 months. Survey team members do not know if the batteries are manifested as hazardous waste.

Oils (crude, engine, lubricant, crankcase, etc.) are recovered from sumps and partially full dr ms by vacuum trucks and are returned to the field production lines

at the 27R oil recovery sump. This oil will mix with the field crude oil and undergo separation in the LACT. If this oil were not recycled, it would be considered a California Hazardous Waste if hazardous waste levels of contaminants were present.

Waste Minimization

Waste minimization at NPR-1 consists of some bulk-container chemical usage and acid neutralization. Product chemicals in bulk containers instead of 55-gallon drums are currently utilized at well development sites. These containers are brought directly out to the well sites by the suppliers. Only the amount needed is taken; therefore, no drums or wastes are left. Additionally, some efforts have been made to treat and neutralize the salt solutions from the acids used in well stimulation at NPR-1 on-site.

The Survey team could not ascertain where NPR-2 lessees recycle or minimize their hazardous wastes.

4.1.1.2 Mixed Radioactive and Hazardous Waste

NPR-1 and 2 do not currently generate mixed radioactive and hazardous waste nor have they done so in the past.

4.1.1.3 Radioactive Waste

NPR-1 and 2 do not currently generate radioactive waste nor have they done so in the past.

4.1.1.4 Nonhazardous Waste

Nonhazardous waste generated at NPRC consists of exempt and solid wastes. Drilling activities are the main source of exempt waste. Solid waste is generated in every operation at the facility.

No complete, comprehensive system exists at this facility for tracking and inventorying the generation and segregation of these waste types. Wastes that are

inventoried by the on-site haulers include drilling muds and fluids, oily water, and produced water. A solid waste inventory is not kept at NPR-1. Policies and procedures for both exempt and solid waste disposal are limited in detail, direction, definition, and responsibility. No formal waste handling or segregation training for operations personnel exists.

Federally Exempt/Nonhazardous Wastes

Exempt wastes generated at NPR-1 consist mainly of produced water, drilling muds, and oily water. These wastes, if contaminated with acids, solvents, or other hazardous constituents, would be considered California Hazardous Waste. However, periodic sampling to determine waste consistency is not performed by NPR-1. Produced water may either be reinjected into the formation to maintain production pressure and formation integrity, or disposed of in sumps on-site. The 10G sumps are currently utilized for surface disposal of produced water. Total annual generation of produced water is approximately 3.230×10^7 barrels. Produced water disposal figures are presented in Table 4-5.

Sections 3.3 and 3.4 contain more information with regard to sumps and produced water and its disposal, respectively.

Drilling muds and oily water from the drilling sumps from NPR-1 are currently disposed of at two California Class II-1 Liquid Disposal Sites as previously discussed: the landfarm area of the 27R Waste Management Facility, and the 10G Landfarm Area. Both landfarm areas are permitted by the State of California. From opening in 1975 until the middle of 1986, these drilling sumps were left in place, with the fluid drained and the pit backfilled. In addition to drilling muds and fluids, other exempt wastes such as well cellar wastes, cement and water, oily polymers, and polymers are also disposed of there. The identities of the polymers are not known. These wastes are hauled via subcontracted vacuum trucks to the landfarms for spreading and mixing. Generation of these exempt wastes is dependent upon the level of new well boring and well work-over activities. The total combined disposal volume for both Sections 27R and 10G for 1987 was 713,307 barrels. January - March 1988 showed a combined total of 174,926 barrels disposed in the 27R and 10G waste management facilities. Specific disposal data can be found in Tables 4-6 and 4-7. As there is no waste site security at the 27R and 10G waste management

TABLE 4-5

ANNUAL PRODUCED WATER DISPOSAL AT NPR-1[a]

Disposal Method	Quantities Disposed of
	Barrels[b]
Discharged to Sumps	2.92 x 10^6
Reinjected	3.409 x 10^7
TOTAL	3.701 x 10^7

Source: Compiled by Survey team members

a Based on average daily disposal values
b Volume is given in 42-gallon barrels

TABLE 4-6

1987 ON-SITE EXEMPT AND SOLID WASTE DISPOSAL[a]

	27R[b]	10G[c]	TOTAL
Drilling Muds	194,640	180,616	375,256
Oil and Water	299,476	37,035	336,511
Cement and Water	980	35	1,015
Oily Polymer	400	---	100
Polymer	125	---	125
TOTAL	495,621	217,686	713,307

Source: Summarized from BPOI, 1988b

a Volume is given in 42-gallon barrels.
b Volumes for landfarm and oil recovery sumps only
c Volumes for landfarm only.

TABLE 4-7

JANUARY - MARCH 1988 ON-SITE EXEMPT AND SOLID WASTE DISPOSAL[a]

	27R	10G	TOTAL
Drilling Muds	40,801	47,950	88,751
Oil and Water	82,321	3,124	85,445
Cement and Water	480	--	480
Oily Polymer	250	--	250
TOTAL	123,852	51,074	174,926

Source: BPOI, 1988b, 1988h

a Volume is given in 42-gallon barrels

areas, vacuum truck activities go unmonitored; therefore, these numbers may not be complete.

Produced water at NPR-2 is also reinjected and discharged to sumps. NPR-2 water is disposed of at the NPR-2 Valley Waste Facility. Drilling pad sumps at NPR-2 containing drilling muds and fluids are not excavated but are left in place, unlike drilling pad sumps at NPR-1. Total numbers of sumps and waste generation numbers at NPR-2 are unknown.

Solid Waste

Solid wastes generated at NPR-1 consist mainly of paper, wood, metal equipment parts, cardboard, garbage, empty spray cans, and drill pad and construction debris. These wastes are placed in solid waste receptacles outside site buildings by S&R or other site personnel. Dumpster volume is approximately 3 cubic yards. There is an average of two of these receptacles at each facility. In addition to these dumpsters, there are two 40-cubic-yard dumpsters at Sections 36S and 35R of NPR-1. These large receptacles are specifically for non-drill pad and field compressor station waste disposal. Specific drill sites have their own dumpsters. Materials such as wood, metal equipment parts, and damaged tools were some of the waste observed in the 36S and 35R dumpsters. Although an inventory of solid waste generation is not kept by NPR-1 environmental staff, the Survey estimates approximately 24,000 cubic yards generated annually based on 50 three-cubic-yard and 2 forty-cubic-yard dumpsters being serviced twice a week. Westside Waste Management, a local outside subcontractor, owns and services these dumpsters. Once collected, solid waste is taken to the Taft County Landfill, located immediately off NPR-1, in Taft, California. There are no active on-site disposal areas for solid waste at NPR-1 except for nonhazardous tank bottoms and drilling muds. Solid waste volumes are known through billing invoices sent to NPR-1 by Westside Waste Management. Overall, no complete, comprehensive system for tracking and inventorying generation of exempt or solid waste or nonhazardous and hazardous waste segregation exists at this installation.

Solid waste generation and disposal practices of NPR-2 lessees were not available to Survey team members.

Recyclable Materials

Nonhazardous materials recycled at NPR-1 include computer paper, metals, rags, and product drums. Metals such as iron, steel, and aluminum from maintenance operations are collected at the garage area in a dumpster and hauled to a reclamation/salvage yard off-site. Rags are placed in red step-cans throughout the site and are collected and picked up by an off-site contractor. Product drums utilized by NPRC are returnable to their suppliers. These containers are returned for deposit by the operating groups throughout the installation to the 35R warehouse area. Only drums in good condition are accepted, as suppliers do not accept damaged drums. Those that are damaged must be shipped off-site as a California Hazardous Waste. These containers are not rinsed prior to return. If they were, however, the rinsate would be a California Hazardous Waste.

The Survey team could not ascertain whether NPR-2 lessees recycle or minimize their nonhazardous wastes.

4.1.2 Findings and Observations

4.1.2.1 Category I

None

4.1.2.2 Category II

1. Lack of formal waste management program at NPRC. There is no formal waste management program for the NPRC; as a result, hazardous wastes may be improperly handled and disposed of and may contaminate soil and groundwater. There is no written documentation of procedures for waste characterization and segregation or for waste handling and storage. In addition, there is a lack of inspections, site security, and worker training focused on hazardous waste requirements.

   Hazardous waste is currently managed by verbal instructions and is dependent upon individual judgments. No major instances of improper disposal have

been noted. However, the lack of formal characterization of waste streams leads to the potential for improper disposal due to unidentified waste streams to be determined in the future as hazardous. For example, the Survey is currently concerned about the status of glycol filters. Should a review of these determine that they meet the definition of hazardous waste, this would imply that they had been improperly managed in the past. Had a systematic review of waste streams been conducted, these and similar issues would not have surfaced after the fact.

Waste segregation, separation of hazardous, nonhazardous, and recyclable waste, at the point of generation is the responsibility of field operations staff. There are no written procedures on determining what constitutes hazardous waste, no training focused specifically on the details of hazardous waste management requirements, and no follow-up inspections to ensure that appropriate segregation is maintained. Examples of this include the 18G oily soil disposal, paint cans in the 36S solid waste container, and potentially, the 1,1,1-trichloroethane in the 27R truck wash area.

There is no labeling of waste, including dating at the point of generation which may result in inappropriate storage in satellite accumulation areas and the 90-day storage facility at Section 35R. This situation also necessitates sampling and analysis prior to disposal including sampling that may have been obviated with proper labeling. Instances of improper or unlabeled drums were noted at the 35R Gas Plant satellite accumulation areas where 134 of 140 drums were unlabeled, while 6 were inappropriately labeled as "hazardous waste". A drum containing scrap metal pieces and located in a scrap area behind the gas plant was also incorrectly labeled with a "hazardous waste" sticker.

Lack of access control at on-site disposal locations such as the 27R waste disposal area may result in improper disposal (see related Category III finding Number 1 in Section 4.1.2.3).

4.1.2.3 Category III

1. The 27R Truck Washout Area at NPR-1 has received a hazardous waste in the past and may receive hazardous waste in the future due to the lack of access control at the site. Access to the 27R Waste Management Facility is uncontrolled and has led to chlorinated organic chemical contamination of the truck washout area and its associated impoundments. Analytical results from samples taken in 1987 evidence levels of 1,1,1-trichloroethane, a hazardous waste, released to the truck washout area. As this area is specifically for washing residual oils from trucks, chlorinated solvents should not be present in this area.

2. Abandoned drums, which if they continue to be left unattended may deteriorate and result in future releases of potentially hazardous materials to the environment, were located throughout NPR-1 and NPR-2. Due to the lack of control over the generators of this waste, drums are left at the point of generation, resulting in the need for periodic sitewide surveys to identify and collect them.

   A limited physical inspection of NPR-1 and NPR-2 identified the following abandoned drums:

   NPR-1

   - Two partially full 55-gallon drums, one containing lubricant oil and one containing Tretolite/Petrolite chemicals, alongside a road near Well 356 and the 36R abandoned gas plant.

   - Two full 5-gallon containers of unknown substances, one with the bung open, on the west side of the front of the Admissions Control Area at the 35R Gas Plant.

   - Two full 55-gallon drums labeled "2-27-STV Waste" in white paint in the northern area of the 35R Gas Plant near the gate to the facility's sumps.

- Two full 55-gallon drums of an unknown substance behind the pumping hut in the northwest corner of LTS-1.

- Two partially full 55-gallon drums which may contain oil behind LTS-2 pumping hut.

- One partially full 55-gallon drum of an unknown substance behind the northwest corner of the LTS-2 compressor facility.

- Three, two full and one partially full, 55-gallon drums containing gear lubricant, motor oil, and turbine oil, respectively, standing upright and lying on their sides on a small loading dock at the 36S Truck Washout Area.

- 150 to 200 full and partially full 35-gallon drums of lubricant oil at the east annex of the 2B storage yard adjacent to the asbestos storage area. These drums are on cradles, pallets, or directly on the ground.

- One partially full 500-gallon poly tank of sulfuric acid approximately 75 yards north-northeast of the methanol tank in the 2B storage yard.

- One partially full 110-gallon poly tank and one full 55-gallon drum (containing sulfuric acid) east of the south cooling tower at LTS-2.

NPR-2

- One full 55-gallon drum of unknown liquid in the center of the 28B Phillips tank setting 3.

- One full 5-gallon drum of unknown substance at the ARCO Compressor Plant (22) at 20B outside the laboratory.

4.1.2.4 Category IV

None

4.2 Toxic and Chemical Materials

4.2.1 General Description of Pollution Sources and Controls

4.2.1.1 Polychlorinated Biphenyls

The program at Naval Petroleum Reserve-1 (NPR-1) for the management and handling of polychlorinated biphenyls (PCBs) is the responsibility of the site management and operations contractor, Bechtel Petroleum Operations, Inc. (BPOI). BPOI's responsibilities concerning PCBs are delineated in Policy and Procedure No. 1870-0001 of the BPOI Environmental Services Unit Policy and Procedures Manual (BPOI, 1987c). Prior to BPOI, Williams Brothers Engineering Company was the site contractor and had responsibility for PCB management and handling. BPOI replaced Williams Brothers as site contractor in 1985. On NPR-2 the individual lessees have maintenance responsibility for PCB-containing equipment on their leases.

PCBs are present at the Naval Petroleum Reserves in California (NPRC) in the dielectric fluids of transformers. All the transformers are located outdoors and are mounted on transmission poles or on concrete pads. There are approximately 400 oil-filled transformers at NPR-1 (Williams Brothers Engineering Company, 1983). An inventory of oil-filled transformers on Government land at NPR-2 does not exist. An inventory of suspected PCB transformers on NPR-1 was provided to Survey personnel during the on-site phase of the Survey. This inventory included 318 suspected PCB transformers that are still in service and have not yet been tested for PCB content (BPOI, 1988h). There are currently no verified PCB or PCB-contaminated transformer units in operation on NPR-1 (Electrical Utility Department personnel, 1988).

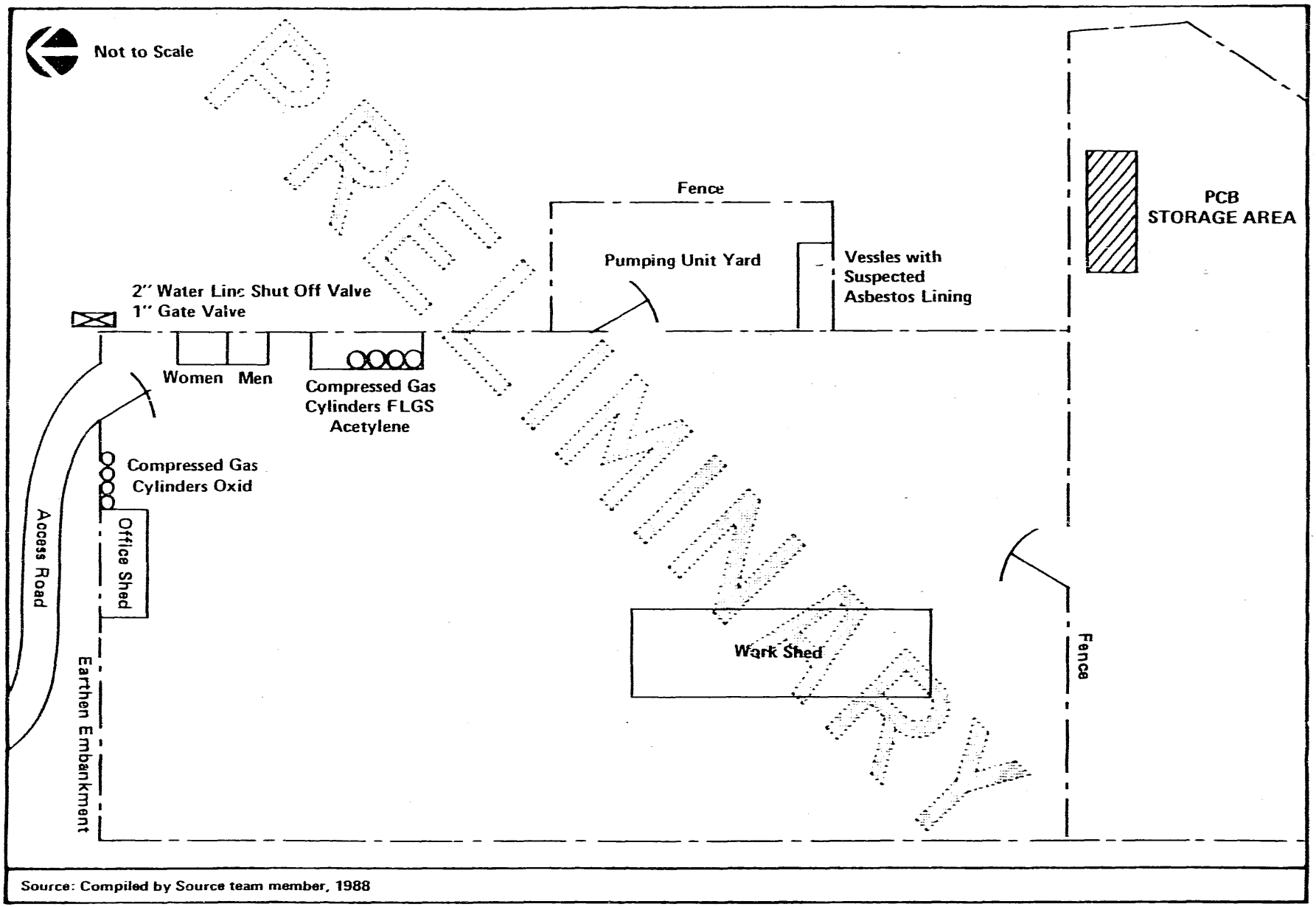
It has been the policy of management at NPRC since 1984 that all transformers at NPRC that have not been tested for PCB content be individually marked with a label that warns of the presence of PCBs (DOE, 1984). During the Survey, 28 active transformer units on NPR-1 were reviewed; 18 were labeled with a yellow label denoting the presence of PCBs, 7 were labeled with blue "NO PCB" labels, and 3 were not labeled as to their PCB content. The 18 units that had yellow PCB labels were included on the site inventory of PCB-suspected transformers. Sixteen active

transformers on DOE leases on NPR-2 were reviewed; 13 were labeled "NO PCB" and 3 were not labeled.

Transformers on NPR-1 are inspected quarterly for leaks. When a unit is noted to be leaking, it is taken out of service and, if suspected of containing PCBs, is taken to the PCB Storage Area in the 2B Storage Yard to await testing. The inspection program was initiated in the first quarter of 1985 and is performed by personnel from the Electrical Utilities Department (EUD). A review of the inspection reports showed that, during the third and fourth quarters of 1985, inspections were not done. Site personnel interviewed could not provide an explanation for this. The reports also showed that two transformers (UNX 10213 and UNX 15471) were removed from the 36S 80 Project Office and taken to the F Camp, a scrapyard adjacent to the maintenance garage in Section 36S. These transformers contained 244 parts per million (ppm) PCBs and 124 ppm PCB, respectively (General Electric Co., 1985). At the time of the Survey, a structure that was intended to fulfill the PCB storage requirements set forth in 40 CFR 761 was not completely constructed and appeared abandoned. Records concerning possible storage of suspected PCB materials at this location were not found.

Prior to August 1987, sampling of transformers was accomplished by EUD personnel (Electrical Utility Department personnel, 1988). Sampling of transformer fluids is currently done by BPOI Environmental Services personnel. At the time that EUD personnel were performing the sampling, there was no training program for handling PCBs (Electrical Utility Department personnel, 1988). Currently, oil leaking from a transformer is sampled by members of the Site Emergency Response Team who are trained in PCB handling. If the release or leak is large, a PCB response specialist is notified to respond (Electrical Utility Department personnel, 1988).

Suspected PCB-containing transformer units are required to remain in the PCB Storage Area of the 2B Storage Yard (see Figure 4-2) until the analysis of the oil is complete. If the presence of PCBs is confirmed, then the unit remains in the PCB Storage Area until proper disposal actions can be initiated. If PCBs are not detected, the units are transferred to the 36S Storage Yard for repair and reissue (Environmental Services Department personnel, 1988). At the time of the Survey, there were 16 transformer units in the holding facility in the PCB Storage Area. The holding facility consists of a concrete floor with a 6-inch berm, corrugated metal



PCB STORAGE AREA IN 2B STORAGE YARD

FIGURE 4-2

walls on three sides, and a corrugated metal ceiling. The facility is labeled with yellow PCB labels. The transformer units are stored on wooden pallets inside the holding facility. An inventory list of the units in the PCB Storage Area, dated April 28, 1988, was given to the Survey team on May 10, 1988. The inventory includes information such as the starting date for storage, UNX number, whether sampling has occurred, and what the results of that analysis were (BPOI, 1988f). It could not be determined through interviews with site personnel how often this inventory is updated.

The 36S storage area is intended for non-PCB transformers, and accordingly, there are no containment facilities. Units are stored on pallets on the ground. At the time of the Survey, approximately 70 transformer units were in storage at 36S.

On November 12, 1985, Industrial Waste Engineering (IWE) began work at NPR-1 to remove chemical drums and PCB-contaminated electrical equipment from the 2B Storage Yard (BPOI, 1986g). The electrical equipment included five PCB-contaminated transformer carcasses and three capacitors, all of which were drained prior to removal from the site. The analysis of the liquid from the transformers indicated PCB concentrations in the range of 0-142 ppm. The capacitors were found to contain approximately 50 percent PCBs.

At that time, the contents of an open-top, 1,500-gallon storage tank adjacent to the PCB Storage Area and used for the storage of transformer fluids containing less than 50 ppm PCB were sampled (BPOI, 1985). The analysis of the liquids from the storage tank revealed a concentration (approximately 6 ppm) of PCBs. The tank contents were removed and placed in sixteen 55-gallon drums for off-site disposal. The storage tank was dismantled and shipped off-site for disposal in late December 1985 (BPOI, 1986g). Table 4-8 shows the quantity and destination of PCB materials shipped from NPR-1 during November-December 1985.

Additional off-site shipments of PCB-containing materials occurred in November 1986, when 20 drums (1,100 gallons) of PCB-containing oil and 13.2 cubic yards of drained transformer carcasses were removed from the 2B Storage Yard. An entry on the manifest for the carcasses noted that a carcass with a capacity of 9 cubic yards had contained 50,000 ppm PCBs (BPOI, 1986g). This was confirmed in a letter dated

TABLE 4-8

PCB-CONTAINING MATERIALS REMOVED FROM NPR-1 DURING NOVEMBER-DECEMBER 1985

Material	Date	Quantity	Destination
PCB-containing oils from storage tank	12/26/85	Sixteen 55-gal barrels	Chemical Waste Management Landfill, Kettleman Hills, CA, for Solidification
PCB-contaminated transformer carcasses	12/26/85	5 carcasses (5 yd^3, 3,000 lb)	Chemical Waste Management Landfill, Kettleman Hills, CA
PCB-contaminated oil from transformer carcasses (>50 ppm PCB) and capacitors (>500 ppm PCB)	12/26/85	One 55-gal drum	SCA Facility, Chicago, IL, for incineration
PCB capacitor carcasses	12/26/85	Three capacitors (two drums, 600 lb)	Rollins Environmental, Deer Park, TX, for shredding
1,500-gallon storage tank structure	12/26-31/85	One tank	Chemical Waste Management Landfill, Kettleman Hills, CA

Source: BPOI, 1986g

July 1986 stating that approximately 505 gallons of oil with a PCB concentration of 50,000 ppm was in storage in the 2B PCB Storage Area (BPOI, 1986h).

In January 1988, six drums of PCB-containing liquids and six cubic yards of PCB-containing solids were shipped off-site for disposal (BPOI, 1988g). The materials were transported off-site by Chemical Waste Management for final disposal.

4.2.1.2 Asbestos

Asbestos is present at NPRC in the insulation of process equipment at the 35R Gas Plant, in the wrapping used around underground pipelines, and in ancillary equipment in use at various well pads and tank settings throughout NPR-1 and 2. An area in the 2B Storage Yard in NPR-1 has been designated for the storage of suspected asbestos-containing materials. Materials are stored in the area until samples are analyzed and the fibers identified.

The asbestos program at NPR-1 is coordinated by the on-site Industrial Hygiene department of BPOI. The asbestos program consists of identifying asbestos or asbestos-containing materials and subsequently making a decision as to whether to remove the material and ship it off-site as a California hazardous waste. Suspect materials are either left in place and encapsulated to prevent deposition of fibers into the atmosphere or taken out of service and stored in the 2B Storage Yard suspect asbestos area to await analysis. If an underground pipe that needs replacing is wrapped with an asbestos-containing material, the pipe is abandoned in place and a new pipeline installed (Thomas, 1988).

The asbestos removal contractors who operate at NPR-1 are licensed by the State of California. Contractors must pass an examination administered by the state and have an ongoing training program in order to be licensed. The State of California supplies contractors with a list of landfills approved for the disposal of asbestos (Thomas, 1988).

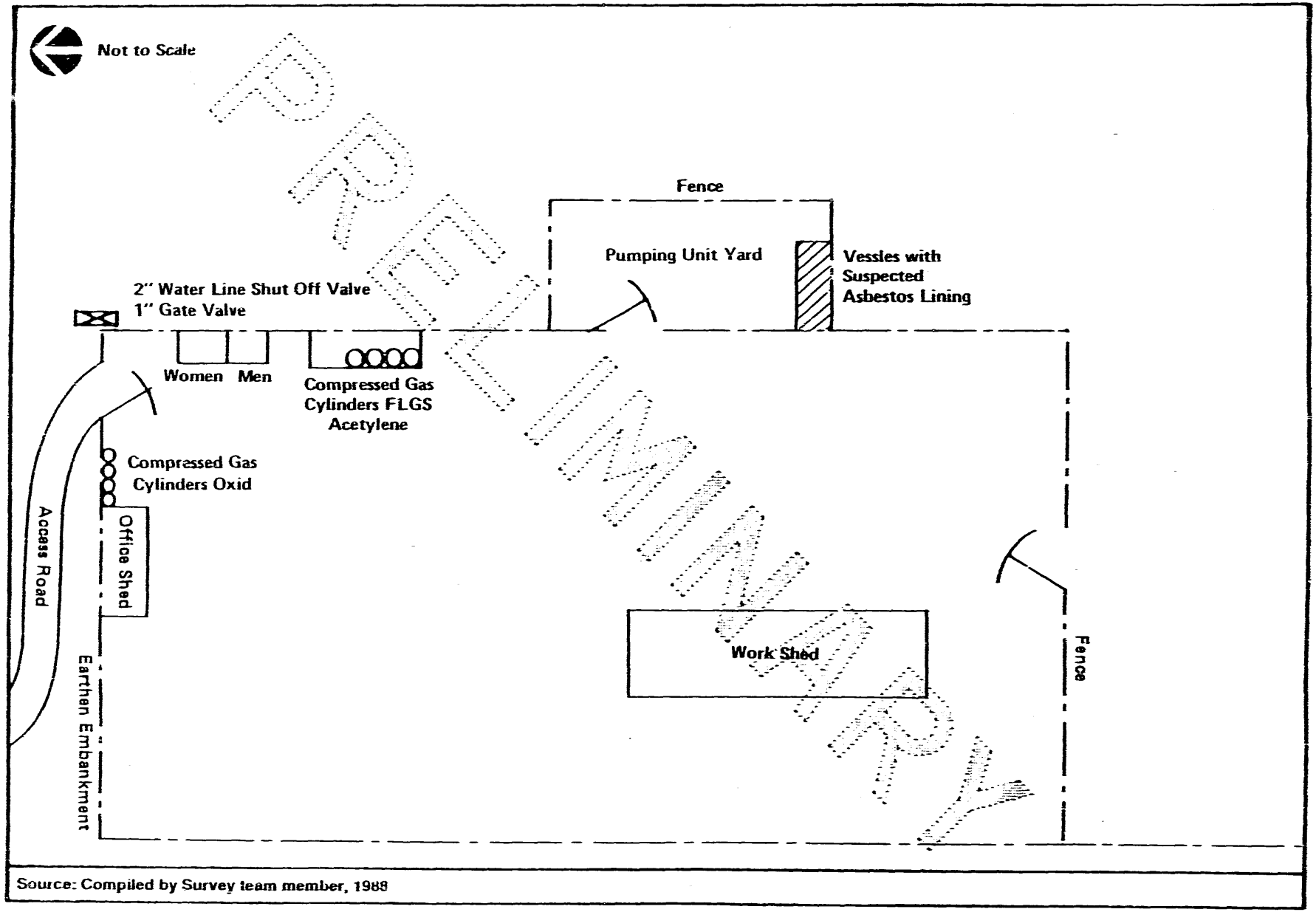
At the time of the Survey, Kern Environmental Services was the asbestos removal subcontractor for NPR-1. The lessees of DOE property in NPR-2 are responsible for coordinating asbestos removal from their respective leases. The Buena Vista Gas Plant, located in Section 8D and operated by Texaco, has asbestos insulation on

various pipe and process lines throughout the facility. Texaco had contracted with West Side Management, Inc., and APC Contractor, Inc., to handle asbestos removal from the gas plant (Texaco, 1986).

At the time of the Survey, BPOI had developed a specification for the removal of asbestos from the 35R Gas Plant on NPR-1. There are approximately 3,800 linear feet of pipeline in the 35 Gas Plant that have been identified as containing asbestos, along with the insulation on six columns and three heat exchangers (Thomas, 1988). All the asbestos in the plant has been identified and marked. Microanalytical Services, Inc., collected 636 bulk samples in October 1987 for asbestos analysis from the gas plant (Microanalytical Services, Inc., 1987). At the time of the Survey, BPOI was awaiting funding to implement the removal work at the 35R Gas Plant (Thomas, 1988).

For the asbestos analysis of miscellaneous samples, BPOI uses Fireman Fund Laboratories (FFL) located in San Francisco, California. FFL is certified by the state to do asbestos analysis. The miscellaneous samples are taken by BPOI Industrial Hygiene personnel (Hanna, 1988).

The area in the 2B Storage Yard used for the storage of suspected asbestos is an open area of approximately 15 feet by 15 feet (see Figure 4-3). The process equipment is stored on the ground, cordoned off and labeled with asbestos warning signs. Equipment stored in this area is not covered or protected from the weather. At the time of the Survey, several pieces of equipment in the storage area were confirmed to contain asbestos while other pieces were confirmed to be asbestos-free (Hanna, 1988). BPOI had not developed a timetable for the removal of the asbestos-contaminated equipment at that time. A review of the remainder of the 2B Storage Yard area was conducted during the Survey. Loose, white, fibrous materials and pipe wrap were noted on the ground in four locations in the southwestern portion of the storage yard. Safety Department personnel took samples of the materials for asbestos analysis. In October 1988, it was reported by BPOI personnel to the Survey team that the samples tested positive for asbestos and that a remediation effort was being planned. A review of site photographs of the 2B Storage Yard showed that the area containing the asbestos materials may have previously been used to store out-of-service process equipment.



Source: Compiled by Survey team member, 1988

LOCATIONS OF SUSPECTED ASBESTOS STORAGE AREAS

FIGURE 4-3

A review of NPRC hazardous waste manifests by the Survey team showed that in 1987 approximately 38 cubic yards of asbestos material was removed from NPR-1. As of April 13, 1988, 7 cubic yards of asbestos had been removed for 1988. The asbestos was disposed of in the Cold Canyon Landfill in San Luis Obispo, California (NPRC, 1988a). NPR-1 did not report shipping any asbestos off-site in 1985 (BPOI, 1986e). In 1986, Texaco shipped 17.5 tons of wetted asbestos, asbestos-contaminated solids, and protective clothing from the Buena Vista Gas Plant off-site as hazardous waste. Of this total amount, 17.2 tons were disposed of in the Cold Canyon Landfill and 0.3 ton went to Petroleum Waste, Inc., of Buttonwillow, California (Texaco USA, 1986).

4.2.1.3 Herbicides/Pesticides

Herbicides

NPR-1

Herbicides are currently used on NPR-1 in order to provide 3 years of protection against weed growth at well pads, tank settings, access roads, and other areas designated by NPRC management. This protection is necessary to provide safe access to designated areas, increase fire protection by preventing weed growth, and alleviate the need for costly and time-consuming mechanical removal of weeds on a yearly basis (BPOI, 1987a).

Management procedures for the use of herbicides and pesticides are detailed in the NPRC draft Environmental Protection and Compliance Plan, March 1986. The guidelines concerning herbicides and pesticides require that application be performed by trained personnel, that the materials being applied be registered with the U.S. EPA and that they be approved for use on NPRC by the Environmental Services Department and Safety Department of NPRC (BPOI, 1986c). It is the policy of BPOI that all herbicides and pesticides be used in a manner such as to minimize the environmental impact and afford maximum environmental protection to the threatened and endangered species on NPRC (BPOI, 1986c).

An overview of the current weed control program at NPR-1 is shown in Table 4-9. A total of 254 acres have been designated for herbicide applications in 1987/1988.

TABLE 4-9

CURRENT WEED CONTROL PROGRAM AT NPR-1

		Total Acreage
Shallow Oil Zone:		
484 SOZ Wells x .15 acre	=	72.6
31 SOZ tank settings x 0.5 acre	=	15.5
6 SOZ vapor recovery settings x 1 acre	=	6.0
25S SOZ Dehydration shipping and wastewater facility x 15 acres	=	15.0
23S SOZ Tank farm x 10 acres	=	10.0
SUBTOTAL	=	119.1
Stevens Oil Zone:		
191 STV wells x .30 acre	=	57.3
14 STV tank settings x 1.0 acres	=	14.0
23 Stevens condensate traps x 0.06 acre	=	1.4
SUBTOTAL	=	72.7
Stevens Zone Waterfloods:		
4 Waterflood pig launchers x 0.06 acre	=	0.24
33S Waterflood facility including electrical substation x 10 acres	=	10.00
SUBTOTAL	=	10.24
36S Area Buildings:		
36S Administration Building	=	20.0
SUBTOTAL	=	20.0
All Zones Ordinary Production:		
5M, 32S, 35S, Fresh Water locations including pump and tank locations 5 x .30 acres	=	1.5
2 Material Control locations (warehouse and storage yard)	=	20.0
SUBTOTAL	=	21.5
33S Compressor Station	=	10.0
SUBTOTAL	=	10.0
Carneros Well:		
1 well x .30 acre	=	.30
SUBTOTAL	=	.30
TOTAL	=	253.84

Source: BPOI, 1987a

The herbicides currently in use at NPR-1 are Hyvar X and Atrazine 80W (BPOI, 1987i). The herbicides are mixed with a dye, Rhodemine B, prior to application so that the treated areas are readily identifiable. Application rates are derived from manufacturers' recommendations and may reach 10 pounds of effective ingredient per acre (BPOI, 1987a).

A similar herbicide application project was conducted in 1986. The locations that were scheduled for treatment during this project are shown in Table 4-10. The effective chemicals applied at that time were atrazine and diuron (BC Laboratories, 1986). Records of the quantities that were applied were not kept but the subcontract required that the applicator mix the herbicide according to manufacturers' recommendation (BPOI, 1986c).

Herbicide applications are usually performed during the rainy season of late fall to early spring. This provides for sufficient rainfall prior to and following application and helps prevent wind-borne suspension of the materials into sensitive areas. Applicators are required to attend a pre-performance review with site personnel to review specific site requirements and demonstrate how they plan to comply with these requirements. The requirements include such items as filing the appropriate Material Safety Data Sheets (MSDSs) with the Environmental Services and Safety Departments; submitting a Health and Safety Plan for the project; and reviewing site-specific regulations for the disposal of excess material and equipment and areas to be treated or not to be treated. Once the pre-performance review is complete and any action items addressed, the project is approved to start.

NPR-2

A project to apply herbicides to eight drilling sites at Ford City (NPR-2) was initiated and completed in 1986. The eight drilling sites are owned by DOE but are situated in residential areas of Ford City. Applications were specified to provide weed control for 3 years and to provide safe access to the site, to provide fire protection, and to alleviate the need for mechanical removal of weeds on a yearly basis. Hyvar X was the herbicide used for this project (BPOI, 1986a). Documentation of a request for weed abatement services for the DOE property in Ford City in 1978 was available to the Survey.

TABLE 4-10

LOCATIONS OF HERBICIDE APPLICATIONS AT NPR-1 IN 1986

WELL LOCATIONS:	138.66 acres
A. 514 Shallow Oil Zone Wells @ 10,000 square feet each	118.00 acres
B. 90 Stevens Wells @ 10,000 square feet each	20.66 acres
TANK SETTINGS:	40 acres
A. 32 Shallow Oil Zone Tank Settings @ 1 acre each	32 acres
B. 1 Stevens Tank Setting @ 1 acre	1 acre
C. 7 Vapor Recovery (VT) Tank Settings @ 1 acre each	7 acres
SHIPPING STATIONS:	4 acres
2 Shipping Stations @ 2 acres each	
WASTEWATER DISPOSAL FACILITIES:	1 acre
1 Wastewater Disposal Facility @ 1 acre	
O-PSI COMPRESSOR STATION:	1 acre
1 O-PSI Compressor Station @ 1 acre	
GAS OPERATIONS COMPRESSOR STATION:	2 acres
1 Gas Operations Compressor Station @ 2 acres	
CONDENSATE TRAP LOCATIONS:	.63 acre
11 Condensate Trap Locations @ 2,500 square feet each	
PIG LAUNCHERS/RECEIVERS LOCATIONS:	.52 acre
9 Pig Launchers/Receivers Locations @ 2,500 square feet each	
BUILDING AREAS	5 acres
11G Administrative Building Area @ 5 acres	
TOTAL ACREAGE:	192.81 acres

Source: BPOI, 1986a

Prior to 1986, records and documentation of herbicide applications are minimal. A review by the Survey team of available documentation concerning environmental aspects of NPRC prior to 1986 determined that weed control programs have been in place since 1982 and that Hyvar X was the herbicide used. Information concerning quantities applied, locations, and pertinent site requirements was not found during the review.

Pesticides

NPR-1

Pesticides are currently used at NPR-1 for the control of ants, roaches, mice, spiders, silverfish, and the sugar beet leafhopper. A licensed subcontractor provides monthly pest control services for designated facilities and buildings, and the California Department of Food and Agriculture annually applies malathion to selected areas in NPR-1 for the control of the sugar beet leafhopper.

The NPRC policies and procedures for pesticide usage follow those for herbicides. Applications are to be made by licensed applicators, materials are to arrive at NPRC pre-mixed, excess material must be taken off-site for disposal, and the applicators must report any spills or releases of material to both the Environmental Services Department and the Safety Department.

The current (1988) pesticide contractor for NPR-1 is Dewey Pest Control of Bakersfield, California (BPOI, 1987i). Dewey provides monthly services at the following locations:

- 11G Administration Building (and trailers)
- 35R Area
- 36S Area
- 36R Area Foreman's Building (and trailers)
- 35R and 36R Area Warehouses
- 36S Area Garage
- Security Guard Shacks.

The materials used are Ficam W®, Diazinon®, and Dursban L.O.® (BPOI, 1987b). Due to the toxicity of these materials to birds and other wildlife, use is restricted for inside or under buildings and is not to exceed a distance of 6 feet from any building foundation. If the materials are to be applied inside a building, the application is to be conducted when the building is not occupied, either after business hours or on weekends (BPOI, 1987h).

The previous pesticide subcontractor was Clarke Pest Control. Documentation reviewed by the Survey team showed that Clarke Pest Control used malathion and Sevin® on trees on NPR-1, Ficam W® for inside applications, and diazinon for exterior applications. Documentation concerning the length of time that Clarke Pest Control performed work at NPR-1 was not available for review.

The California Department of Food and Agricultural (CDFA) has been spraying pesticides on selected areas of NPR-1 since 1973 in order to eradicate the sugar beet leafhopper, which is a carrier for the curly-top virus (UC Davis, 1973). The areas that have been sprayed are generally in the east, southeast, and southern portions of NPR-1. Occasionally, sections in the western portions of NPR-1 are treated. The applications occur once a year and consist of 8 ounces of malathion per acre (BPOI, 1987c). Applications generally occur in October or March, or both, depending on the leafhopper density and virulence. The virulence of the curly-top virus varies from year to year as does the size of the insect population. Annual infestations do not always become serious enough to warrant spraying (BPOI, 1987c). A review of documentation by the Survey team concerning the CDFA spraying program discerned no information as to the years in which applications have not occurred.

In 1985, the U.S. Fish and Wildlife Service (FWS) issued a non-jeopardy decision regarding the spraying of malathion onto habitat of the blunt-nosed leopard lizard and giant kangaroo rat (DOI, 1985). Several recommendations were included in the decision and these have been incorporated into the spraying program. These recommendations include information on application rates and methods, species field surveys, and event reporting.

At the time of the Survey, there was no information available concerning the use of pesticides on DOE lands on NPR-2. The use of pesticides on these lands is the responsibility of the lessee and there is no requirement for reporting applications to DOE.

4.2.1.4 Storage Tanks

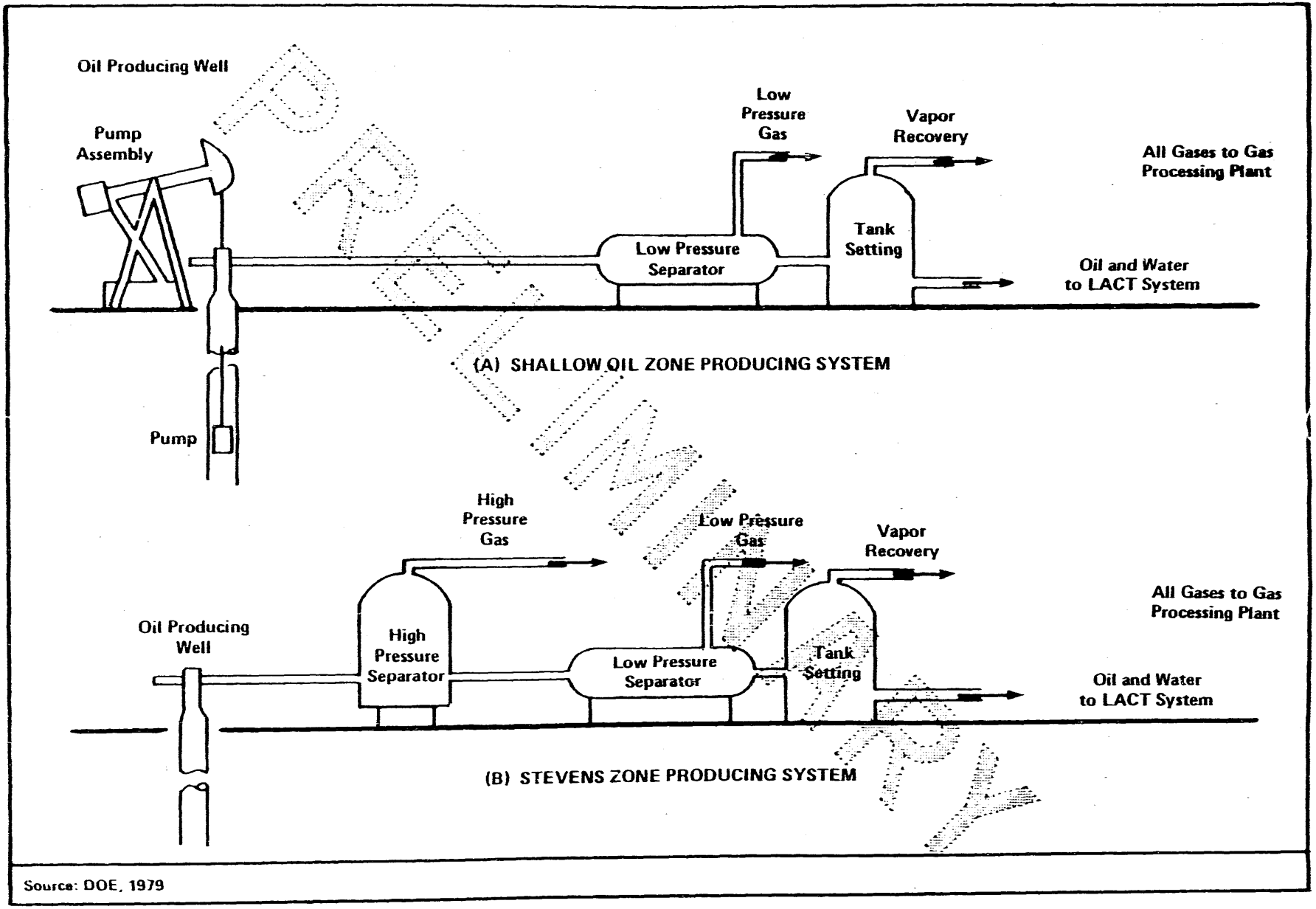
Aboveground Storage Tanks

Aboveground storage tanks (ASTs) are in use at the NPRC for storing crude oil, produced water, gasoline, and waste oil. The majority of the ASTs are situated in tank settings. Tank settings separate the gas and oil that are coproduced from oil-producing zones. Most tank settings have one or more gas-liquid separators. The oil/water liquids are stored in fixed roof tanks prior to being sent to the dehydration/Lease Automated Custody Transfer (LACT) facilities. Tank settings can include from one to three storage tanks for liquids. Typical tank setting configurations are shown in Figure 4-4.

Dehydration/LACT facilities receive oil/water liquids from the tank settings, separate the liquids, store product oil, and provide for the unattended transfer of oil from the run tank to trucks and/or pipelines. A typical dehydration/LACT facility consisting of wash, settling, and shipping or run tanks is shown in Figure 4-5.

The wash and settling tanks provide time for the separation of oil, water, and sediment due to varying specific gravities. Oil floats to the top of the mixture due to its lower specify gravity, and sediment settles to the tank bottom due to its higher specific gravity. Product oil is transferred to the shipping tank prior to being sold. Wastewater is drained from the tank bottoms and returned to injection wells and evaporation/percolation sumps for disposal. Sediment is removed when tanks are taken out of service for cleaning.

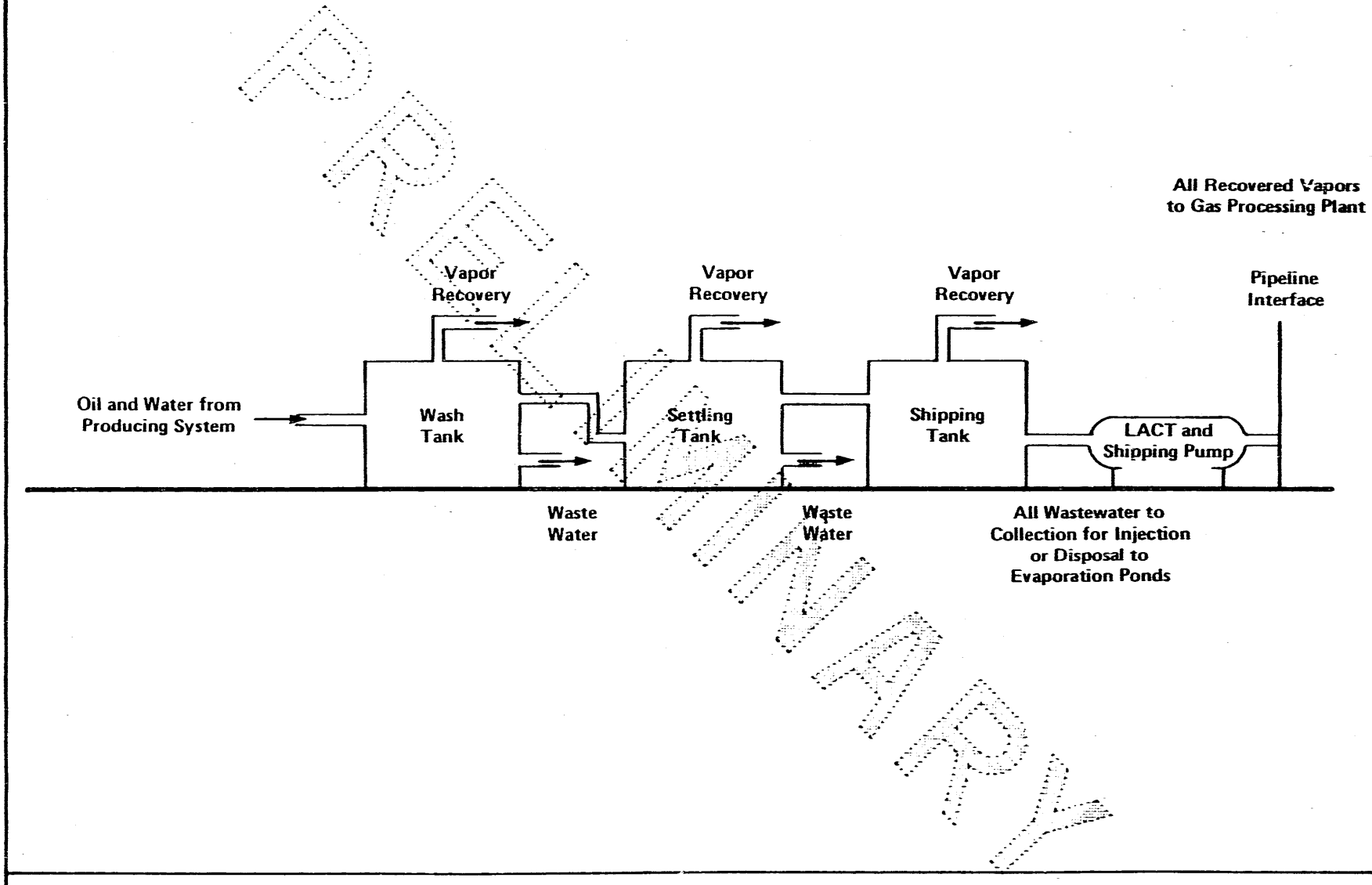
At the time of the Survey, there were 79 permitted tank settings and 5 dehydration/LACT facilities on NPR-1 (KCAPCD, 1987b). There are 34 tank settings on leased DOE property on NPR-2 (BPOI, 1986d). There are a number of abandoned



Source: DOE, 1979

GAS/OIL SEPARATION SYSTEMS AND TANK SETTINGS

FIGURE 4-4



Source: DOE, 1979

LACT SYSTEM

FIGURE 4-5

or removed tank setting locations on NPR-1. Information derived from the NPR Chemical Inventory and Site Maps indicated that there are 31 tank settings that have been abandoned in place or removed. This information could not be confirmed through other documentation reviewed by the Survey team. A listing of the permitted tank settings is presented in Table 4-11. A listing of the abandoned or removed tank settings is presented in Table 4-12. A listing of the tank settings on DOE leased land that are active or abandoned on NPR-2 is shown in Table 4-13.

The capacity of tanks in tank settings generally ranges from 250 to 2,000 barrels of oil (1 barrel of oil equals 42 gallons of oil). Several tank settings were reviewed by the Survey team, including the 2-17R Stevens, 2-3G Stevens, and 1-2G Stevens tank settings on NPR-1 and the #3 and #4 tank settings in Section 28B of NPR-2. Pollution controls consisted of overflow tanks connected to the storage tanks. None of the tanks reviewed had secondary containment. A spill event occurred at the 2-3G tank setting immediately prior to the Survey review of the location. The contents of the overflow tank (approximately 50-75 barrels of crude oil) were released when the tank was filled beyond capacity. Since there was no secondary containment at this tank setting, the released crude oil began to migrate downslope and traveled approximately 150 feet before the release was discovered and remediation efforts began.

Dehydration/LACT facilities are located in Sections 18G, 25S, 24Z, 26Z, and 10G. The facilities are located downslope from tank settings in order to take advantage of gravity and lessen pump activity. These facilities consist of large-capacity storage tanks, generally 16,000 barrels (672,000 gallons), and at least two of these large-capacity tanks are at each facility. The 18G dehydration/LACT facility consists of 19 tanks, with the largest having a capacity of 30,000 barrels (1,260,000 gallons) and the remaining tanks all at 16,000-barrel capacity. As mentioned previously, a dehydration train consists of wash, settling, and shipping tanks in series. The 18G facility consists of six dehydration trains and a separate, large (30,000 barrels) tank which feeds the crude oil to the six trains. The 25S dehydration/LACT facility consists of six tanks with two being inactive due to leakage. The active tanks consist of a 20,000-barrel wash tank, a 31,000-barrel settling tank, a 31,000-barrel shipping tank, and a 35-barrel overflow tank. This facility is located approximately one-half mile from the NPRC boundary and the California Aqueduct. Earthen berms are in place for the dehydration train. The 24Z dehydration/LACT facility consists of four

TABLE 4-11

PERMITTED TANK SETTINGS ON NPR-1

Tank Setting	Tank size		Tank Setting	Tank Size	
	Barrels	Gallons		Barrels	Gallons
3-33S	500	21,000	2-36R	1,000	42,000
	500	21,000		500	21,000
	35	1,470		500	21,000
2-4G	1,000	42,000		100	4,200
	1,000	42,000		35	1,470
	500	21,000	3-30S	500	21,000
	35	1,470		500	21,000
4-34S	1,000	42,000		35	1,470
	500	21,000		35	1,470
	500	21,000	1-31S	500	21,000
	35	1,470		500	21,000
3-35S	2,000	84,000		35	1,470
	1,000	42,000	3-31S	500	21,000
	500	21,000		500	21,000
	500	21,000		500	21,000
	500	21,000		35	1,470
	35	1,470	2-31S	500	21,000
1-25R	1,000	42,000		500	21,000
	500	21,000		35	1,470
	35	1,470	1-32S	500	21,000
3-25R	1,000	42,000		500	21,000
	500	21,000		35	1,470
	500	21,000	3-32S	500	21,000
	35	1,470		500	21,000
2-25R	500	21,000		35	1,470
	500	21,000	4-32S	1,000	42,000
	35	1,470		500	21,000
4-25R	500	21,000		35	1,470
	500	21,000	4-26R	2,000	84,000
	35	1,470		2,000	84,000
1-26R	2,000	84,000		35	1,470
	1,000	42,000	1-29R	1,000	42,000
	500	21,000		500	21,000
	500	21,000		35	1,470
	500	21,000	2-30R	500	21,000
	500	21,000		500	21,000
	35	1,470		35	1,470
2-26R	2,000	84,000	4-19R	1,000	42,000
	500	21,000		500	21,000
	35	1,470		35	1,470
4-23R	500	21,000	3-19R	500	21,000
	500	21,000		500	21,000
	35	1,470		35	1,470
1-34R	500	21,000	1-24Z	1,000	42,000
	500	21,000		1,000	42,000

TABLE 4-11

PERMITTED TANK SETTINGS ON NPR-1 (Continued)

Tank Setting	Tank Size		Tank Setting	Tank Size	
	Barrels	Gallons		Barrels	Gallons
	35	1,470		35	1,470
4-28R	1,000	42,000	3-15R	2,000	84,000
	500	21,000		500	21,000
	35	1,470	4-16R	1,000	42,000
2-33R	500	21,000		1,000	42,000
	500	21,000		35	1,470
	35	1,470	4-3G	500	21,000
1-33R	1,000	42,000		500	21,000
	500	21,000		100	4,200
	35	1,470	1-8G	500	21,000
3-28R	1,000	42,000		500	21,000
	500	21,000		100	4,200
	35	1,470	4-8G	500	21,000
4-29R	500	21,000		500	21,000
	500	21,000		500	21,000
	35	1,470		100	4,200
3-9G	500	21,000	4-36S	500	21,000
	500	21,000		500	21,000
	500	21,000		100	4,200
	100	4,200	3-6G	500	21,000
4-10G	500	21,000		500	21,000
	500	21,000		250	10,500
	500	21,000		100	4,200
	100	4,200	1-7R	2,000	84,000
3-11G	1,000	42,000		2,000	84,000
	1,000	42,000		750	31,500
	1,000	42,000		500	21,000
	100	42,000	4-24Z	500	21,000
1-12G	500	21,000		2,000	84,000
	35	1,470		2,000	84,000
	35	1,470		100	4,200
3-21S	500	21,000	4-24Z SOZ	500	21,000
	500	21,000	2-3G	1,000	42,000
	100	4,200		500	21,000
3-25S	500	21,000		35	1,470
	500	21,000		35	1,470
	100	4,200	1-3G	1,000	42,000
4-28S	500	21,000		500	21,000
	500	21,000		35	1,470
	500	21,000	3-34S	1,000	42,000
	100	4,200		500	21,000
3-27S	1,000	42,000		500	21,000
	1,000	42,000		35	1,470
	100	4,200	4-33S	500	21,000
4-26S	500	21,000		1,000	42,000
	500	21,000		35	1,470
	500	21,000	3-8R	500	21,000
	100	4,200		5,200	218,400

TABLE 4-11

PERMITTED TANK SETTINGS ON NPR-1 (Continued)

Tank Setting	Tank Size		Tank Setting	Tank Size	
	Barrels	Gallons		Barrels	Gallons
1-4G	1,000	42,000		5,200	218,400
	1,000	42,000		35	1,470
	500	21,000	1-17R	500	21,000
	35	1,470		5,200	218,400
2-5G	500	21,000		4,500	189,000
	500	21,000	2-17R	500	21,000
	500	21,000		3,000	126,000
	35	1,470		5,200	218,400
1-5G	500	21,000	3-26R	500	21,000
	500	21,000		2,000	84,000
	500	21,000		2,000	84,000
	500	21,000		100	4,200
	35	1,470	2-27R	500	21,000
4-31S	500	21,000		2,000	84,000
	500	21,000		2,000	84,000
	500	21,000		100	4,200
	35	1,470	2-35R	500	21,000
1-2G	1,000	42,000		2,000	84,000
	500	21,000		2,000	84,000
	35	1,470		100	4,200
	35	1,470	4-35R	1,000	42,000
1-36R	2,000	84,000		2,000	84,000
	1,000	42,000		100	4,200
	500	21,000	4-29R	500	21,000
	500	21,000		500	21,000
	35	1,470		35	1,470
2-30R	250	10,500	2-33R	500	21,000
	35	1,476		500	21,000
1-35R	1,000	42,000		35	1,470
	35	1,470	2-36R	500	21,000
3-34R	500	21,000		500	21,000
	500	21,000		35	1,470
	35	1,470	4-14B	1,000	42,000
1-35R	500	21,000		90	3,780
1-36R	500	21,000	3-28R	500	21,000
	35	1,470		500	21,000
	500	21,000		1,000	42,000
	35	1,470		35	1,470
			35R Gas Plant	1,400	58,800
				1,400	58,800
				1,400	58,800
				1,400	58,800
			2-29R	500	21,000
				500	21,000
				35	1,470

Source: KCAPCD, 1987b

TABLE 4-12

ABANDONED OR REMOVED TANK SETTINGS ON NPR-1

Tank Setting	Status
3-24R	3 tanks abandoned in place
3-27S	1 tank abandoned in place
4-27S	Tank removed
4-28S	3 tanks abandoned in place
4-29S	2 tanks abandoned in place
1-33S	1 tank abandoned in place
2-33S	Tanks removed
1-34S	2 tanks abandoned in place
2-34S	Tanks removed
1-35S	Tanks removed
2-35S	1 tank abandoned in place
4-35S	Tanks removed
1-36S	1 tank abandoned in place
3-36S	Tanks removed
1-1B	2 tanks abandoned in place
2-1B	3 tanks abandoned in place
1-1G	Tanks removed
3-1G	2 tanks abandoned in place
2-2G	Tanks removed
3-2G	3 tanks abandoned in place
4-2G	1 tank abandoned in place
2-4G	3 tanks abandoned in place
3-4G	4 tanks abandoned in place
4-5G	2 tanks abandoned in place
4-6G	2 tanks abandoned in place
2-8G	2 tanks abandoned in place
3-9G	1 tank abandoned in place
4-9G	1 tank abandoned in place
1-10G	3 tanks abandoned in place
3-11G	Tanks removed

Source: BPOI, 1988e

TABLE 4-13

TANK SETTINGS ON DOE LEASES ON NPR-2

Section	Leasee	Tank Setting	Status
20B	Texaco ARCO	1 3	Active 2-Active 1 abandoned
28B	Chevron Phillips Texaco	1 4 1	Active Active Abandoned
22B	Texaco Chevron	1 1	Abandoned Active
26B	Chevron Texaco	2 1	Active Active
34B	Texaco Union Oil	1 1	Abandoned Abandoned
30G	Phillips	1	Active
32G	Phillips Mobil	1 1	Active Active
2D	Chevron Texaco	2 1	Active Abandoned
12D	Texaco	1	Abandoned
14D	Texaco	4	Active
18D	Chevron	1	Abandoned
12C	Chevron	1	Active
8D	Texaco	1	Active
6D	Texaco	3	Active

Source: BPO, 1986d

active tanks, two 16,000-barrel wash tanks, one 16,000-barrel settling tank, and a 16,000-barrel shipping tank. The facility is surrounded by an earthen berm. The 26Z dehydration/LACT facility consists of three tanks, two of which are active. Both active tanks have 1,000-barrel capacities and the inactive tank has a 2,000-barrel capacity. There are no berms or dikes at this facility. The 10G dehydration/LACT facility consists of three active 16,000-barrel-capacity tanks. The facility is built into a hillside with earthen berms on three sides with the remaining side open. A summary of the NPR-1 dehydration/LACT facilities is presented in Table 4-14.

There are five large, inactive crude oil ASTs in the western portion of Section 18G. These tanks were constructed in 1978 and only one has ever been used. All the tanks are built of steel and have 246,960-barrel (10,372,320-gallon) capacities. At the time of the Survey, these tanks were inactive due to leaks. There are earthen berms surrounding the tanks.

There are several additional locations on NPR-1 and NPR-2 where ASTs are used for the storage of products, engine fuels, process lubricants, process coolants, and waste oils. At the western boundary of both LTS-1 and LTS-2 are tank locations that contain six ASTs. The materials in these tanks include diesel fuel, glycol, coolant, lube oil, cylinder lube oil, and engine lube oil. A listing of these tanks is presented in Table 4-15 and their locations are shown in Figure 4-6. The tanks are situated on gravel inside a secondary containment structure constructed of cinder blocks. In the southwest corner of each containment structure is a manually operated valve through which precipitation can be drained. Most of the gravel inside the secondary containments at both LTS-1 and 2 was oil-stained and oil appeared to have penetrated through the walls or traveled beneath the walls and stained the soil outside the containment. At LTS-1, an area adjacent to the drain valve, outside the containment, was freshly stained with oil.

There are five ASTs located at the 35R Gas Plant. A listing of the ASTs is presented in Table 4-16 and their locations are shown in Figure 4-7. None of the ASTs in the 35R Gas Plant had secondary containment. The triethylene glycol storage tank, at the eastern side of the plant, is situated approximately 100 feet from a storm drain.

Two ASTs are located in Section 36S and one in Section 36R. A listing of these tanks is presented in Table 4-17. In Section 36S, there is an 8,000-gallon gasoline storage

TABLE 4-14

NPR-1 DEHYDRATION/LACT FACILITIES

Section	Tank Number (UNX)	Tank Capacity		Age (yrs.)	Secondary Containment
		Barrels	Gallons		
18G	52127	30,000	1,260,000	13	yes
	15624	16,000	672,000	13	yes
	15633	16,000	672,000	13	yes
	12258	16,000	672,000	13	yes
	11465	16,000	672,000	13	yes
	11107	16,000	672,000	13	yes
	11112	16,000	672,000	13	yes
	15625	16,000	672,000	13	yes
	15634	16,000	672,000	13	yes
	12259	16,000	672,000	13	yes
	11466	16,000	672,000	13	yes
	11108	16,000	672,000	13	yes
	11111	16,000	672,000	13	yes
	15626	16,000	672,000	13	yes
	15635	16,000	672,000	13	yes
	12260	16,000	672,000	13	yes
	11467	16,000	672,000	13	yes
	11109	16,000	672,000	13	yes
	11110	16,000	672,000	13	yes
25S	371	31,000	1,302,000		yes
	372	31,000	1,302,000		yes
	373	20,500	861,000	unk	yes
	374	20,500	861,000		yes
	375	20,500	861,000		yes
	16227	35	1,470		
24Z	11468	16,120	677,040	13	yes
	11469	16,120	677,040	13	yes
	11470	16,120	677,040	13	yes
	50539	16,000	672,000	6	yes
26Z	12465	1,000	42,000		no
	12464	1,000	42,000	unk	no
	12462	2,000	84,000		no, inactive
10G	11103	16,120	677,040	15	yes, inadequate
	11104	16,120	677,040	15	yes, inadequate
	11105	16,120	677,040	15	yes, inadequate

Source: Compiled by Survey team member, 1988

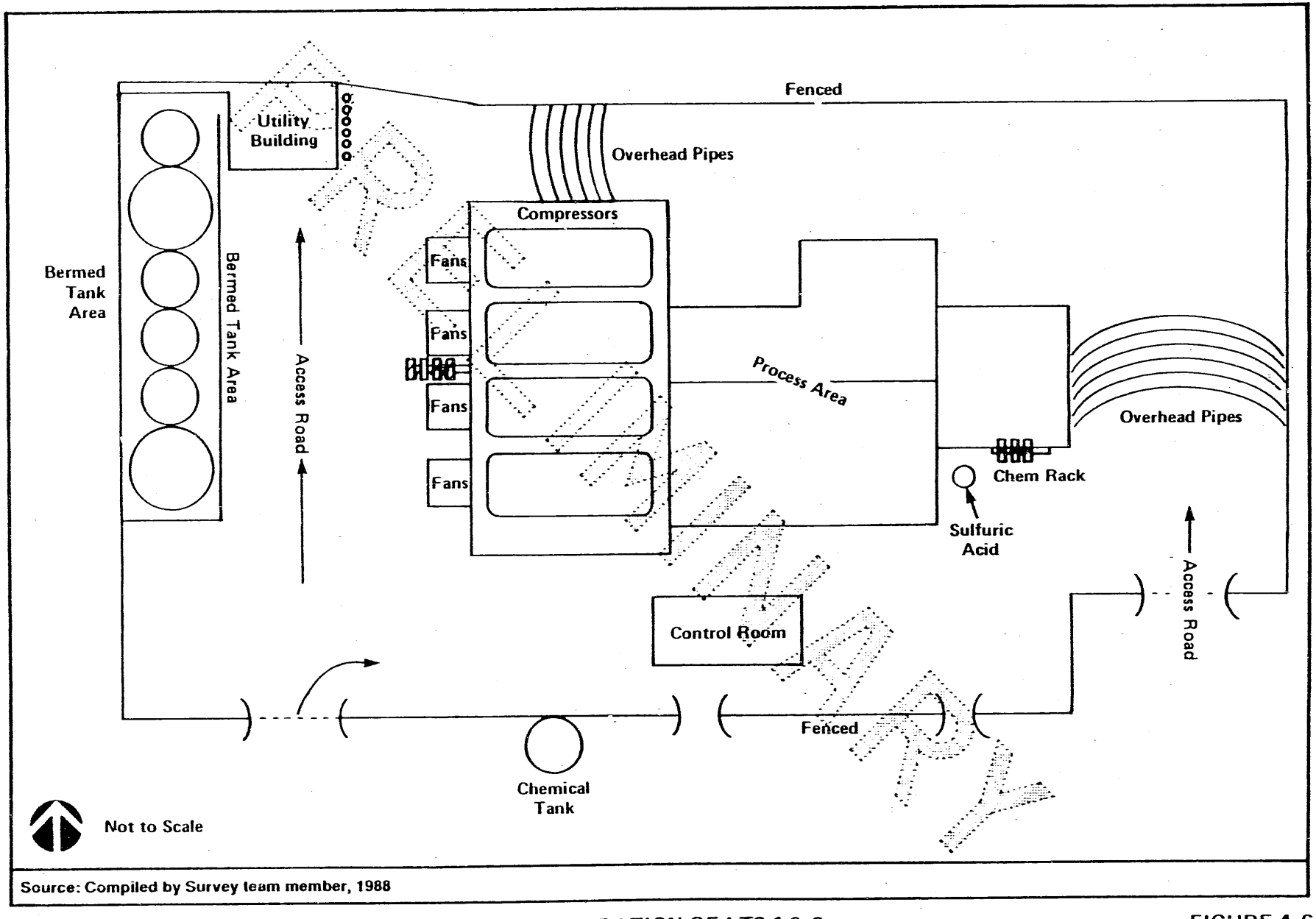
TABLE 4-15

ABOVEGROUND STORAGE TANKS AT LTS-1 and 2*

Unit Number	Material	Capacity (Gallons)
42-502	Diesel Fuel	2,000
42-301	Glycol	2,000
42-269	Coolant Storage	10,000
42-268	Lube Oil	5,000
42-266	Cylinder Lube Oil	2,000
42-265	Engine Lube Oil	5,000

Source: Compiled by Survey team member, 1988

* LTS-1 and 2 each have a set of the above-mentioned tanks



Source: Compiled by Survey team member, 1988

CONFIGURATION OF LTS 1 & 2

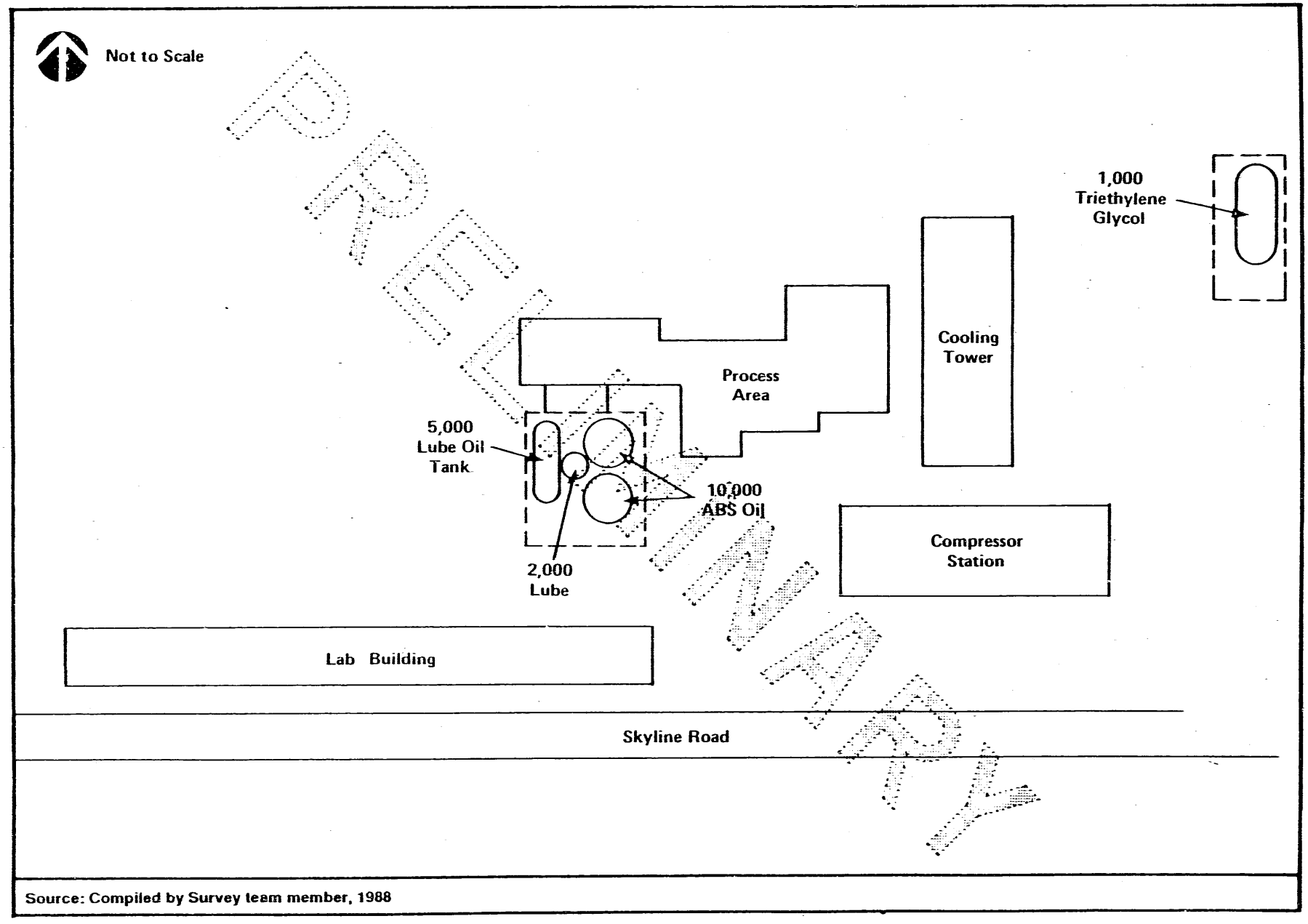
FIGURE 4-6

TABLE 4-16

ASTs AT THE 35R GAS PLANT

Material	Tank Capacity (Gallons)	Secondary Containment
Triethylene Glycol	1,000	No
Absorption Oil (Kerosene)	10,000	No
Absorption Oil (Kerosene)	10,000	No
Lube Oil	2,000	No
Lube Oil	5,000	No

Source: BPOI, 1988e



Source: Compiled by Survey team member, 1988

35R GAS PLANT ABOVEGROUND STORAGE TANKS

FIGURE 4-7

TABLE 4-17

ASTs FOR GASOLINE AND WASTE OIL ON NPR-1

Section	Facility	Material	Capacity (gal)	Age (yrs)	Adequate Secondary Containment
36S	Warehouse	Gasoline	8,000	1	yes
36R	Warehouse	Gasoline	8,000	1	yes
36s	Garage	Waste Oil	1,000	1	yes

Source: Compiled by Survey team member

tank at the warehouse facility. This tank has secondary containment constructed of cinder block walls with cement flooring. There is an AST at the 36S Garage area for waste oil. This tank has a surrounding earthen berm for secondary containment. There is an additional 8,000-gallon gasoline AST at the 36R warehouse area. This tank has secondary containment of cinder block walls and cement flooring.

There are seven ASTs located at the Texaco Gas Plant in Section 8D of NPR-2. Two of these ASTs are utilized for the storage of process oils. Both tanks are steel construction of unknown age. There are secondary containment structures surrounding both of the ASTs. Five ASTs, with a combined capacity of approximately 45,000 gallons, contain natural gasoline produced by the plant. Texaco personnel indicated that these tanks are more than 25 years old. There is no secondary containment for these tanks. A diesel fuel AST and a solvent AST are located adjacent to the Texaco Gas Plant and situated on a small rise. Both tanks are steel construction of unknown age and neither has secondary containment. Stained soil was visible downslope from these ASTs.

Three ASTs are located at the ARCO compressor plant in Section 20B of NPR-2. Two of the tanks contain lube oils. There is no secondary containment for either tank and large stained soil areas are evident. A 100-gallon glycol tank is also at the plant. This tank, of unknown age, does not have secondary containment.

Underground Storage Tanks

NPR-1

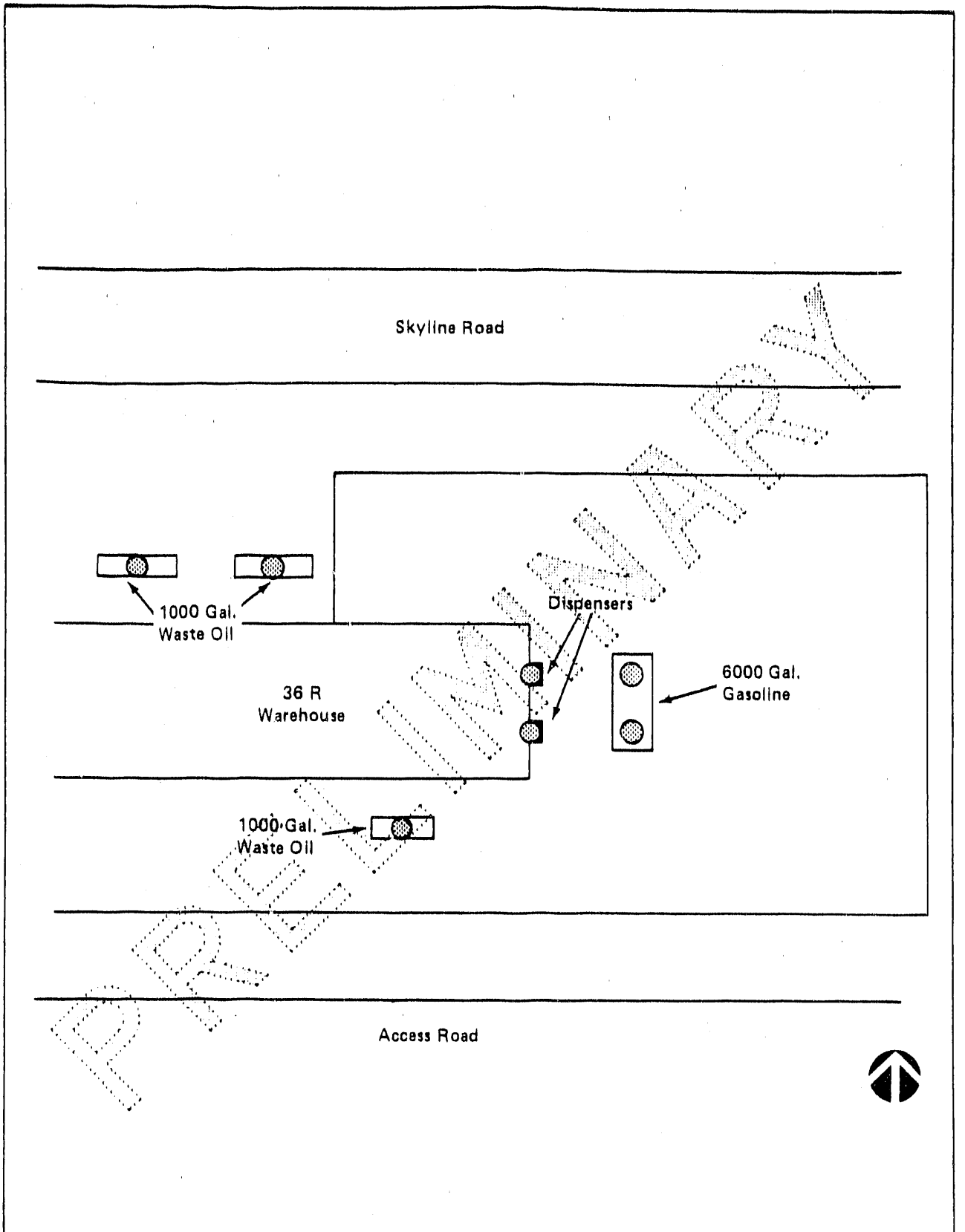
At the time of the survey, there were no operational underground storage tanks (USTs) at NPR-1. In February 1987, 10 storage tanks were removed from three locations on NPR-1, as depicted in Table 4-18 and Figures 4-8, 4-9, and 4-10. The storage tanks removed included four underground tanks for the storage of unleaded gasoline and six tanks for the storage of waste oils. Two of the three waste oil tanks at the 36R Warehouse were never used and were out of service at the time of removal (BPOI, 1987e). The third waste oil UST at the 36R warehouse was empty and out of service at the time of removal but had been used in the past for an unspecified time period to contain waste oils, waste solvents, and water (BPOI, 1987e). The four gasoline storage tanks were all in service at the time of

TABLE 4-18

UNDERGROUND STORAGE TANKS REMOVED FROM OPERATION IN 1987

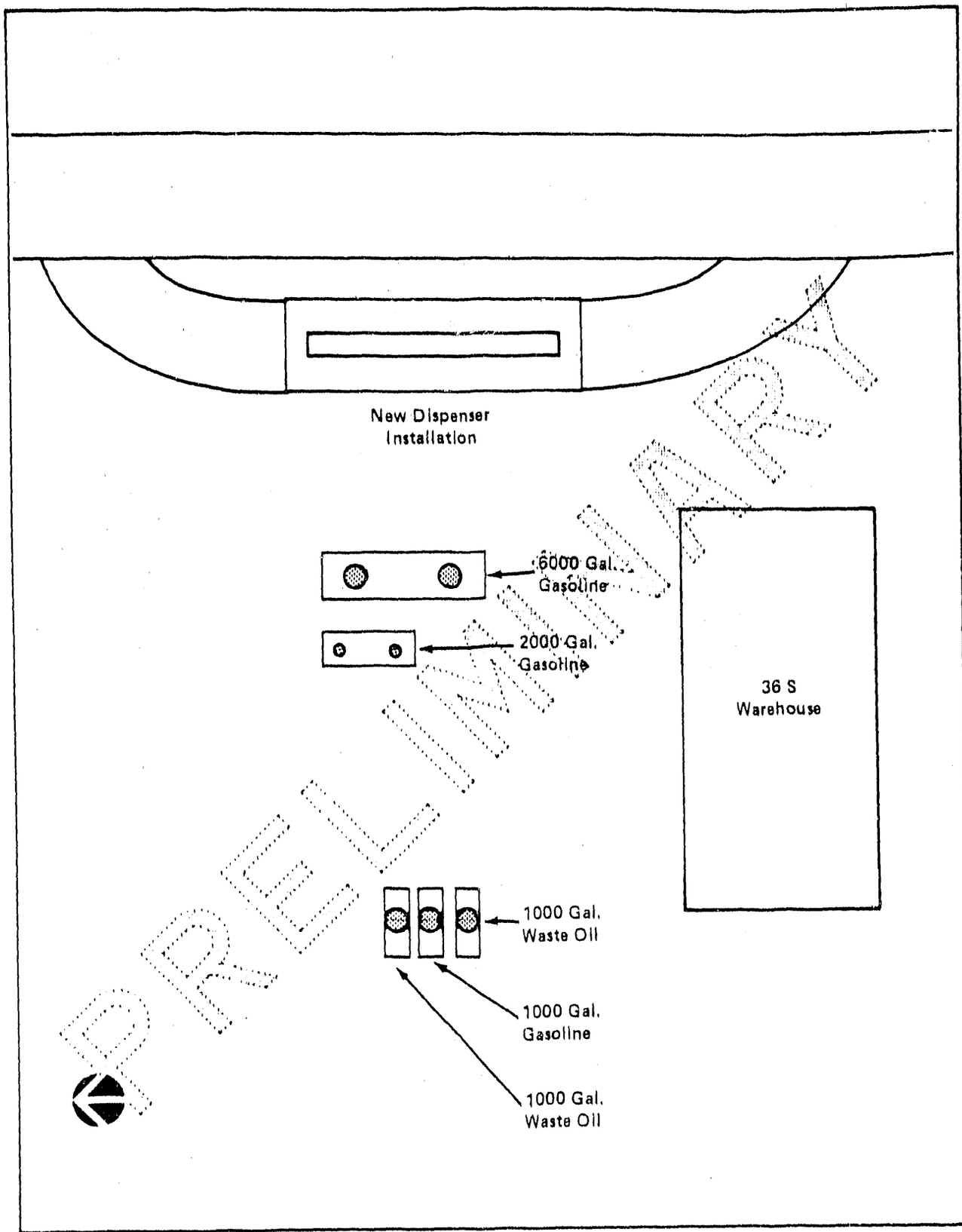
Area	Material	Capacity (gal)	Construction	Age (yrs)	Comments
36S Warehouse	Gasoline	6,000	Unknown	11	Possible Leak
	Gasoline	2,000	Carbon Steel	11	Possible Leak
	Gasoline	1,000	Carbon Steel	11	Possible Leak
	Waste Oil	1,000	Unknown	33	Possible Leak
	Waste Oil	1,000	Unknown	Unknown	Possible Leak
36R Warehouse	Gasoline	6,000	Unknown	7	
	Waste Oil	1,000	Carbon Steel	7	Never Used
	Waste Oil	1,000	Unknown	7	Never Used
	Waste Oil	1,000	Unknown	1	
36S Garage	Waste Oil	1,000	Carbon Steel	7	

Source: (Golden State Environmental Services, 1988; UST Permits BPOI, 1985, BPOI, 1987e)



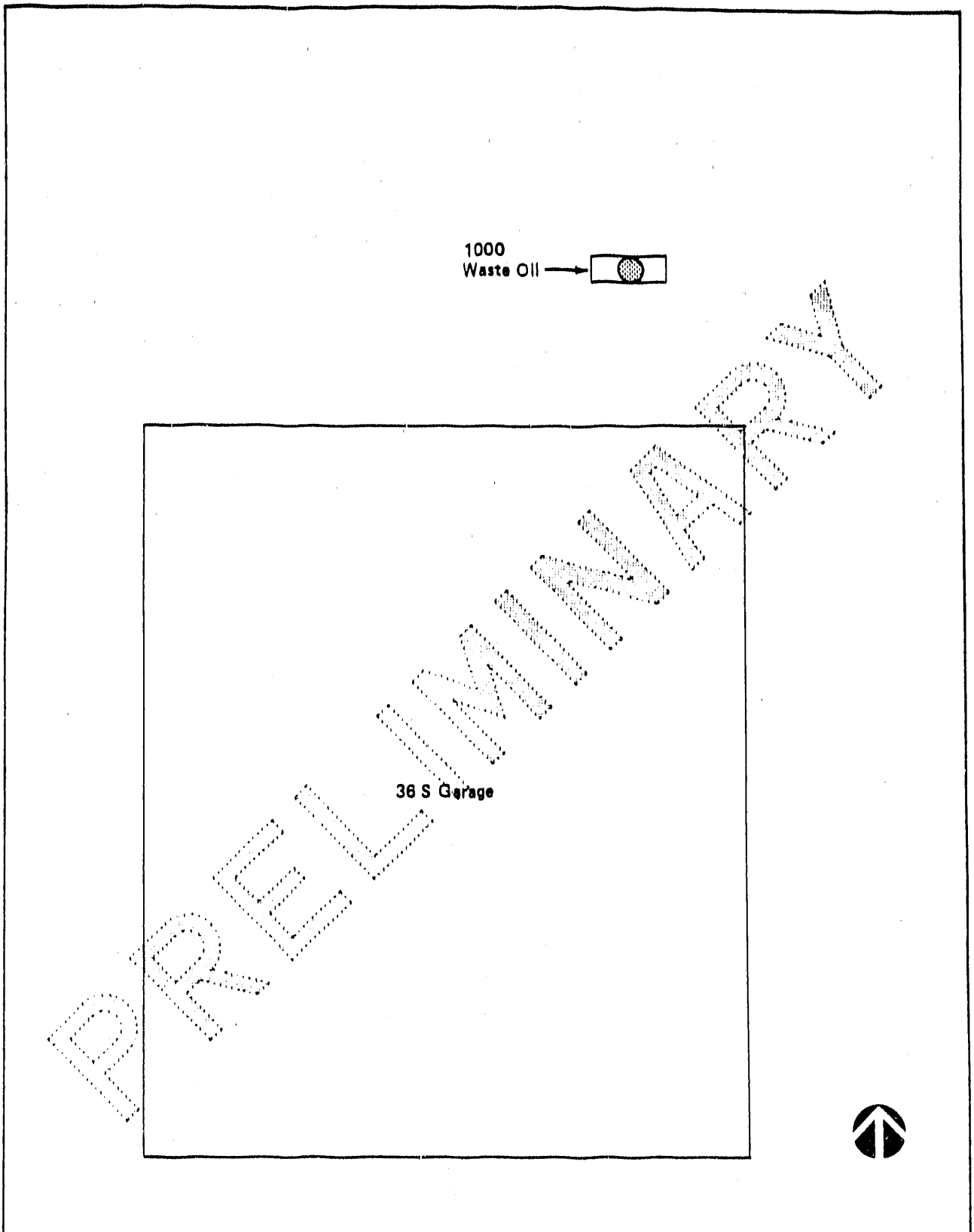
Source: Golden State Environmental Services, 1988

LOCATION OF USTs AT 36 R WAREHOUSE FIGURE 4-8



Source: Golden State Environmental Services, 1988

LOCATION OF USTs AT 36 S WAREHOUSE FIGURE 4-9



Source: Golden State Environmental Services, 1988

LOCATION OF UST AT 36 S GARAGE FIGURE 4-10

removal and had to be pumped out prior to removal. The two waste oil USTs at the 36S Warehouse were in service at the time of removal, as was the waste oil UST at the 36S Garage.

Soil samples were obtained during excavation of the tanks and data showed that the USTs at the 36S Warehouse had leaked (Golden State Environmental Services, 1988). A more detailed discussion of the leakage from these tanks is presented in Section 4.5.

During the operational tenure of the gasoline tanks, they were monitored daily for liquid level by "sticking", which entails measuring the liquid level in the tank on a calibrated pole and calculating the tank volume. Permanent records of the daily tank volumes were not maintained (Environmental Services Department personnel, 1988).

Tank tightness testing was performed on the 6,000-gallon gasoline UST at the 36S Warehouse in 1984. At that time, no leaks were found (UST Permit Application BPOI, 1985). Tightness testing of the buried waste oil line from the 36S garage to the waste oil UST was performed in January 1988. At the time, no leaks were found (Liquid Construction, Inc., 1988).

NPR-2

Texaco maintains an underground gasoline storage tank in Section 8D of NPR-2. This tank has a 2,000-gallon capacity and is of unknown age and construction. It was reported to the Survey by Texaco personnel that the tank was pressure-tested in 1987 and passed.

4.2.1.5 Toxic and Process Chemicals

Chemicals are used extensively at NPRC for the operation and maintenance of process equipment and facilities. BPOI, as the site management contractor, is responsible for implementing and maintaining NPR-1's management strategy for these chemicals. The main component of this strategy is the Hazard Communication Program. The Safety Department is responsible for inspections, documentation, training, and subcontractor compliance issues with regard to the Hazard

Communication Program. Each subcontractor that brings chemicals on-site is required to submit to BPOI a written Hazard Communication Program plan, a Spill Prevention Control and Countermeasures (SPCC) plan, and MSDSs, for the chemicals used on-site (Safety Department personnel, 1988). BPOI's Hazard Communication Program consists of maintaining an up-to-date MSDS file and training employees on various aspects of chemical handling and management.

The MSDS file at NPR-1 is maintained by the site Industrial Hygienist (IH). The file is to be updated whenever an MSDS is received but this procedure had not been fully implemented at the time of the Survey (Safety Department personnel, 1988). MSDSs are received from chemical suppliers and from subcontractors. If a chemical order is received at the 35R warehouse without an MSDS, the order is not accepted. New MSDSs are reviewed by the site IH in order to determine whether the chemical should come on-site. This is the only review of chemical materials performed by the site IH because purchase orders are not reviewed for hazardous or restricted materials prior to ordering.

The largest annual chemical usage on-site is for methanol, glycol, and treatment chemicals. Methanol is used in transmission pipelines to keep the lines from freezing. Treatment chemicals are added to the crude oil at tank settings, dehydration/LACT facilities, and transmission pipelines in order to inhibit corrosion and microbial growth. A listing of the annual chemical usage at tank settings and transmission lines at NPR-1 is presented in Table 4-19.

Chemicals that are added to the crude oil are stored in bulk chemical tanks at the tank settings and other injection points. The bulk chemical tanks are owned and operated by subcontractors and are present at nearly all the tank settings at NPRC. Any maintenance or cleanup activities associated with these chemical tanks are the responsibility of the tank owners. Several bulk chemical tanks were reviewed by the Survey team to determine their condition and integrity. Bulk chemical tanks were reviewed at the following locations: 1-2G Stevens tank setting; 10G dehydration/LACT facility; 24Z dehydration/LACT facility; 30R Compressor site, LTS-1 and 2, and 35R Gas Plant on NPR-1; and the Texaco Gas Plant on 8D in NPR-2. There was no secondary containment at any of the bulk chemical tank locations. Several leaks were noted, including active leaks at Tank 009 (Cronox E-200) and Tank 011 (Calnox 216R) at the 10G dehydration/LACT facility and at a tank of Tretolite®

TABLE 4-19

ANNUAL CHEMICAL USAGE AT TANK SETTINGS AND TRANSMISSION LINES AT NPR-1

Material	Main Components (%)	Annual Usage (gal)
Methanol	Methanol 100	89,200
Magnicide 434	I-(Alkyl Amino)-3-Amino Propane - 48% Isopropanol - 25%	76,011
Magnicide 495	Glutaraldehyde - 50%	48,793
Kontol KW1 31	Oxydiethylene Bis - 6% Methanol Ammonium Bisulfate	42,755
Cronox E-200	Methanol - 20%	42,018
Magnicide 407	Isopropanol - 10%	39,645
Corexit 7754	2-Butoxyethanol Acid/Amine Salts Aromatic Naphtha	38,353
Glycol	Triethylene Glycol	28,520
Calnox 216R	Polyacrylate	11,975
RP 4014	Light Aromatic Naphtha Oxylated Alkyl Phenol Formaldehyde Polyglycols	9,697
SP0237	Methanol	9,169
Aquasurf 10-TA	Isopropanol - 10%	7,053
P6865	Ammonium Chloride Potash Sodium Bicarbonate	6,000
Tretolite Mixture	RP 4014 - 20% YP 168 - 80%	1,825
PD 11	Heavy Aromatic Naphtha Isopropyl Alcohol	1,200
KP 680	Proprietary	1,075

TABLE 4-19

ANNUAL CHEMICAL USAGE AT TANK SETTINGS AND TRANSMISSION LINES AT NPR-1 (Continued)

Material	Main Components (%)	Annual Usage (gal)
BETZ 736	Sodium Nitrate Sodium Molybdate	1,060
Kontol KG49	Proprietary	974
Magnatreat OS	Ammonium Bisulfite	905
RP 675	Heavy Aromatic Naphtha	705
Xylene	Xylene - 100%	365
Kontol YK 7490	Heavy Aromatic Naphtha	355
Kontol K 477	Cobalt Chloride - 1%	200
RP 801	Light Aromatic Naphtha	173
PD 100	VM & P Naphtha Toluene	100
C10C	Proprietary	20

Source: BPOI, 1988e

product on the north side of LTS-1 on NPR-1. Stained soil beneath a solvent bulk tank at the Texaco Gas Plant on NPR-2 was evidence of a past or present release from this tank. The releases at NPR-1 were of low flow rate but had been ongoing for some time as evidenced by the size of the stain on the soil. Environmental Services Department personnel interviewed concerning these releases stated that the responsible subcontractors had been notified but that no remedial action had yet occurred.

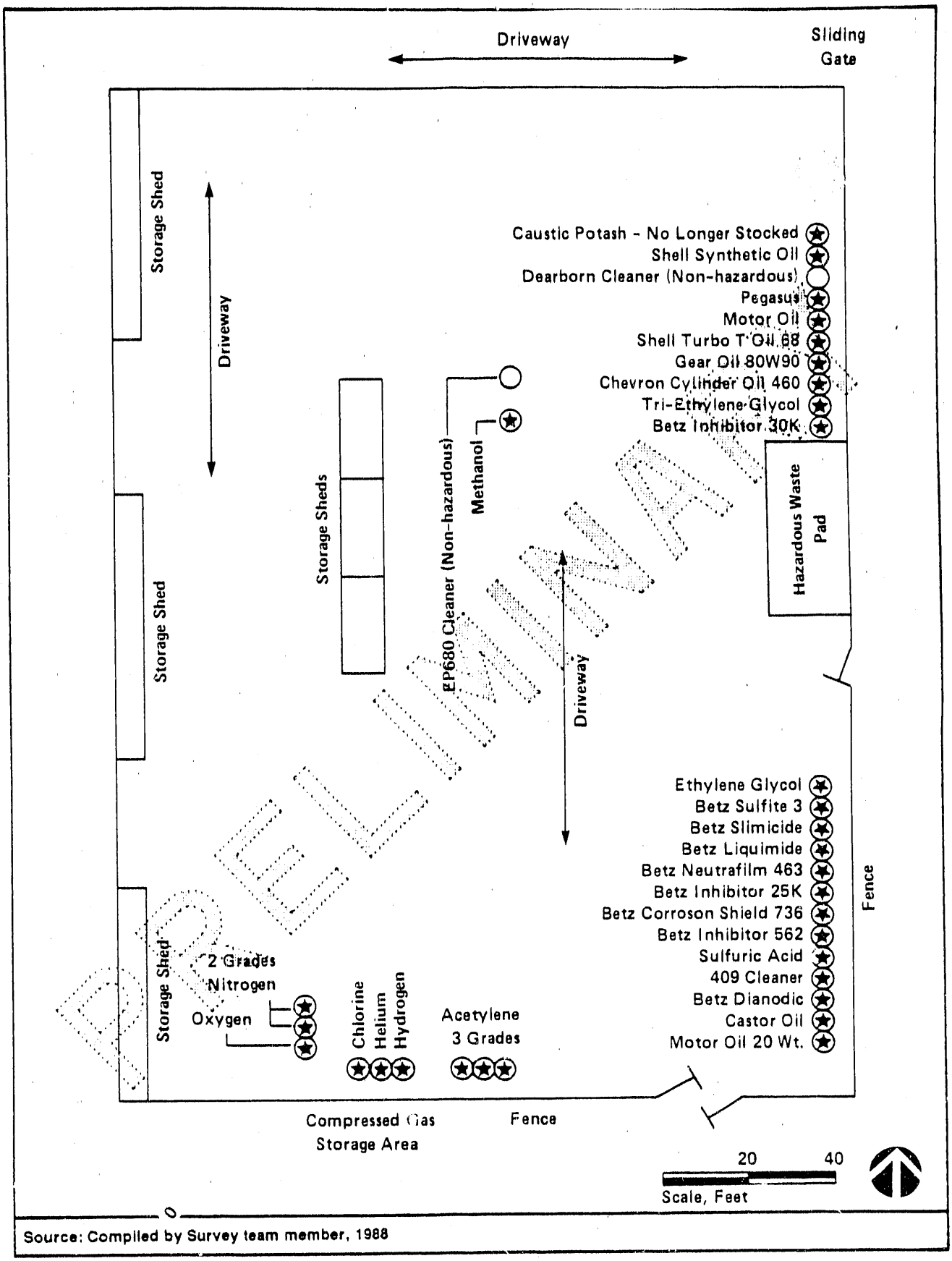
Various process and maintenance chemicals are used at the production facilities at 35R and are situated on drum cradles to facilitate dispensing. These drum cradles hold the chemical drums on their sides and have spill troughs to catch leaks or spills. The Survey team reviewed drum cradles at the following locations: 35R Gas Plant, LTS-1 and 2, and the 30R Compressor Site. There were two drum cradles at the 35R Gas Plant, one of which was situated inside a berm. The other cradle did not have a plug in the spill trough and stains were evident underneath the trough. The drums in the cradle contained oils and slimicides. LTS-1 had three drum cradles, none of which had plugs in the spill trough drains. Stained soil was evident under each trough. The drums in the LTS-1 cradles contained oils, slimicides, and corrosion inhibitors. There were two drum cradles at LTS-2, one of which had an unplugged drain trough while the other cradle did not have a spill trough. Stained soil was evident under each drum cradle. There were two drum cradles at the 30R Compressor Site, neither of which had plugs in the spill trough drains. Stained soils were evident under each trough.

Chemical drums are stored in the 35R Storage Yard prior to use. The location of the drums in the 35R Storage Yard is shown in Figure 4-11. The drums are stored on wooden pallets over bare soil. There is no secondary containment structure for this storage area. No bulk liquid chemicals are stored inside the 35R Warehouse.

4.2.2 Findings and Observations

4.2.2.1 Category I

None



Source: Compiled by Survey team member, 1988

LOCATION OF CHEMICAL DRUM STORAGE AT 35 R CHEMICAL STORAGE AREA

FIGURE 4-11

4.2.2.2 Category II

1. Potential for uncontained releases of gasoline and crude oil. There is a potential for an uncontained release of chemical product materials, such as gasoline and crude oil, from large, aboveground storage tanks to natural drainages and in some instances to tributaries of navigable waterways due to inadequate secondary containment. A significant portion of the approximately 400 crude oil and gasoline tanks on NPR-1 and 2 do not have adequate secondary containment, and a release from these tanks has the potential to enter the navigable waters of NPR-1 and 2. These tanks have capacities ranging from 500 barrels (21,000 gallons) to 16,120 barrels (677,040 gallons).

   The following dehydration/LACT facilities and tank settings were reviewed and found not to have secondary containment that is adequate to contain spillage or releases:

   - 10G dehydration/LACT;
   - 1-2G Stevens tank setting and overflow tanks;
   - 26Z dehydration/LACT;
   - 2-3G Stevens tank setting and overflow tanks.

   Releases from these tanks have the potential to enter Buena Vista Creek through ephemeral/intermittent drainages in NPR-1 that have been designated navigable waterways by the California Regional Water Quality Control Board, Central Valley Region. Discharges of oil "into or upon the navigable waters of the United States or adjoining shorelines" are prohibited by 40 CFR 110 and 112.

   The five gasoline storage tanks (total capacity 45,000 gallons) at the Texaco Gas Plant in Section 8D of NPR-2 have no secondary containment such as berms or dikes. A release or spill from any of these tanks has the potential to reach Sandy Creek, which has been designated a navigable waterway.

   Some areas of NPRC have gully plugs as drainage barriers. These are located one-fourth to 1 mile from storage tanks. An uncontained release in these

instances would result in significant soil contamination and adverse impacts to wildlife and vegetation prior to reaching the gully plugs or drain barriers. In addition, in some instances gully plugs are not present in drainageways downslope from the tanks.

2. Potential for the release of asbestos to the environment. Several sources and potential sources of asbestos on NPR-1 and NPR-2 are not properly encapsulated or in other ways contained and thus pose the potential for the release of asbestos to the environment. Suspension of the asbestos materials into the atmosphere, either by mechanical agitation (vehicles) or natural forces (wind) poses an inhalation threat.

   Sources include, but are not limited to, asbestos insulation on two process vessels in the 35R gas plant (UNX 9144 and UNX 9093). A plastic sheet on UNX 9144 had become partially detached, exposing the asbestos insulation to climatic effects, such as rain and wind. Examples of potential sources include the asbestos storage section in section 2B of NPR-1. Several pieces of process equipment within the storage section had insulation or tank wrap, suspected of being asbestos, exposed to the elements. The equipment was also situated on bare soil and asbestos fibers potentially would be deposited on this soil. Materials found on the ground in the southwest portion of the 2B Storage Yard during the Survey were later determined to contain asbestos. The materials included a white solid substance that resembled preformed piping insulation and pipe wrap. A review of site photographs of the 2B Storage Yard showed that the area containing the asbestos materials may have previously been used to store out-of-service process components such as condensers and heat exchangers. A piece of abandoned equipment directly adjacent to Well 24 on Section 6D of NPR-2 had exposed, friable insulation that appeared to be asbestos.

4.2.2.3 Category III

1. Potential for the release of toxic chemicals to the environment. There is the potential for the release of toxic chemicals to the environment due to the absence of spill containment at subcontractor bulk chemical tank locations. Sources include, but are not limited to, the chemical poly tanks at the 10G

dehydration/LACT facility in NPR-1 and the diesel fuel and solvent tanks at the Texaco Gas Plant in Section 8D of NPR-2.

Two bulk chemical tanks, each with 200-gallon capacity, at the 10G dehydration/LACT facility (009 and 011), containing Cronox E-200 and Calnox 216R, respectively, have leaks associated with ancillary equipment, such as valves and taps. A release of Cronox E-200 has covered approximately a 2-square-foot area and the tank is actively leaking. A similar release is occurring at the tank containing Calnox 216R. There is no secondary containment associated with these tanks, and a chemical release at this location will enter and degrade the environment.

Stained soil was noted beneath and downslope from the diesel fuel and solvent storage tanks located northeast of the equipment storage yard at the Texaco Gas Plant in Section 8D of NPR-2. There is no secondary containment at this location to prevent spills or releases from entering and degrading the environment.

Along the north fence of LTS-1, a 500-gallon poly tank containing Tretolite® chemical has leaks associated with valving and piping. The released material is flowing toward the drainage ditch north of LTS-1. The poly tank does not have secondary containment.

The subcontractors who own and operate these tanks are responsible for spill containment and remediation. Notification letters from DOE and BPOI are sent to the subcontractors to alert them to spills. However, cleanup actions are at the discretion of the subcontractor (Environmental Services Department personnel, 1988).

2. Lack of adequate spill containment at chemical drum storage areas. There is a potential for the release of toxic chemicals to the environment due to the lack of adequate spill containment at chemical drum storage areas. Drums of toxic chemicals, such as sulfuric acid and corrosion inhibitors, are stored on pallets on the ground or directly on the ground at several locations, including the 35R Storage Yard in NPR-1 and at the Texaco Gas Plant in Section 3D of NPR-2. A spill or release of materials at these locations will not be contained due to the absence of dikes and would enter and degrade the environment. These

storage areas offer no protection from climatic effects such as rain, and an undetected spill has the potential to traverse into the navigable waterways of NPR-1 and NPR-2.

Additionally, the drain troughs at several chemical dispensing drum cradles on NPR-1 provide inadequate spill containment because the drain plugs are missing. Any liquids that spill into the drain trough are subsequently released to the soil. Drum cradle drain troughs without drain plugs include the following:

Location	Chemicals Involved
35R Gas Plant - east of cooling tower	Oils and Slimicides
LTS-2 - west of compressor house	Oils
LTS-1 - 50 yards east-northeast of control room	Slimicide, Betz Inhibitor 30K
LTS-1 - along west fence	Oils
LTS-2 - along west fence, no drain trough present	Betz Inhibitor
30R Compressor station - east and adjacent to the compressor engines	Oils

4.2.2.4 Category IV

1. Deficiencies in segregation, storage, dating and labeling of suspected PCB-contaminated equipment. There are deficiencies in the segregation, storage, dating, and labeling of suspected PCB-contaminated transformer units at NPRC. Examples of segregation deficiencies include two transformer units (UNX 10578 and UNX 50278) that were stored at the 36S Storage Yard although the units were not analyzed for PCB content and were labeled with yellow PCB labels. The 36S Storage Yard contains transformers that have been tested for PCB content and found not to have any measurable quantities of PCBs.

The transformer units in the NPR-1 2B PCB storage shed are not labeled as to the date of storage. The units are required to be dated when placed in storage, according to 40 CFR 761.65(8).

The three pole-mounted transformer units adjacent to the 26Z dehydration/LACT facility on NPR-1 are not labeled with regard to PCB content. The units appeared to have been painted black, which conceals the UNX identification numbers. Site policy is to label transformer units with undetermined PCB content with a yellow PCB label. Additionally, the three pole-mounted units directly adjacent to the tank setting on Section 2D of NPR-2 are neither marked nor labeled in any manner.

4.3 Radiation

4.3.1 General Description of Pollution Sources and Controls

There are no nuclear fuels, nuclear weapons materials, or radioactive test materials at the Naval Petroleum Reserves in California (NPRC). All equipment and resources at NPRC are directed toward oil and gas production and associated activities such as environmental compliance. The only issue involving radiation at NPRC was raised in the Final Environmental Impact Statement (FEIS) for the expansion of the gas production facilities in 1979. Wet gas, as taken from the wellhead, always contains trace amounts of the radioactive gas radon. In the gas plants, the radon is concentrated into the ethane and propane fractions because the vapor pressure of radon is between those of ethane and propane (Donelson, 1979). A concern was raised in the FEIS that the decay products of radon, notably lead-210, would build up in pipes, pumps, and valves, causing an increase in gamma radiation exposure to workers. The EIS committed NPRC to perform a baseline radiation study (gamma radiation) at the gas plants (DOE, 1979).

A radiation survey was made on April 23, 1979 of the new gas plants while they were being built and of 35-R Gas Plant while it was operating. The background radiation measurements at Low Temperature Separation (LTS)-1, LTS-2, and the 35-R loading facility ranged from 0.01 to 0.02 milliroentgen per hour (mR/hr), and measurements at the 35-R Gas Plant ranged from 0.01 to 0.04 mR/hr on the propane lines and storage tank (Donelson, 1979). Thus, the 35-R plant, which had been operating for many years, had acquired only a minor increase in activity over that measured at the plants under construction. This effect on worker exposure from the increased production was considered negligible (Donelson, 1979).

4.3.2 Findings and Observations

4.3.2.1 Category I

None

4.3.2.2 Category II

None

4.3.2.3 Category III

None

4.3.2.4 Category IV

None

4.4 Quality Assurance

4.4.1 General Description of Data Handling Procedures

Bechtel Petroleum Operations, Inc. (BPOI) does not directly perform chemical analyses for environmental contaminants. Samples are collected either by Environmental Services Department personnel or by subcontractors and submitted to one of two subcontractor laboratories (DOE, 1988). The current subcontractor laboratories are BC Laboratories, Inc., of Bakersfield, California, and Zalco Laboratories, Inc., also of Bakersfield. These laboratories were first contracted with NPRC to do environmental analysis in 1984. BPOI does not have any control over environmental sampling and analysis programs on NPR-2. These programs are the responsibility of the lessees.

BC Laboratories, Inc., currently holds laboratory approvals from both the State of California, Department of Health Services' Sanitation and Radiation Laboratory, and the Hazardous Materials Laboratory (BC Laboratories, Inc., ND). The Sanitation and Radiation Laboratory issued an approval in April 1984 for bacteriological, general chemical, and organic chemical analyses. The approval expires in June 1989. The Hazardous Materials Laboratory has certified BC Laboratories for a variety of analyses, including trace metals, chlorinated pesticides and herbicides, polychlorinated biphenyls (PCBs), and volatile organics. The Hazardous Materials Laboratory certification is issued yearly (BC Laboratories, ND).

Zalco Laboratories Inc., currently holds approvals from the State of California Department of Health Services' Sanitation and Radiation Laboratory and Hazardous Waste Testing Laboratory. Zalco's approval from the Sanitation and Radiation Laboratory was first issued in May 1980 and is scheduled to expire in June 1989. The approval is for general chemical analyses. The Hazardous Waste Testing Laboratory approval was issued in September 1986 and expires in September 1988. The approval is for full inorganic chemical analysis, physical property testing, and California Waste Extraction Test (Zalco Laboratories, 1986).

Bechtel Petroleum Operations, Inc. (BPOI), requires that laboratories analyzing samples from NPR-1 and 2 be certified by the State of California and that a written

Quality Assurance/Quality Control (QA/QC) Program Plan from the laboratories be on file with BPOI. The QA/QC Program Plan, at a minimum, must include:

- analytical methodologies
- sample custody and tracking procedures
- instrument calibration procedures and requirements
- data management procedures (BPOI, 1987c).

Program plans from both laboratories were on file at NPRC and a review by the Survey team found the plans to be adequate.

As part of the NPRC QA Program, BPOI representatives have visited both laboratories in order to inspect their equipment and discuss the methods, procedures, and QC used to analyze NPRC's hazardous waste samples. This visit occurred in December 1986 (BPOI, 1986l). The conclusion reached by the BPOI representatives was that both laboratories were capable of analyzing hazardous waste samples but that both laboratories have limited QA/QC programs.

There is no formalized procedure to determine which laboratory is to receive samples from NPRC. For organic analyses, BC Laboratories has state approval while Zalco Laboratories does not; accordingly, organic analyses are handled by BC Laboratories. Bacteriological samples are also handled by BC Laboratories for the same reason.

The QA/QC programs described in each Program Plan include information on:

- frequency and procedures for method blank analysis
- frequency and procedures for duplicate and spike analyses and calculations
- frequency and procedures for instrument calibration
- data review by management
- QA/QC data records maintenance (BC Laboratories, Inc., ND; Zalco Laboratories, Inc., 1986).

At the time of the Survey, BPOI did not require that QA/QC information be included in the data reports prepared by the subcontractor laboratories. BPOI relies on the State of California Laboratory Certification Program to determine the reliability and quality of the data produced annually by the subcontractor laboratories (Environmental Services Department Personnel, 1988).

4.4.2 Findings and Observations

4.4.2.1 Category I

None

4.4.2.2 Category II

None

4.4.2.3 Category III

None

4.4.2.4 Category IV

1. Lack of quality assurance/quality control (QA/QC) data being provided to NPRC. There is no procedure in place to ensure that QA/QC information from the subcontractor laboratories is provided to the site. QA/QC data, such as spikes, duplicates, and blanks, provide information on the accuracy and precision of the analytical results and would provide NPRC with a measure of the laboratories' performance.

   Although both subcontractor laboratories are certified by the State of California and must undergo annual inspections and performance evaluations, reliance on the state certification program alone to determine the quality of the data is inadequate. This is because the State reviews laboratory operations once a year and laboratory performance can fluctuate in the period between state reviews. Receiving and reviewing QA/QC data on a regular basis from the subcontractor laboratories provides NPRC with a mechanism for

determining data quality and laboratory performance on a more timely basis than once per year.

4.5 Inactive Waste Sites and Releases

This section presents a description of potential and actual sources of environmental pollution that have resulted at the Naval Petroleum Reserves in California (NPRC) from inactive waste disposal sites, and historic spills and releases of hazardous materials. This review of possible sources of pollution was performed on the Naval Petroleum Reserve-1 (NPR-1). Lands under surface ownership of the Federal Government were included in the review of Naval Petroleum Reserve-2 (NPR-2). Because of the differences in current and historical operation of NPR-1 and NPR-2, the review of each reserve was different. As explained in Section 2.1, NPR-1 has been jointly operated by the Federal Government and industry from its creation in the early part of this century through to the present. As a result, a complete set of historical documents and reports concerning waste generation and disposal were available. The majority of DOE-surface-owned land in NPR-2 however, has always been leased by private oil companies for royalty share, which has included full control of operations. Two wells drilled by DOE in the 1980s on unleased NPR-2 land did not result in commercial production. Older wells on non-leased land are present which are marked U.S. Navy. A well for DOE on non-leased land in NPR-2 is reported by the site as currently being considered. The review of NPR-2 conducted during this investigation was based strictly on current visual observations and the monthly inspection records of NPR-1 operations contractor staff.

From the review conducted of the physical site, study of available site records and aerial photographs, and on-site interviews with current employees, the following historical activities were investigated concerning hazardous wastes and toxic substances at NPR-1 and NPR-2:

- past waste disposal areas on-site that have been identified;
- unidentified areas on-site where past undocumented disposal may have occurred; and
- areas on-site where leaks, spills, or inadvertent disposal by abandonment may have created on-going sources of contamination or traceable plumes of surface or subsurface contamination.

4.5.1 General Description of Pollution Sources and Controls

4.5.1.1 Historical Use of Hazardous Substances at NPRC

Except for brief periods of production in the 1920s and during World War II and the Korean War, NPR-1 was maintained in an essentially undeveloped status until the Arab oil embargo of 1973-74. As a result of the embargo, the United States Congress in 1974 directed that the reserves be explored and developed to their full economic and productive potential.

NPR-1 and NPR-2 are different in their state of development and amount of remaining production capacity. Facilities on NPR-1 include 2,200 wells (1,300 of which are active), four gas processing plants, numerous storage tank facilities and several clusters of administrative and support buildings. Since 1912, over 816 million barrels of oil have been produced at NPR-1, of which 63 percent has been produced since 1976. The current production rate for NPR-1 is over 100,000 barrels per day from two oil zones: the Shallow Zone at 4,000-5,000 feet; and the Stevens Zone at 8,500-9,000 feet.

In contrast, NPR-2 has been in continuous production since the early 1920s. Wells on NPR-2 are considered "stripper wells" which produce less than 10 barrels of oil per day (BOPD). Over 640 million barrels have been produced from NPR-2 since the early 1920s; however, current production is only slightly over 3,000 BOPD. Most of the wells on NPR-2 are drilled to the Shallow Zone and none of the wells are deeper than approximately 5,000 feet. The only facility located on Government-owned land on NPR-2 other than oil wells, tank settings, and lease automated custody transfer stations (LACTS) is a gas plant dating to the 1930s. This plant is currently operated by Texaco Oil Company and is located in Section 8D. Section 2.1 of this report contains additional information on the history of NPRC.

There have been few changes in the types of chemical materials utilized and wastes produced and disposed of at NPRC between the 1920s and the present except those resulting from the use of more specialized chemicals as they were developed historically. Hazardous and toxic materials utilized and wastes produced at NPRC in the past and present may be grouped into three categories: Drilling fluid additives; corrosion inhibitors and biocides; and general industrial chemicals including

solvents and cleaning chemicals. The following paragraphs will discuss each of these types of wastes and how they were generally disposed of.

Drilling Fluid Additives

Drilling fluids have been an essential component of oil well drilling at NPRC to provide lubrication, cooling and a medium to remove cuttings from the boring. Drilling muds, as these fluids are called, are generally oil or water based. The oil muds are mixtures of oxidized asphalt, organic acids, alkali, stabilizing agents, and mineral oil. Usually after use, oil based muds are recycled to offset their high cost. Water-based muds were more widely used at NPRC. In the 1940s, water-based low-pH phosphate and quebracho muds were believed to have been commonly used. These muds required large amounts of water. After World War II, lime muds became popular. Surfactant, and gypsum muds were also common. Beginning in the mid 1950s, chromium lignosulfate and oil-based emulsion muds were widely used at NPRC to enable drilling deeper wells at higher temperatures. Other forms of chromium were also added to drilling muds including sodium chromate, potassium chromate, and sodium bichromate. Other drilling fluid constituents were barium sulfate, calcium carbonate, potassium hydroxide, sodium hydroxide, and phosphoric acid.

Chromium lignosulfate compounds are prepared by the dichromate oxidation of sulfite pulp lignosulfate liquor. The material is used at the drill pad as a powder which contains mostly trivalent chromium (Cr^{+3}), the less toxic state. Chromium lignosulfate may contain up to 5 percent hexavalent chromium (Cr^{+6}). Because of concern of potential detrimental environmental effects of the Cr^{+6}, chromium lignosulfate has not been used at NPR-1 since about mid-1984 (BPOI 1986b). Hexavalent chromium containing compounds were used at NPR-1 as additives to chromium lignosulfate mud to act as gel inhibitors or thinners, high-temperature stabilizers, and corrosion inhibitors. These chemicals, which were added in dry form from 50-pound bags or 100-pound cans at the drilling pad, include sodium chromate (Na_2CrO_4), sodium bichromate ($Na_2CrO_72H_2O$), and potassium dichromate ($K_2Cr_2O_72H_2O$). These compounds were used at NPR-1 between 1975 and 1982 as shown by drilling records. Neither trivalent nor hexavalent chromium containing drilling muds were used at NPR-2. In wells of 5,000-foot depth or less,

chromium use is not necessary because the temperature and depth of drilling allow the use of less costly additives (Texaco, 1988).

Corrosion Inhibitors and Biocides and General Industrial Chemicals

In order to prevent corrosion of the well sucker rod assembly in idle and producing deeper wells at NPR-1 (Stevens Zone) and in idled shallow oil zone (SOZ) wells, a caustic arsenic compound was used. This compound was known as W-41 and its use was terminated in the early 1970s (BPOI, 1986b). The W-41 was removed from the wells when the well went into production or was flow tested. The W-41 was released into either oil collection lines and mixed with product oil or into sumps with produced water and oil. If it went into sumps it would be collected at a separator and disposed of in evaporation/percolation sumps or treated and reinjected into the groundwater (see Section 3.4).

In March 1960, approximately 500 sheep died after drinking water from a sump associated with Well 1A-6M. It was determined that the water was contaminated with an estimated 4,500 parts per million (ppm) of arsenic from W-41 meant for the well and that the sheep probably died of arsenic poisoning. Well 1A is located in the northwest quarter of the northwest quarter of Section 6M. Two sumps were in use at the time of this incident, a primary sump and an overflow sump. The sheep are believed to have drunk collected surface water from the overflow sump.

There are four gas separation plants at NPR-1 and one at NPR-2, which is currently operated by Texaco on Section 8D. These facilities utilize numerous chemical compounds for the maintenance of equipment. Condensate or drips (water and liquid hydrocarbons) are extracted from the gas fractions during processing. Various biocides, scale inhibitors, and corrosion inhibitors have been added to cooling tower water, including in the past sodium chromate and sulfuric acid. Engines and compressors, piping, vessels, and valves are also regularly washed with cleaning solutions, which prior to 1987 contained chlorinated solvents such as trichloroethylene and 1,1,1-trichloroethane.

4.5.1.2 Past Waste Disposal

Disposal of liquid and solid materials at NPRC was carried out in several ways. These include landfills, surface dumps, drilling mud, and road-spreading and land-farming (see Section 4.1), and sumps. A brief discussion of each of these types of disposal and how they were utilized at NPR-1 and NPR-2 is provided in the following paragraphs.

Landfills on NPR-1

Three recently utilized landfills exist on NPR-1: 26S-East, 26S-West, and the 35R landfill. These landfills were all active until 1986-1987. An inactive landfill operated by Standard Oil Company between 1915 and 1940 also exists in Section 36R. The 36R landfill received most or all of the wastes from a nearby gas plant and an "oil camp" or small housing complex for the workers who ran the plant. Only the foundations of this gas plant in 36R now remain. The property including the gas plant was known as the Hay property.

The primary wastes deposited in the recently utilized landfills (35R, 26S East and West) were from construction projects. Some items from the maintenance garage were also reported to have been deposited (BPOI, 1986n). Types of waste included wood, cardboard, asphalt and broken concrete, metal strapping, tires, paper and plastic, and up to 50 percent putrescibles. The size, volume of waste and status of each landfill is shown in Table 4-20. Figures 4-12 and 4-13 show the locations of each landfill.

Although the 26S East, 26S West, and 35R landfills were all covered and/or regraded in 1987-1988, the requirements of a formal closure plan, which potentially could include additional cover, were being negotiated, at the time of the Survey, between the site and the California Regional Water Quality Control Board. Solid waste assessment tests were conducted in 1987 by an outside contractor, Anthrosphere, Inc., for the 26S East, 26S West and 35R Landfills. These tests were in compliance with a California law requiring review of all solid waste landfills. First geomigration testing was conducted at all sites by placing probes around the site periphery. Second, ambient air sampling was conducted over a 24-hour period. Thirdly, an internal soil well was installed to determine if 10 specified constituents were

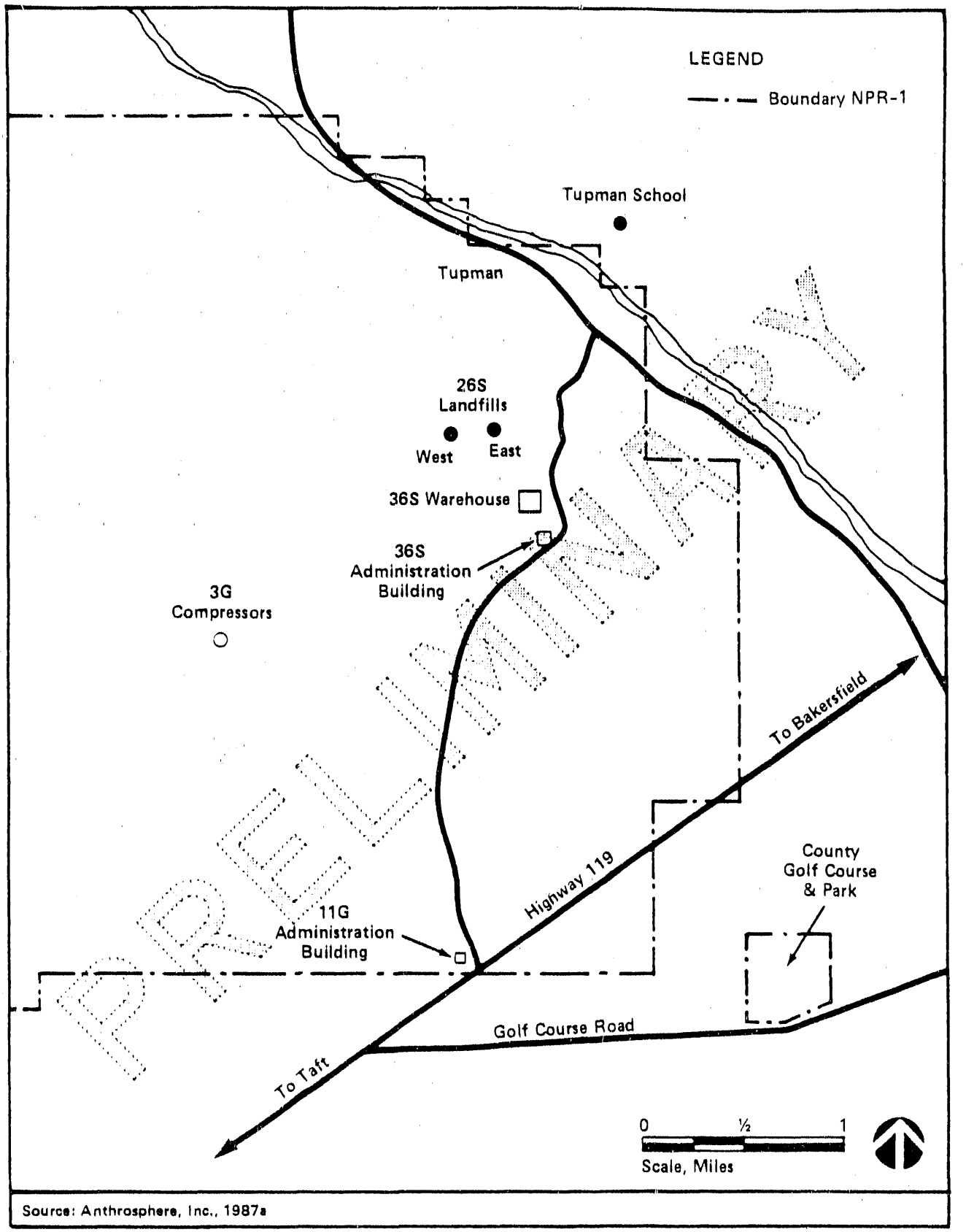
TABLE 4-20

INACTIVE LANDFILLS ON NPR-1

Location	Surface Area (Acres)	Estimated Waste Volume (cubic yards)	Dates of Operation	Date Covered
26S-East	3* 2.5-3**	3872* 9000**	1978, 79-1981	1987
26S-West	9* 2.5-3**	11,500* 18,500**	1982 - summer, 1987	1988
35R	10* 8-10**	12,900*	1974* (1978/9)** - Dec, 1986	regraded summer 1987
36R (Hay Property)	unknown	unknown	1915-1940	unknown

Source: Compiled by Survey team member

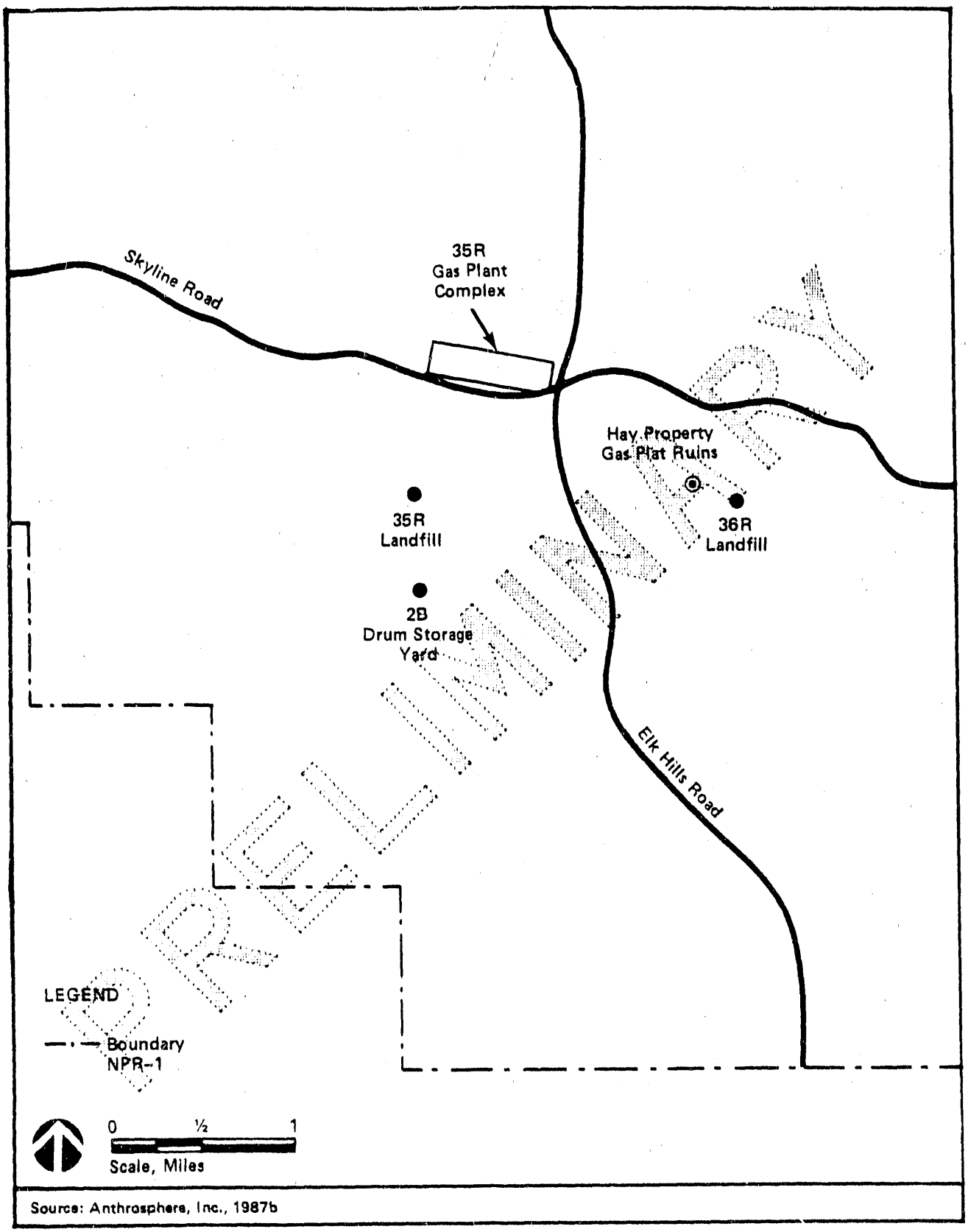
* in accordance with BPOI, 1986n
** in accordance with Williams Brothers Engineering Company, 1985b



Source: Anthrosphere, Inc., 1987a

LOCATION OF 26S EAST & WEST LANDFILLS ON NPR-1

FIGURE 4-12



Source: Anthrosphere, Inc., 1987b

LOCATION OF 35R & 36R LANDFILLS ON NPR-1

FIGURE 4-13

present in the landfill gas. Finally a walkover emissions test using a hand-held organic vapor analyzer was conducted on a traverse over the center of the site at a height of 3 inches. Table 4-21 shows the results of these tests. The reports of these tests did not contain any evaluation of the data, and the State of California had not yet reviewed and commented on the reports. Many of the constituents detected, however, were chlorinated organics, which would indicate at least some level of disposal of wastes that might be considered hazardous wastes. The State may require further testing for this reason.

Landfills on NPR-2

The only known landfill on NPR-2 exists at the site of the Texas Gasoline Plant in Section 8D. The gas plant was originally constructed by the Honolulu Oil Company in the early 1920s. The company later became Tidewater Oil and was acquired by Getty Oil in 1969 and then Texaco in 1984-85. The plant, which separates propanes and gasoline from natural gas, operates by the ambient absorption lead oil process. Historically, the workers who operated the plant lived in homes nearby in the section adjacent to wells #522 and #532. At the time of the Survey, these houses were no longer present. A landfill is located approximately 500 yards northeast of the gas plant. It is estimated to be about 2-3 acres in size although it appears to have been utilized for many years and all wastes are covered with the exception of surface trash. It is believed by the current gas plant operators that all wastes from the plant and the operator's houses went to this landfill.

Surface Dumps on NPR-1

Many small surface dumps exist throughout NPR-1. These are generally sites of less than an acre, frequently located in ravines, where spare parts; household trash; cars; paper; glass; boards; pipes; etc were dumped but not buried. The Phase I site assessment (Williams Brothers Engineering Company, 1985b) identified 24 such sites throughout NPR-1 varying in size from 75'x100' to 20-30 acres. Only 5 of the 24 sites, however, were over one acre in size, and the total combined area of the 24 sites was 58 acres. Only one of these surface dumps (the 25S site referred to in the Phase I study as site #2) was recommended for additional sampling of 2-5 random soil samples. The field assessment (Williams Brothers Engineering Company, 1985b) stated that the site contained "Essentially a non-hazardous collection of material. If

TABLE 4-21

SOLID WASTE ASSESSMENT TESTS
26S EAST, 26S WEST AND 35R LANDFILLS

Landfill	Compounds Detected in Air Samples (all ppbv* except as noted)			
	24-Hour Ambient	Internal Well Gas	Off-site Probes	Walkover Emissions Test
26S East	Benzene 0.4 Carbon tetrachloride 0.07 Trichloroethylene 0.20	Benzene 0.6 Chloroform 1.90 Methylene chloride 5.9 Tetrachloroethylene 0.6 1,1,1-trichloroethane 44.0 Trichloroethylene 0.6	Less than 0.02% methane	Less than 50 ppm organic vapors as methane
26S West	Benzene 1.6 Carbon tetrachloride 0.1 1,1,1-trichloroethane 1.3 Trichlorethylene 0.4 Vinyl chloride 35.0	Chloroform 5.1 Tetrachloroethylene 280.0 1,1,1-trichloroethane 35.0	Less than 0.02% methane	Less than 50 ppm organic vapors as methane
35R	Benzene 0.7 Carbon tetrachloride 0.8	Benzene 1.2 Carbon tetrachloride 1.3	Less than 0.02% methane	Less than 50 ppm organic vapors as methane

TABLE 4-21

SOLID WASTE ASSESSMENT TESTS
26S EAST, 26S WEST AND 35R LANDFILLS (Continued)

Landfill	Compounds Detected in Air Samples (all ppbv* except as noted)			
	24-Hour Ambient	Internal Well Gas	Off-site Probes	Walkover Emissions Test
	Methylene chloride 4.2 Tetrachloro-ethylene 0.2 1,1,1-Trichloroethane 1.8 Trichloroethylene 0.4	Chloroform 13.0 1,2 dichloroethane 1.3 Methylene Chloride 19.0 Tetrachlorethylene 100.0 1,1,1-trichloroethane 2700 Trichloroethylene 49		

Source: Anthrosphere, Inc., 1987a,b

* ppbv = Parts Per Billion by Volume

some organics had been disposed of on the surface they probably would have dissipated by now. Long term surface and groundwater contamination believed to be non-existent to very remote." The site is estimated to be 20-30 acres in size and is located approximately 300 feet from the Tupman School, as shown on Figure 4-14.

Surface Dumps on NPR-2

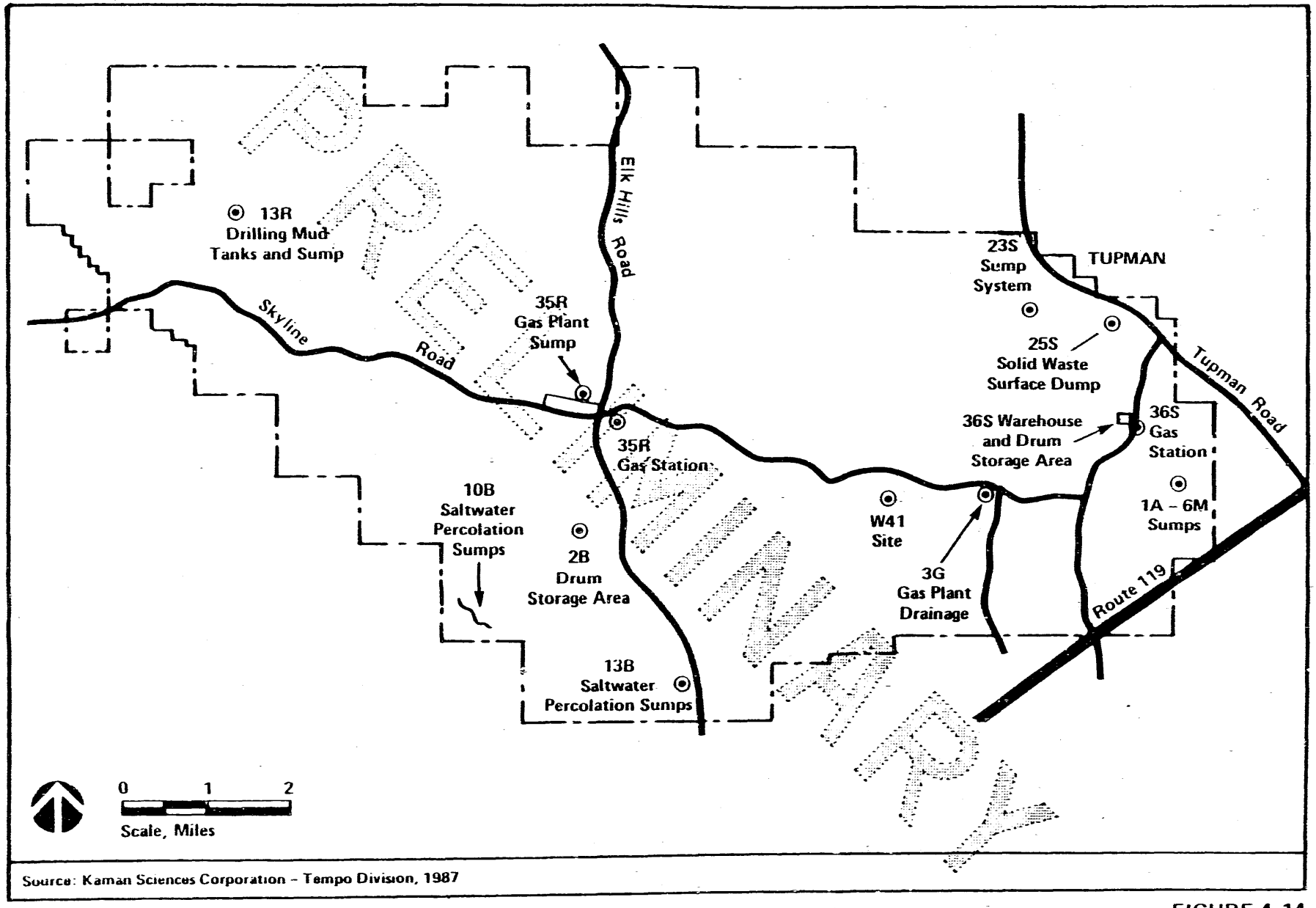
Surface dumps are known to exist on NPR-2 as they do on NPR-1; however, no formal survey of these dumps has ever been conducted. Since NPR-2 has been in continuous production for over 60 years and many employees have historically lived on their leases, it is a reasonable assumption that NPR-2 contains many domestic waste landfills in ravines and borrow pits or other open locations. Most of these sites likely still remain as surface dumps.

Drilling Mud Disposal on NPR-1

Although drilling fluids are exempted from being classified as hazardous waste under RCRA or CERCLA, California classifies waste drilling mud as a hazardous waste if it contains a listed hazardous material. There are some exceptions, however, when hazardous additives are diluted as recommended by the manufacturer. Prior to 1973, waste mud on NPR-1 was either left in the drilling sump; reclaimed; or spread on roads, embankments, and drill pads to aid in soil stabilization. There are an estimated 75-100 old mud or reserve pits at well locations on NPR-1 which have never been properly closed following completion of drilling activities (Williams Brothers Engineering Company, 1985b).

Chromate in 50-pound bags or 100-pound cans was believed to have been frequently spilled at drill pads due to exposure of the containers to the elements, intensity of the work, and rough handling of materials. Subsequent to its deposition at a well site, many of the spills were buried, bladed, or otherwise modified. Today the chromate spills are exposed on a number of well pads (BPOI, 1986b).

Currently, liquid fractions of used, nonhazardous drilling muds are removed by tank truck to landfarm disposal facilities at Sections 10G and 27R. At these facilities, which have been in use since about 1973, the waste muds are spread onto the



Source: Kaman Sciences Corporation - Tempo Division, 1987

NPR-1 WASTE SITE LOCATION MAP

FIGURE 4-14

surface of the ground by special vehicles and then worked into the soil. A more complete discussion of these disposal facilities is contained in Section 4.1.

Drilling Mud Disposal on NPR-2

No formal disposal facilities for waste drilling mud exist on NPR-2. Wells have been drilled by varied contractors continuously throughout the entire history of NPR-2. It is believed that prior to the mid-1970s all drilling muds were either left in the drill pad sump, allowed to flow across the land and into natural drainages, or spread on the drill pads and adjacent roads to aid in soil stabilization.

Sumps on NPR-1

Sumps have been widely used at NPR-1 for two major purposes: the containment and disposal by percolation/evaporation of drainage waters from gas plants; and the handling and disposal of produced waters and other well drilling related fluids. A principal by-product of the production of oil and gas is formation water, called produced water, as is explained in detail in Section 2.3 of this report. While produced waters are highly mineralized, they are not considered hazardous. In Shallow Oil Zone wells, however, W-41 containing arsenic was added to some wells to prevent corrosion of metal well parts which contaminated the produced water. This is known to have occurred on NPR-1 and presumed not to have occurred on NPR-2 since wells on NPR-2 are continually produced and do not require the use of corrosion prevention chemicals. As is explained in Section 3.4, most produced water is injected into disposal wells; however it was formerly processed in sumps to separate contained oil and then allowed to evaporate and percolate into the ground. In some sumps, arsenic residues could remain on surface soils. The major categories of sumps are drilling mud sumps, produced water sumps and miscellaneous sumps which could include oil recovery sumps, catch basins, and oil spill sumps.

The Phase I site investigation (Williams Brothers Engineering Company, 1985b) for NPR-1 categorized sumps into salt water percolation sumps, and oil-contaminated surface water retention basins. Thirty-seven salt water percolation sumps were identified with a total of 16.5 acres of surface area. All of these sumps were assumed active in 1985. As is elaborated in Sections 3.3 and 3.4, approximately 25 of

these sumps were operated by Valley Waste Disposal Company in Section 10B. The Phase I report also identified site oil contaminated surface water retention basins with a combined total surface area of 5.3 acres. A listing of these sumps is contained in Table 4-22.

Waste discharges from the process areas of the 35R, LTS1 and LTS2 gas plants are currently contained within various waste and mechanical systems within the plants (see Section 3.3). After daily washdown, effluent enters a closed hydrocarbon drain system along with the drips, or condensed hydrocarbons. At a "drips accumulator" stabilized hydrocarbons, solvents, and detergents collect prior to entry into condensate lines. Condensate is flushed and recovered, while oil and water go to the LACT settings. Unchanneled plant storm drainage (non-process area drainage) at the LTS-1 and LTS-2 plants is routed via a cement-lined ditch and culverts to an unlined earthen sump (BPOI, 1986b).

Effluent liquids from the process area of the 35R gas absorption plant are held in a 500 barrel oil/water separator. The water is discharged into a percolation sump. This sump also formerly collected any storm water that bypassed the unchanneled plant drainage system by draining it into natural drainage channels although this path is blocked by an earthen berm. Light oil fractions in the oil/water separator are removed by a vacuum truck and discharged into the oil recovery line at 27R.

The 3G Gas Plant has functioned as a compressor plant since about 1952. It is presently not used. When the gas plant was in operation, hydrocarbon drips were collected in a barrel and pumped into the condensate collection system. Washdown solvent and soap residue were drained into the sub-floor pad where they evaporated. Cooling tower blowdown was originally drained into the ravine north of the cooling tower and later removed by vacuum trucks. Effluent also drained out of pipes on the south side of Skyline Road and into ravines draining to the south and 3G canyon. Employees indicate that in the past, cooling tower blowdown was drained into these drainages. Among the chemicals possibly used in the cooling tower water were chromate, biocides, and sulfuric acid (BPOI, 1986b).

The former gas plant in Section 36R, of which now only the ruined foundations remain, is believed to have piped all of its condensed hydrocarbon drips to the adjacent landfill in 36R (the Hay property; see earlier discussion in Section 4.5.1.2).

TABLE 4-22

OIL-CONTAMINATED SURFACE WATER RETENTION BASINS AT NPR-1

Location	Nearest Well(s)	Brief Description and Significant Site-Specific Comments
27S - SE1/4, NE1/4	Well #27	WBE* Site #10, surface water basin with very small amount of old oil and sludge in bottom est. 1/2 acre
30R - NW1/4, SE1/4	Well #364	WBE Site #29, 75'x75' basin approximately 6" of old decomposed sludge in bottom. Excellent vegetation growth around pit and on dikes.
18G - NE1/4, SE1/4	Well #86	WBE Site #61, three basins (1 small, 2 large) south of tank farm full of oil and water. Dead ducks, birds, rabbits, birds around bank edge. Total surface area for 3 basins is 4.6 acres estimated. No fences or nets.

Source: Williams Brothers Engineering Co., 1985b

* Williams Brothers Engineering

Sumps on NPR-2

On NPR-2 as on NPR-1, sumps have been and are currently widely used for two main purposes: the handling and disposal of produced water and other well-drilling-related fluids, and the handling and disposal of oil and water in oil recovery sumps, catch basins, and oil spill sumps. Most of the sumps on NPR-2 are located at or near LACTs, tank settings or facilities.

Drum Storage Areas on NPR-1

Drum storage areas were inventoried in 1985. Six separate drum storage locations were identified (Williams Brothers Engineering Co., 1985b). The total area of these sites is over 3.6 acres. A list of these storage areas is provided in Table 4-23.

Currently drums of waste are stored at the 35R drum storage facility prior to shipment off-site for disposal or recycling (see Section 4.1). The 2B storage yard, which is currently only utilized for product storage (see Section 4.2) was formerly utilized as a collection point for drums of hazardous and non-hazardous wastes prior to shipment off-site for disposal (see Figure 4-13). The 1985 Williams Brothers Engineering Company interim Phase I Report stated that the 2B Storage Yard contained numerous full and partially full drums of unknown chemicals, hydrocarbons and waste, as well as a large open-topped steel tank which contained approximately 600 gallons of unidentified chemicals. This tank was later determined to contain PCB-containing transformer oil and the soil around the tank was visually heavily discolored by spilled oil (BPOI, 1986b). The PCB concentration of the oil in the tank was analyzed and found to be less than 7 ppm, and the stained soil was sampled and found upon analysis to contain less than 1 ppm PCB.

The 36S warehouse (see Figure 4-12) was also a location of former storage for drums of wastes. An unspecified number of drums were reported to have been stored directly on the ground along the north fence of the 36S warehouse, 650-800' east of well 39-36S. The area of this site was reported as 500 square feet.

In late 1985, drums containing unused product and waste materials were collected by BPOI from around NPR-1 and stored at the 2B drum storage yard prior to a large

TABLE 4-23

FORMER DRUM STORAGE AREAS AT NPR-1

Site Location	Nearest Well(s)	Brief Description and Significant Site-Specific Comments
36S - NE1/4, NW1/4	Well #39	WBE Site* #19, used and full drum storage area, inside north fence at 36S warehouse, some spillage and migration off-site 500 square feet no berm
35R - SW1/4, NE1/4	Well #363	a) Full drum storage area inside east fence of 35R warehouse yard no berm. estimated 0.1 acre. b) Full drum storage area (flammable materials) just outside east fence 1800 square feet. c) Empty drum storage just south of fence of 35R warehouse yard. 0.35 acre estimate. d) Full drum storage site (inactive stock area) just north of exit road on east side 35R warehouse. 0.12 acre estimate no berm.
2B - NW1/4, NW1/4	Well #331	Non-reclaimable (full and empty) drum storage area. PCB transformer storage area with concrete sump and rain cover. Drum emptying trough with drain to open-top storage tank (containing 600 gal. est. of unidentified liquid chemicals and hydrocarbons). Empty drum area NW of trough has much leakage on ground and migration off-site to dry water course below. Many stored empty drums without bung plugs. Many leaking drums. Total acreage this site - 3.0 acres (est.).

Source: Williams Brothers Engineering Co., 1985

* Williams Brothers Engineering Co.

shipment for off-site disposal. It was reported by BPOI environmental personnel, that 2,600 drums, eight pieces of PCB equipment, and over 11,000 gallons of solid and liquid waste including over 700 gallons of PCB-contaminated oil were collected and shipped off-site. These drums contained petroleum products, acids, bases, corrosion inhibitors, neutralized hydrofluoric acid, herbicides, and chromium and arsenic wastes. The cleanup was contracted to Industrial Waste Engineering (IWE). A summary of the materials cleaned up and their deposition is shown in Table 4-24.

4.5.1.3 Spills and Leaks

NPR-1

Spills of chromium drilling mud additives and arsenic containing corrosion inhibitor fluids at well pads has been discussed in Section 4.5.1.2.

Numerous oil spills have occurred at NPR-1, both of large and small volume. These are characterized as major oil spills if the spill is either 100 barrels or greater on the land surface or 1 barrel or more into navigable waters. NPRC maintains detailed reports of both major and minor spills including the quantity spilled and quantity recovered. Table 4-25 list the recorded spills of oil for 1986.

The NPRC policy and procedures manual provides in instruction 1810-007 for the maintenance of an emergency response team (ERT). This instruction details the guidance for response, documentation, and follow-up to spills and releases of hazardous materials. An additional instruction, 1810-008, defines the procedures to be followed in the event of an unplanned/unpermitted release of air emissions, wastewater discharge, or spill of hazardous material into the ambient environment. Reports of chemical spills are kept separately from oil spill reports. The BPOI chemical spills file for 1985 on the date of the on-site Survey visit contained only three recorded chemical spills. These are summarized in Table 4-26.

Subsurface leaks of petroleum product tanks were also detected upon excavation of 10 underground storage tanks at three locations: the 36S warehouse gas station, the 36R warehouse gas station, and the used oil tank at the 36S garage. All of these tanks, which ranged in size from 1,000 to 6,000-gallon capacity, were removed in 1987 and replaced with aboveground tanks. Soil beneath several of the tanks was

TABLE 4-24

CHEMICAL DRUM CLEANUP PROJECT OF DECEMBER 1985

Material	Destination
- 2607 crushed drums	Chemical Waste Management Landfill, Kettleman Hills, California
- 190 bbls hazardous liquids	Casmalia Resources Disposal, Santa Barbara, California
- 16 bbls oil with PCBs	Chemical Waste Management Landfill, Kettleman Hills, California
- 5 PCB contaminated transformers	Chemical Waste Management Landfill, Kettleman Hills, California
- 3 capacitors	Chemical Waste to Rollins Environmental for shredding
- PCB contaminated oil (1 bbl)	Chemical Waste to SCA for incineration
- 23 bbls solid (inert, NaOH, grease)	Chemical Waste Management Landfill Kettleman Hills, California
- 1:1500 gallon "vat"	Chemical Waste Management Landfill Kettleman Hills, California
- 35 bbls off-spec oil	27R oil recovery sump

Source: Valentino, 1986

TABLE 4-25

OIL SPILLS AT NPR-1 DURING 1986

MAJOR SPILLS

Incidents	Bbls Spilled	Bbls Recovered	Cost of Bbls Lost ($)	Estimated Cleanup Cost ($)
62	3,004.3	2,790.6	4,090.50	10,803.00*

Cumulative actual cleanup cost for 1986 - $12,042.70

MINOR SPILLS

Category	Incidents	Bbls Spilled	Bbls Recovered	Cost of Bbls Lost ($)	Estimated Cleanup Cost ($)
Stuffing Box Failure	62	180.36	60.5	2,027.85	7,778.00
Mechanical Failure	82	624.50	303.5	3,954.08	14,287.60
Corrosion	122	466.63	244	3,296.30	11,225.96
Human Error	18	107.55	37.5	1,251.10	4,372.00
Total	284	1,379.04	645.5	10,529.33	37,663.56

Source: Greenberg, 1987

Cumulative actual cleanup cost for 1986 - $34,545.36

*Revised from December, 1986 monthly report.

TABLE 4-26

CHEMICAL SPILLS AT NPR-1 1985 - 1988

Date	Substance Spilled	Amount	Location	Disposition
8/3/86	Magnacide-434	150 gal	186 LACT	Contaminated soil excavated and sent for disposal to Casmalia Resources Disposal, Santa Barbara Co., California.
11/17/86	Pyranul Transformer Oil PCB Contaminated)	1 gal	186 transformer UNX 14988	Industrial waste engineering removed contaminated soil.
12/31/86	Unknown corrosion inhibitor	20 gal	106 LACT	Material judged non-hazardous. Spill covered with fresh dirt.

Source: Compiled by Survey team personnel

found to be contaminated after analysis for volatiles and total petroleum hydrocarbons (TPH) (Golden State Environmental Services, 1988). Figures showing the location of these tanks are contained in the discussion of underground storage tanks in Section 4.2.

In addition to the chemical spills reported in Table 4-26, several undocumented spills of potentially hazardous substances were noted at both NPR-1 and NPR-2 during the Survey. At NPR-1 a spill of petroleum and/or chemicals on a hillside west of the 36S warehouse gas station was observed. It is believed to have originated from elevated storage tanks located just north of the gas station. These tanks were marked as follows: pearl oil 370 gallons and 400 gallons (2 tanks), diesel - 450 gallons, zerolene 900 gallons. They were contained in a small sand-bottomed berm which was heavily oil stained and appeared to have a drain leading to the hillside. Also on NPR-1, glycol and therminol leaks were noted on the soil underneath piping runs at the LTS-1 and LTS-2 gas plants (see also Section 3.3). In addition, during the on-site portion of the Survey, a spill of about 50-75 barrels of crude oil occurred (see Section 4.2.1.4).

NPR-2

During tours of NPR-2, the Survey staff noted several small oil spills that had not been covered or removed. These include numerous oil spills at Phillips tank setting #3, and apparent disposal of compressor engine oil on the ground surface at the Kern County Water Pumping Station. At the Texaco gas plant on NPR-2 in Section 8D, several spill areas were noted; these included apparently chromate-stained soil adjacent to the cooling towers at the southern edge of the plant, and the remains of an oil spill contained inside an earth-bermed area approximately 100 feet in diameter, approximately 800 feet north of the gas plant. At the ARCO Compressor station in Section 20B on NPR-2, a yellow-stained area of 25 feet square was noted next to an abandoned cooling tower. This area is presumed to be contaminated with chromates from cooling tower blowdown.

4.5.1.4 Identification of Waste Sites and Releases

NPR-1

Since 1985, in order to comply with DOE Order 5480.14 which required phased investigation and remediation of inactive hazardous waste disposal sites, NPRC has funded a series of preliminary assessments, site investigations, and partial characterization of such sites. Phase I of the program, installation assessment, required an evaluation of site history and records to locate any inactive hazardous waste disposal sites that may pose a risk to health, safety and the environment as a result of migration of hazardous substances.

The first effort to fulfill the Phase I requirement was reported in an interim progress report (Williams Brothers Engineering Co., 1985b). This document identified 65 active and inactive waste sites on NPR-1. Thirty-three of these sites were active sites and not subject to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Three of these active sites were recommended for more detailed investigations. These sites included the 27R Landfarm (Site #27) (see Section 4.1); the 36S warehouse drum storage area (Site #19); and the 2B drum storage area (Site #63). Of the 32 inactive sites identified, 2 were recommended for additional investigation. These included the 26S oil recovery sump (Site #6) and the 10B saltwater percolation sumps in a streambed utilized by Valley Waste Company (Site #64). In order to accomplish this site review, the author, Williams Brothers Engineering Company, performed a very thorough review of the entire NPR-1 site. This included interviews with current and past employees, records and aerial photograph review, and physical inspection and photography of all identified sites.

The Phase I installation assessment (BPOI, 1986b) continued and completed this review. This report was published in December 1986. The report identified 10 sites and three groups of sites that may be potentially hazardous. These sites are listed in Table 4-27. In addition, all sites were ranked using the Environmental Protection Agency's Hazard Ranking System (HRS).

Sampling and analysis of sites recommended by Phase I was carried out in two phases, reported as CERCLA Phase IIA and IIB. In the Phase IIA, all specific sites listed in the CERCLA Phase I report were inspected at least three times by a minimum of

TABLE 4-27

INACTIVE WASTE DISPOSAL SITES IDENTIFIED ON NPR-1 BY PHASE I INSTALLATION ASSESSMENT AND PHASE IIA DISPOSITION

Site	Major Contaminant	Recommended Action by Phase Ia	Disposition by Phase IIA			Phase IIB Additional S&A Required
			Sampled	Analyzed	Non-Hazardous	
1. 18R tanks	Arsenic	Sampling and analysis (S&A) of tank contents	√	√	√	
2. 18R mud sumps	Arsenic	Waste mud S&A	√	√	√	
3. 4G-W41 disposal site	Arsenic	Soil S&A	√	√	√	
4. 36S-W-41 tanks	Arsenic	Soil S&A	√	√	√	
5. W-41 Spill	Arsenic	Soil S&A	√	partial		√
6. 35R gas plant sump	Solvents Metals	Soil S&A	√	partial		√
7. 23S salt water sumps	Arsenic	Soil S&A	√	√		√
8. 9G check dam	Chromium	Waste pile S&A	√	√	√	
9. Drilling mud disposal* sites	Chromium	Large-scale S&A program				√
10. Chromate spills*	Chromate	Large-scale S&A & trial remediation				√
11. Sumps*	Arsenic heavy metals	Large-scale S&A program				√
12. 3G Drainage	Chromium	Soil S&A	√	√	√	
13. 2B transformer oil tank	PCB's	Waste oil & soil S&A	√	√	√	
14. 27S sump	-	**				√
15. 26S sump	asphaltic residue	**				√
16. 7R sump	crude oil	**				√

TABLE 4-27

INACTIVE WASTE DISPOSAL SITES IDENTIFIED ON NPR-1 BY PHASE I INSTALLATION ASSESSMENT AND PHASE IIA DISPOSITION (Continued)

Site	Major Contaminant	Recommended Action by Phase I	Disposition by Phase IIA			Phase IIB Additional S&A Required
			Sampled	Analyzed	Non-Hazardous	
17. 36S warehouse spill	Lube oil, grease	**	√	not analyzed		√
18. 10B percolation ponds	-	**				√

Source: BPOI 1986b, 1987n

* Groups of several sites
** Sites added by Phase IIA

two BPOI technical specialists. Several of the oil recovery/percolation sumps and other sites recommended for additional sampling and analysis in the WBEC Interim Report were added to the list of potential CERCLA sits in the Phase I report and also inspected. The result was 15 potential sites which were considered for further investigation. Three sites were eliminated from further consideration because they had only crude and oilfield brine waste. Eleven (11) locations were sampled and analyzed in order to determine if an environmental or health hazard does exist. The W-41 disposal site was sampled and the soils did not show hazardous waste levels of arsenic. The pipes recovered from the site did contain high levels of arsenic and were hauled to a hazardous waste disposal site.

The 25 samples collected (several sites had multiple samples) were reduced to 15 samples to be sent for laboratory chemical analysis since at least three sites, the Section 4G disposal site, the Section 6M arsenic spill and the old 35R gas plant sump, were already recommended to be characterized in Phase IIB. The chemical analyses were to be used with other information to either eliminate the site from further investigation at that time or to confirm the presence of a hazardous waste exceeding Total Threshold Limit Concentration (TTLC) and/or Soluble Threshold Limit Concentration (STLC) levels, thus warranting detailed characterization in Phase IIB. The remaining 10 samples were retained.

Environmental Services Department staff and the corporate support specialist inspected and eliminated several sites from further consideration. Some samples were sent for analysis to confirm visual judgments, other samples were retained for possible future analysis. The disposition of this sampling and analysis is shown in Table 4-27.

As a part of the Phase IIA study, two large-scale sampling and analysis programs were conducted: a sump investigation, and an investigation of chromium spill sites. These two programs are described in the following paragraphs.

The sump investigation included three categories of sumps: drilling mud sumps; produced water sumps; and miscellaneous sumps, which included oil recovery sumps catch basins, and oil spills. In total, 30 sumps were inspected, surface sampled and evaluated for possible contamination from arsenic or chromium, and one additional sump was tested for volatile organic hydrocarbons. These included 12

drilling mud sumps, 7 produced water sumps and 12 miscellaneous sumps. The arsenic and chrome soil samples were analyzed by acid extraction for total content and this result was compared with the California STLC and TTLC of California Code of Regulations (CCR) Title 22. These limits are used to determine if a waste is a hazardous material based on total analysis (TTLC) or water extraction (STLC). A total analysis of soil was first compared to TTLC. If the total analysis exceeded this limit additional characterization or remediation was determined necessary. The total soil analysis was then compared to 10 times the STLC value. If it exceeded this value, an additional analysis was performed on the sample by water extraction and this result was again compared to 1 times the STLC. If the limit was exceeded, additional characterization or remediation was determined necessary. The results of this investigation are listed in Table 4-28. It should be noted that the TTLC and STLC are thresholds for waste characterization, not remediation cleanup criteria for in-place contaminated soil. Based on these criteria, the only sump that warranted additional characterization was the #3 produced water sump in the 10G area.

The chromium spill site investigation performed as a part of the CERCLA Phase IIA study was based on an earlier study conducted concurrently with the Phase I study. This original report of investigation of chromium spills on NPR-1 (BPOI, 1986o) involved the review of records of all wells drilled at NPR-1 into the Stevens and Carneros oil zones, approximately 6,000 to 8,000 feet below sea level, between the years 1954 and 1985. It has been determined that these wells may be drilled using chrome additives in the drilling mud. This record search resulted in a list of 554 potentially contaminated wells. All of these well pads were visually inspected and 67 were selected for sampling based on visual staining of surface soil. Based on this sampling, 54 well pads were determined to be contaminated with chromium. Most of these contammated sites were determined using a colorometric field kit using powdered soil, distilled water and "hach chromaver 3" reagent for hexavalent chromium. Eight of these well pad sites were previously surface sampled and analyzed in the laboratory by SW-846 method 7190 for total chromium, and the California waste extraction test (wet) for hexavalent chromium in leachate. These results indicated contamination at 7 of 8 pads tested at a range in total chromium of 12-6,800 mg/kg with a background sample showing 6.8 mg/kg. Soluble hexavalent chromium varied from <0.1 mg/L to 470 mg/L with a background sample showing 0.34 mg/L. Subsequently three of these eight sites were characterized in detail by progression of 11 test borings at a depth of up to 5 feet. A total of 61 samples were

TABLE 4-28

SUMP INVESTIGATION RESULTS

Location	Total Arsenic (mg/kg)	Total Chromium (mg/kg)	Soluble Arsenic (mg/L)	Soluble Chromium (mg/L)	Notes
I. Drilling Sumps					
333A-34S	3.85	2.01			
344A-26R	4.66	177.*	-	<0.20	
26-35S	6.30	16.1			
42A-35S	5.82	20.9			
328-28R	2.19	16.7			
345-28R	5.77	37.7			
344-30R	4.65	75.6*	-	<0.20	
386-30R	3.82	30.9			
381-76	16.8	460.*	-	<0.20	
328-9R	9.02	28.9			
13D-1G	27.1	22.3			
5D-1G	7.30	14.6			
II. Brine Sumps					
25S	16.3	37.4			Small sump
25S	18.3	31.7			Near fence
25S	11.1	42.0			Large sump
10G Sump 1	4.62	10.8			WBEC #59
10G Sump 2	2.63	14.3			WBEC #59
10G Sump 3	403*	18.7	23.0		WBEC #58
10G Sump 4	12.0	8.39			WBEC #58
10G Sump 5	6.77	28.9			
III. Miscellaneous Sumps					
26S	4.27	16.7			WBEC #6
26S	4.46	29.5			Drainage
10G LACT	-	-			WBEC #60
10G LACT	4.67	18.0			WBEC #60
10G LACT	17.2	43.4			WBEC #60
10G Land farm	4.55	31.8			Firefighting pit
27S Trench	49.0	22.7	0.24		WBEC #11
27S Catch basin	4.51	26.7			WBEC #10
316-26S	20.5	25.4			
18R	5.56	51.1*		<0.20	Catch basin
18-31T	1.85	6.30			2nd Catch basin
384-30R	4.95	48.0		<0.20	Catch basin

Source: BPOI, 1987n

* Exceeds 10 times STLC arsenic (STLC = 5 mg/l) or exceeds 10 times STLC hexavalent chromium (5 mg/l)

Note: TTLC arsenic = 500 mg/kg, TTLC hexavalent chromium = 500 mg/kg, WBEC = Williams Brothers Engineering Co.

taken and analyzed in the laboratory for total chromium and hexavalent chromium by acid extraction. These results showed a range of total chromium of 2.4-20,600 mg/kg and hexavalent chromium of <2.0-14,750 mg/kg. Of the total chromium, hexavalent chromium as a percentage ranged from 0 percent to approximately 80 percent. Based on this characterization, the quantity of chromate at each of the three sites was calculated, and it ranged from 130 to 1,800 pounds per site. Although the quantity of contaminated earth was not calculated, the surface area of these three sites was 1 to 4 square yards.

Based on all the above information, a test excavation program was contracted by NPRC for selected chromium spill sites. A report of this work, which was performed by Positive Incident Control Inc. (PIC), is included as the previously mentioned appendix to the Phase IIA study report. In this program, chromium-contaminated soil was hand-excavated from 26 sites. The criteria for excavation was visual staining with completion of excavation confirmed by the earlier described Hach colorimetric field test. Quantities of contaminated soil excavated ranged from zero to ten 55-gallon drums per site. A total of 117 55-gallon drums containing 30 cubic yards of contaminated soil were excavated and shipped off-site for disposal. Follow-up laboratory analyses of the sites showed that 9 of the sites had been totally excavated and the remainder required additional excavation. It was estimated by the study that 143 cubic yards of contaminated soil remained in the 17 sites. At the time of this study, 28 other chromium sites remained with an estimated 113 3/4 cubic yards of contaminated soil. Therefore, it was estimated that for 54 contaminated sites, approximately 257 cubic yards remained to be excavated.

The CERCLA Phase IIB investigation involved additional characterization of the Section 4G arsenic burial site, 1A-6M arsenic-contaminated sumps, Section 23S arsenic-contaminated sumps and 9 other sites (as listed in Table 4-27). At the 46 sites, four borings were progressed to 20 feet depth and analyzed for arsenic, and a magnetometer survey was performed. Although all arsenic concentrations were below 35 mg/kg, the site was excavated due to magnetic anomalies found, which were suspected of being buried drums. Upon excavation, no drums were found and the site was reburied in place. It was not judged to be a hazard although the results of the excavation were not included in the Phase IIB report. Soil samples at the 1A-6M and 23S arsenic sites showed arsenic levels recommended for remediation.

NPR-2

No formal program of initial installation assessment and subsequent characterization of inactive waste disposal sites has ever been conducted by NPRC. A program of monthly inspections of all DOE-owned NPR-2 lands is conducted by BPOI environmental staff. Notes of these inspections are maintained and were reviewed by the Survey team. Information contained in Section 4.5.1.5 is based upon these files and in visual observations of NPR-2 by the Survey team.

4.5.1.5 Waste Sites and Releases That Present a Potential Impact

There are 76 inactive waste disposal sites at NPR-1 that are judged by this Survey to pose a potential impact to soils and surface water. Sixty-nine of these sites (including 62 chromium-contaminated sites) were identified by the CERCLA Phase II studies as requiring further characterization and remediation. An additional five sites were previously identified by the Phase I identification that may present potential impact on soils and surface water; however, these were eliminated from Phase II characterization work. Lastly, two previously unidentified sites were identified by the Survey team.

NPR-1 Sites Identified by Phase II Study

- Chromium Spill Sites

The chromium spill sites have been investigated continuously since their initial discovery in 1985 through routine drilling site revegetation soil analyses. As a part of a program to reseed and vegetate disturbed soil areas, EG&G has sampled and analyzed hundreds of soil samples for metals content and basic other parameters that would affect plant growth such as nutrient content. This revegetation program has been pursued to restore habitat for NPRC wildlife. BPOI's Final Report of the Investigation of Chromium Spill Sites dated October 1986 documents previous investigations. Several new sites have been identified by BPOI through an ongoing inspection program. Currently, 62 spill locations are located on NPR-1 as listed in Table 4-29. Nine of these sites have been cleaned up by hand excavation and removal of the contaminated soil for off-site disposal at a permitted land burial area, although they have not been backfilled after excavation pending later

TABLE 4-29

CHROMIUM SPILL SITES AT NPR-1

Section	Well No.	Section	Well No.
2G	311	28R	328*
2G	324	28R	345
3G	331	29R	346
3G	373	29R	366*
4G	326	30R	344*
5G	324X*	30R	362*
5G	366X*	30R	384*
5G	376*	30R	386*
5G	386*	32R	368*
7G	81*	33R	316*
7G	381*	34R	354*
9G	326	35R	361
7R	337*	36R	331X
7R	358*	36R	332X
7R	365*	36R	345
7R	374*	26S	316
7R	378*	26S	321
7R	384X*	31S	328A
9R	328	33S	364X
14R	315	33S	375
17R	353	34S	333A
17R	386X	35S	342
18R	361	14Z	5-344
19R	312*	24Z	386*
20R	562*	24Z	578
23R	356A	26S	Old dump
25R	351	34S	356
25R	9-387	32S	375
26R	344A	35S	342
27R	361	6G	374
27R	343		

Source: Compiled by Survey team member

* Believed by BPOI to have been previously remediated by excavation until clean, based on colorimetric field test or visual observations.

sampling and analysis to certify the completeness of excavation. An additional 16 sites were cleaned by mechanical excavation in the Fall of 1987 - Spring 1988 and these holes were also left open. Concentrations of hexavalent chromium range from <0.2 to 14,750 mg/kg. Because these sites are geographically dispersed throughout NPR-1 and range in size from less than a cubic yard to over 20 cubic yards, BPOI believes that excavation and removal is the most cost-effective remedial action alternative. The current estimate of contaminated soil at the remaining sites is 257 cubic yards.

- 23S Sump System

The 23S oil recovery and saltwater disposal sumps were used to handle Shallow Oil Zone produced water. W-41, an arsenic corrosion inhibitor, was used in these wells. Sumps #1 and #2 are oil recovery sumps which are connected into Sumps #3 and #4. The sumps range in size from 50 feet by 50 feet to 180 feet by 205 feet and are 8-10 feet in depth. The 23S Tank Farm has been out of service for several years and the sumps have not been used in some time. Arsenic was found in a surface sample in Sump #3 during the CERCLA Phase IIA investigation of Sumps #3 and #4. Later a detailed investigation was conducted in Sump #3 and the wash leading into it (Kaman Tempo, 1987b). A supplemental investigation at the unloading area and Sumps #1 and #2 confirmed that arsenic-contaminated brine probably flowed through Sumps #1 and #2 before reaching Sump #3.

The four produced water sumps were investigated for contamination due to heavy metals. During Phase IIA investigation, Sump #3 was found to contain 2,630 mg/kg arsenic. This level exceeds the California Department of Health Services (DHS) recommended soil cleanup level (RSCL) of 50 mg/kg and TTLC for arsenic of 500 mg/kg. The site was further investigated by Kaman-Tempo. The site was found to contain up to 43 mg/mL of extractable arsenic.

Sump #3 is estimated to contain 260 cubic yards of contaminated soil. Sumps #1 and #2 (including part of the unloading area) are estimated to contain an additional 585 cubic yards of contaminated soil.

The location of the 23S sump system is shown on Figure 4-14.

- 1A-6M Sumps

Site 1A-6M is an abandoned well pad with a primary sump and an overflow sump. In 1960, over 500 sheep were killed by arsenic poisoning after drinking contaminated water from the overflow sump. At that time, grazing leases were still being issued and the Reserve was not fenced. There are now partial fences and grazing is no longer permitted although apparently unauthorized grazing was observed during the Survey on NPR-2 property in Section 18H. Both sumps have been partially filled in with soil and the surface area disked in 1986 as a part of the soil revegetation program. It should be noted that the disking was performed without knowledge that the site was under investigation for possible remediation. The site was not marked at the time of the Survey. Borings to 10 feet in the sumps and on the well pad showed arsenic levels in the soil below the California RSCL of 50 mg/kg. Three surface composite samples exceeded this criteria. The location of these samples was in the area leading to the primary sump and a maximum concentration of 190 mg/kg on the well pad. Extractable arsenic concentrations for these three samples were slightly above the California STLC limit of 5.0 mg/L for arsenic, ranging from 5.0 mg/L to 8.4 mg/L. The location of the site is shown in Figure 4-14.

- 4G-W41 Site

The Section 4G disposal site (see Figure 4-14) is the only known site on NPR-1 where potentially hazardous wastes were disposed by burial. The site is approximately 700 feet long varying in width from 40 to 100 feet, and is located on a ridgeline with steep sideslopes. Trenches were believed to have been used for disposal of scrap material contaminated with W-41, a caustic arsenic compound used as a corrosion inhibitor prior to 1970. There were verbal reports of buried 55-gallon drums at the site. The disposal site was closed and covered in 1971.

Sampling and analysis for total chromium and arsenic at four boring sites to a depth of 20 feet found only low background concentrations of arsenic below 10 mg/kg except for one sample at 10 feet with 35 mg/kg and at 5 feet with 13 mg/kg. Soil resistivity and magnetometer surveys were conducted of the site. Although the soil resistivity proved of limited usefulness, the magnetometer survey showed 43 major magnetic anomaly areas. It was decided by NPRC to excavate the earth around these anomalies to search for buried drums. Excavation at the site is now complete

and the site has been filled back into the original holes. No written report exists of the excavation or additional soil sampling and analysis that was believed done. Although no buried drums were found, magnetic materials consisting of piping, tubing, and valves contaminated with arsenic were unearthed and were disposed of at a Class I disposal site off NPR-1.

- 18R Drilling Mud Tanks and Sump

A past attempt was made to reclaim drilling mud for reuse. A series of eight tanks in the northwest quarter of Section 18R (immediately east of Well 314-18R) was used to store reclaimed drilling fluids. Two tanks have been removed and three tanks are badly corroded and empty. Three other tanks, however, still contain material. In one instance, an oily liquid is seeping through pinholes which have eaten through the tank. This may represent oil-base mud or oil floating on top of used drilling fluid. This site drains into the 18R mud sump.

There is also an indeterminate but large quantity of drilling mud deposited on the pad and sump immediately east of the 18R mud reclamation tank setting. The drainage comprising the sump is blocked by two retaining walls and further downstream flow of this material is presently unlikely.

This site is situated on the north flank of the Elk Hills. Ephemeral drainages lead to the principal north-south water channels and subsurface aquifers along the western edge of the San Joaquin Valley.

The liquids in one of the tanks was sampled and determined to be nonhazardous (Cummins, 1987). Soil samples were collected at the base of the tank and from the sump. Although it was recommended that the sump area was not to be considered for further sampling and analysis (Cummins, 1987), the soil sample from the sump contained 770 mg/kg total chromium. It was recommended, however, that although the contents of the three tanks were presumed to be nonhazardous, the liquids be removed and properly disposed of. The location of this site is shown on Figure 4-14.

- 35R Gas Plant Sump

An abandoned sump for plant effluent from the 35R absorption gas plant is located in the northeast quarter of Section 35R. It is about 20 meters west of Well 361-35R. Although the sump has been replaced with another sump to the north, it is still used to receive runoff and prevent it from entering the new sump. This is accomplished by either excavating trenches within the confines of the former sump or flooding the filled surface.

The sump is located within a natural, north-flowing drainage, as is the newer sump. This drainage also receives effluent from the LTS plants at a point north of the sumps. The water received from these sources, and possibly other unidentified sources, has supported an established marsh-like plant association in the past, including cattails, tamarisk, and sedge, indicating a fairly consistent water supply. Furthermore, stream entrenchment further downstream suggests that the flow has either been relatively strong and/or consistent. The sump is approximately 300 feet by 150 feet in plan dimensions. Some of the fencing that had surrounded the sump is still visible in several places. The sump has been backfilled with native soils. The present surface is level, the actual boundaries or embankments had been eradicated to an extent where they are indistinguishable from the surrounding areas. Actual depths from the existing ground surface to the old sump bottom are not known, nor is the source of the backfill materials. A stockpile of native soils is located in the western portions of the area once occupied by the sump.

Five borings and six surface soil samples were analyzed for metals and volatile and semi-volatile organic compounds. Low levels of arsenic (up to 15 mg/kg) and total chromium (up to 36 mg/kg) were found; however, high volatile organics levels were found in the subsurface soil samples, up to 240 mg/kg ethyl methyl ketone; up to 21 mg/kg isobutyl methyl ketone, and up to 3.1 mg/kg xylenes. The location of the 35R sump is shown in Figure 4-14.

- 3G Gas Plant South Drainage

At least two of the drainages leading from the 3G Gas Plant (compression booster station) receive or have received effluent from that facility. A drainage running from the western end of the plant to the 3G Canyon Road has an active flow and

supports a more luxuriant vegetation than surrounding areas. Another drainage running north from the west end of the facility formerly terminated in a sump which is now filled and breached.

In the past, cooling tower blowdown was released into these drainages (BPOI, 1986b). Among the chemicals used in the cooling tower water were chromates, biocides, and sulfuric acid.

The compressors at the 3G plant have been decommissioned since 1986. The cooling tower has been out-of-service since approximately 1987. Once or twice per year, washdown water to remove bird droppings from the steel framework of the building and equipment is discharged at a low flowrate into the drainageway.

The drainage begins at a pond about 6 feet in diameter and formerly ran downhill for approximately 2,500 feet to a catch basin. The drainage path has been built over by the recent (Fall 1987) construction of a drill pad. The basin has been breached on its north side. Further down the drainageway several ponded areas formerly existed.

Five soil borings and five surface samples were taken along the drainageway (Kaman-Tempo, 1987b) and analyzed for metals, volatile and semi-volatile organics. The results indicated no elevated metals but high levels of volatiles were present, both in surface soil and at depths of up to 7 feet. Contaminants found included up to 18 mg/kg tetrachloroethylene, 18 mg/kg 1,1,1-trichloroethane, up to 140 mg/kg methyl ethyl ketone and up to 70 mg/kg methyl isobutyl ketone. The location of this site is shown on Figure 4-14.

- Removed Petroleum Tank Contamination at 36S and 35R Gas Stations

Five underground storage tanks at the 36S gas station and four at the 35R gas station were recently removed and replaced by aboveground tanks. Soil analyses performed in the excavated area have shown petroleum contamination (Golden State Environmental Services, 1988). Sections 4.2 and 4.5.1.3 contain additional descriptions of these sites.

NPR-1 Sites Identified by Phase I Study

- 2B Drum Storage Area

The 2B storage yard (see Figure 4-14) was used, until late 1985, for the storage of miscellaneous drums containing waste materials and scrap unused product chemicals. In 1985, up to 2,600 such drums were collected and stored in the yard prior to shipment for off-site disposal (see Section 4.5.1.2). It is not known how many of these drums were full or partially full of waste materials; however, extensive ground level photographs of the area (Williams Brothers Engineering Co., 1985b) showed extensive soil staining around the groups of drums, which were stored on bare ground or pallets. Soil samples recommended in the Phase I Study were never taken.

- 36S Drum Storage Area

This site was listed in the WBEC interim progress report as site number 19 with a recommendation that it be tested to confirm whether the soils at the site are hazardous. Inspection by BPOI in 1986 as a part of the Phase IIA study showed the site to be a small surface spill outside the north fence of the warehouse area. The material stored inside the fence is lube oil and grease. It was also reported that drums had at one time been stored outside the fence where the spill is located, implying that the spill originated outside the fence. A sample was taken but was not sent to the laboratory because it was from an area of only about 1 inch of contaminated soil on top of an asphalt pad and was judged to be a small non-hazardous spill which should be cleaned up. It was not recommended for further study in Phase II-B. The site location is shown on Figure 4-14.

- 25S Solid Waste Surface Dump

This site (see Figure 4-14) was reported in the WBEC interim progress report as site number 2 with a recommendation that 2 to 5 surface soil samples be taken. No additional sampling was ever performed. The site is a 40-acre surface dump that was operated between 1950 and 1965. The dump is believed to contain mainly steel, concrete, wood, and domestic trash. The north edge of the site is 300 feet south of

the Tupman School and the NPR-1 boundary fence. Surface ephemeral streams drain to the north and northeast.

- 10B Salt Water Percolation Sumps

These percolation ponds are located in the Buena Vista Creek drainage near Valley Waste's BV-4 facility. The site was listed in the WBEC interim progress report (as Site #64) and recommended for further study and soil sampling. These sumps are located downstream of several different Valley Waste facilities. However, wastewaters are treated to remove oil and go through other percolation/evaporation ponds prior to reaching the 10B sump area. These sumps are not normally used by Valley Waste. It is believed that the 10B ponds were designed to handle an emergency overflow situation of produced water from Valley Waste's facilities.

The site was judged nonhazardous by the Phase IIA study; however, the WBEC listed wastes disposed of at the sumps to include boiler blowdown, steam injection well condensate, and drilling fluids and noted dry oil sludge in a couple of sumps. See Figure 4-14.

- 13B Salt Water Percolation Sumps

These sumps were listed by the WBEC interim progress report as requiring water and soil sampling and possibly vadose zone and groundwater monitoring. The estimated area is 1.5 acres and the Phase I assessment by WBEC provided only that "salt water percolating into the alluvium may result in a degradation of the perched water" and that the site was potentially hazardous.

NPR-1 Sites Identified by the Environmental Survey

- 36R Abandoned Gas Plant

As described in Section 4.5.1.2, the ruins of a former Hay property gas plant exist on Section 36R. Only the foundations of the plant remain. All of the foundations contain a thick layer, approximately 2 inches deep, of black ash of unknown origin or composition. See Figure 4-13 for the location of the site.

- 36S Warehouse Sump

A large sump exists to the northwest of the warehouse in the 36S administration area. This sump, which is downhill of the 36S gas station and truck wash rack, may have received drainage from the cleaning of vehicle tanks in the past. Much of the surface runoff from the 36S warehouse flows into the sump as does the runoff from the area of the 36S petroleum spill described in Section 4.5.1.3.

4.5.2 Findings and Observations

4.5.2.1 Category I

None

4.5.2.2 Category II

1. Undocumented remediation of chromium spill sites. Remediation of chromium-contaminated inactive waste disposal sites is being carried out without a reviewed and DOE approved Remedial Investigation/Feasibility Study (RI/FS) and final remedial design. This presents the potential for some of the environmental concerns posed by these sites to remain. These concerns include potential contamination of groundwater and surface water runoff, airborne suspension, and bioaccumulation in flora and fauna.

   Sixty-two chromium-contaminated sites have been identified by NPRC in a study conducted under Phase II of the former DOE CERCLA investigation process. The site has not prepared either a complete characterization and engineering design as called for under the former DOE CERCLA program nor an RI/FS as required by SARA. An internal report by BPOI reviewing remedial alternatives largely on a cost basis has not been released or submitted to state or Federal environmental agencies.

   Due to the lack of an ongoing remedial planning program, inappropriate or incomplete remedial action may have been initiated at sites without proper consideration of all remedial alternatives nor of appropriate clean-up levels.

Approximately 27 of the 62 identified sites have been excavated completely or partially and the excavated material disposed of off-site by land burial. The excavations have been left open to the elements. Many of the excavations are incomplete and chromium still remains and is migrating. The following concerns applied where partial remediation has already taken place:

- no system of analyses to ensure that excavation is complete at each site;
- no justification that less significant sites may have been remediated before more dangerous ones;
- no documentation that the most environmentally sound remedial alternative has been implemented and why other alternatives do not apply.

2. No PA/SI for NPR-2 sites. There has been no Preliminary Assessment and Site Investigation (PA/SI) for NPR-2 as required under SARA. Inactive waste disposal sites exist on NPR-2 that have not been identified and assessed. These sites may potentially be causing contamination of groundwater, surface water runoff, and flora and fauna. Sites that were observed during the Survey include:

- 8D Texaco Gas Plant inactive landfill - approximately 1,000 feet east of plant;
- 8D Texaco Gas Plant oil spill sump approximately 1,500 feet east of plant;
- 14D Texaco overflow sumps for Baker tank 460N;
- 28B Phillips tank setting #3, miscellaneous oil spills and 2 oil sumps;
- 20B ARCO Compressor station chrome spill site next to abandoned cooling tower and septic field that received chromate-containing cooling water blowdown.

4.5.2.3 Category III

1. Inactive waste disposal sites. There are 76 inactive waste disposal sites at NPR-1 that may present a potential to impact soils and surface water.

Seven sites and one additional group of approximately 62 sites have been identified by the NPRC as requiring further characterization for potential remediation. These sites contain wastes and contaminated soil that may cause contamination of ephemeral streams or present a hazard to people and site wildlife by direct contact. These sites are:

- chromium-contaminated sites (61 sites);
- 23S sump system (arsenic);
- 1A-6M sumps (arsenic);
- 4G W41 site (arsenic);
- 18R drilling mud tanks (arsenic);
- 35R gas plant sump (solvents);
- 3G gas plant south drainage; and
- contaminated soil at locations of removed underground petroleum storage tanks at 36S gas station.

An additional five sites that may present potential impact on soils and surface water were identified by the Phase I identification and assessment program, but were eliminated from characterization in Phase II work. Insufficient documentation was provided to justify this lack of characterization. These sites include:

- 2B drum storage area - (Williams report #63);

- 36S drum storage area - (Williams report #19);

- 25S solid waste surface dump - (Williams report #2);

- 10B salt water percolation sumps - (Williams report #64); and

- 13B salt water percolation sumps - (Williams report #65).

Two inactive waste disposal sites exist that have not been assessed as to their potential for impact on soils and surface water. These are:

- 36R abandoned gas plant - ash of unknown origin exists in the plant foundations, and sumping areas may exist in which soil is contaminated with aromatic hydrocarbons.

- 36S warehouse sump - may have received contaminated runoff from waste drum and PCB storage at warehouse and from oil/chemical spill on hillside west of 36S gas station.

2. Inadequate reporting and handling of hazardous material spills on NPR-1 and NPR-2. There is no system on NPR-2 and an inadequate system on NPR-1 to ensure proper reporting and handling of spills of hazardous materials. As a result, numerous undocumented spill sites exist at both NPR-1 and NPR-2 which present a potential impact to soil and surface water.

Detailed policies and procedures exist for assessing, reporting, and cleaning up chemical spills on NPR-1. However, spills are going unreported to NPRC environmental staff and, therefore, it is not known if they are properly handled in accordance with state and Federal regulations. Specific examples include:

- Spills of petroleum and/or chemicals on the hillside west of 36S gasoline storage tank believed to originate from elevated storage tanks just north of the gasoline storage tank;

- Glycol and therminol leaks on soil underneath piping runs at the LTS-1 and LTS-2 gas plants.

No procedures exist for reporting, assessing, and cleaning up chemical spills on NPR-2. Thus such spills on NPR-2 are unreported to NPRC environmental staff and are not properly handled.

4.5.2.4 Category IV

1. Deficiencies in coordination of activities at inactive waste sites. There are deficiencies in coordination concerning inactive waste disposal sites between site contractors and site operations staff and NPRC's environmental staff. Information concerning some construction activities and sampling and analysis results has not been provided to NPRC environmental staff in all cases. Generally, NPRC's environmental staff is provided Authorization for Expenditures and construction plans for review. However, detailed drilling location plans and revegetation plans have not always been provided. This has resulted in activities at two inactive waste disposal sites that may have caused the further spread of contamination or exacerbated the difficulty of characterization. These examples include:

   - 3G Gas Plant south drainage - a drill pad was constructed on this inactive waste disposal site in the Fall of 1987. A previous recommendation for site characterization had been made in a July 1987 report, but had yet to be carried out.

   - 1A-6M arsenic site - this inactive waste disposal site, where 500 sheep were killed in 1960, was partially disked as part of a revegetation program by site contractors after it had been identified as requiring further characterization.

Additionally, soil sampling and analysis data obtained by site contractor EG&G Energy Measurements, Inc. for arsenic, chromium and other contaminants as part of the revegetation program is not being provided to BPOI environmental staff to assist in the identification of potential new inactive disposal sites.

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APPENDIX A

SURVEY PARTICIPANTS

NAVAL PETROLEUM RESERVES IN CALIFORNIA
SURVEY PARTICIPANTS
MAY 9 - MAY 20, 1988

DOE

Team Leader	Richard Aiken
Assistant Team Leader	George Detsis

CONTRACT PERSONNEL

Coordinator	Kevin Walter (NUS Corporation)
Air	Roger Andes (NUS Corporation)
QA/Toxics	Mark Notich (NUS Corporation)
Surface Water	David Miserhimer (NUS Corporation)
Waste Management	Lynn Scholl (NUS Corporation)
Inactive Waste Sites	Kevin Walter (NUS Corporation)
Hydrogeology	William Murray (NUS Corporation)

APPENDIX B

SITE-SPECIFIC SURVEY ACTIVITIES

B.1 Pre-Survey Preparation

The DOE Office of Environmental Audit, Assistant Secretary for Environment, Safety and Health, selected a Survey team for the Naval Petroleum Reserves in California (NPRC) in late 1987. The site is operated by the DOE with support services provided by Bechtel Petroleum Operations, Inc. (BPOI) and EG&G Energy Measurements, Inc. (EG&G). Mr. Richard Aiken was designated the DOE Team Leader, and Mr. George Detsis the Assistant Team Leader. The remainder of the team was composed of contractor specialists from the NUS Corporation.

The Survey team members began reviewing the NPRC general environmental documents and reports in February 1988. Messrs. Aiken, Detsis, Walter, and Misenhimer conducted a pre-Survey site visit on March 1-3, 1988, to gain familiarity with key NPRC personnel and to tour the site. A cursory review of the data generated in response to an information request of November 25, 1987, was also conducted during the pre-Survey site visit. The request listed environmental information of interest to the Survey team for planning purposes. The Survey team reviewed the information generated prior to and during the pre-Survey visit, and subsequent additional information provided by the Site in late March pursuant to verbal requests of the Survey Team. A Survey Plan for NPRC was then prepared. This plan discussed the specific approach to the Survey for each of the technical disciplines and included a proposed schedule of activities for on-site activities. The Survey Plan was transmitted to NPRC on April 18, 1988.

B.2 On-site Activities

The on-site portion of the Survey of NPRC was conducted during the period of May 9 to May 20, 1988. The opening meeting held on May 9, 1988, was attended by representatives from NPRC and by the Survey team members. Discussions during this meeting centered on the purpose of the Survey, logistics at NPRC, and an introduction of the key personnel involved.

During the Survey, team members reviewed file materials, permits and applications, background studies, engineering drawings, accident reports, and operating logbooks. The production process was thoroughly analyzed to identify existing and

potential pollutants. Site operations were observed. Extensive interviews were conducted with plant personnel regarding environmental controls, operations, monitoring and analysis, past operations, regulatory permits, and waste management.

Daily meetings of the Survey team members were held to report observations and compare findings. A representative from the BPOI Environmental Services Department met daily with the DOE Team Leader or Assistant Team Leader to arrange for specific site personnel and facilities to be available, as needed, on the following day. BPOI or EG&G personnel accompanied Survey team members on all field reconnaissances.

The Survey team members did not identify any further Sampling and Analysis (S&A) requirements necessary to complete the Survey effort. The S&A requirements were discussed by the team on May 18, 1988. The Oak Ridge National Laboratory (ORNL) was designated by DOE to provide a sampling team for NPRC and to perform the laboratory analytical services, had S&A been required.

A site closeout briefing was held on May 20, 1988, where the DOE Team Leader and Assistant Team Leader presented the preliminary environmental findings of the Environmental Survey. These environmental findings were classified as preliminary, because additional research was required to positively confirm the observations.

B.3 Report Preparation

An Environmental Survey Preliminary Report for NPRC will be prepared to summarize the findings from the on-site Survey effort. This report will be provided to NPRC for review. The findings presented in the Preliminary Report are considered preliminary and subject to modifications until comments are received. At that time, the findings will be modified and incorporated into the Environmental Survey Summary Report.

APPENDIX C

SURVEY PLAN

ENVIRONMENTAL SURVEY PLAN

NAVAL PETROLEUM RESERVES IN CALIFORNIA

MAY 9 - 20, 1988

TUPMAN, CALIFORNIA

TABLE OF CONTENTS

1.0 INTRODUCTION

The Environmental Survey is a one-time baseline inventory of existing environmental problems and environmental risks at DOE operating facilities. It will be conducted in accordance with the principles and procedures contained in the DOE Environmental Survey Manual of August 1987.

The Environmental Survey is an internal management tool to aid the Secretary of Energy in identifying current and potential environmental problems in all of DOE's facilities and in prioritizing these problems for appropriate corrective actions.

2.0 SURVEY IMPLEMENTATION

The Environmental Survey of the Naval Petroleum Reserves in California (NPRC) will be managed by the Team Leader, Richard Aiken, and the Assistant Team Leader, George Detsis. Ted Anderson of the U.S. Department of Energy (DOE) will serve as the NPRC site contact person. Technical support will be provided by the following NUS Corporation personnel:

Kevin Walter	Coordinator & Inactive Waste Sites/Releases
Roger Andes	Air
David Misenhimer	Surface Water
Lynn Scholl	Waste Management
William Murray	Hydrogeology
Mark Notich	Toxic Substances and Quality Assurance

2.1 Pre-Survey Activities

Members of the Survey team began reviewing NPRC environmental documentation available at the DOE Office of Environmental Audit in February 1988. Messrs. Aiken, Detsis, Misenhimer, and Walter conducted a pre-Survey site visit on March 1-3, 1988, to become familiar with the site, to identify any potential environmental problems, and to coordinate plans for the upcoming Survey. During the pre-Survey visit, the team met with representatives of DOE; management and operations contractor, BPOI; and endangered species support contractor, EG&G. In addition, the team toured the facility and discussed documents assembled by site personnel in response to an information request memorandum (November 25, 1987). This Survey Plan is based upon the information received by the Survey team as of April 4, 1988.

In addition, an all-day Federal/State/County regulatory agency meeting was conducted on March 3, 1988. The DOE Team Leader Richard Aiken presented the purpose, scope, and objectives of the Environmental Survey and purpose of the pre-Survey site visit. Each agency representative was given 15 minutes to present their agency concerns relative to NPRC. Following this regulatory agency meeting, a closeout with the NPRC Director and his staff was conducted by the DOE Team Leader Richard Aiken and Assistant Team Leader George Detsis.

2.2 On-Site Activities and Reports

The Environmental Survey for NPRC will be conducted from May 9 through May 20 1988. The agenda for the on-site visit is shown on the attached table. Modifications to this agenda will be made during the conduct of the Survey. All modifications will be coordinated with the site officials designated as Survey contacts and in particular with Ted Anderson. The on-site activities of the Survey team will consist of interviews and consultations with, among others, environmental, safety, operations, waste management, purchasing, and warehousing personnel; a review of files and documents unavailable prior to the on-site portion of the Survey; and process-specific and area-specific tours of the facility.

A closeout briefing will be conducted on Friday morning, May 20, 1988, to present initial environmental findings on the on-site activities. A Preliminary Report of the Survey will be issued in the spring of 1989. Subsequently, an Interim Report will be prepared by the Survey team following the completion of the Sampling and Analysis Report (if sampling and analysis is identified during the Survey to help validate environmental problems). The Interim Report will reflect the data from the sample analyses as well as the technical accuracy review comments from the Preliminary Report. The findings from the 37 Surveys, as presented in the various site Interim Reports, will be updated as appropriate and included in the Environmental Survey Summary Report to the Secretary of Energy. This Summary Report is scheduled for completion in 1989.

2.3 Sampling and Analysis

Based upon the results of the on-site portion of the Survey, the Survey team will identify any sampling needs. Sampling and analysis (S&A) for the NPRC Survey will be conducted, if necessary, by a team from Idaho National Engineering Laboratory (INEL) in late 1988. The INEL S&A team will draft an S&A Plan based upon the needs identified by the Survey team.

The Assistant Team Leader, George Detsis, will coordinate the review of this S&A Plan with the U.S. Environmental Protection Agency (EPA) Laboratory at Las Vegas, which has quality assurance responsibility for the Survey's S&A efforts. Sampling at most facilities takes between 3 and 5 weeks to complete, depending on the

complexity of the sampling needs of each facility. Analysis of the samples will be conducted following protocols provided in the Environmental Survey Manual, supplemented by the NPRC S&A Plan. Results of the S&A will be transmitted to the Survey Team Leader for incorporation into the Interim Report.

3.0 AIR

3.1 Issue Identification

The air-related Survey activities will involve an assessment of the air emission sources within the facility and of any administrative and technological emission controls applied to the sources. The emphasis of the Survey will be on operational and procedural practices associated with the emission sources and any emission control equipment.

The general approach to the Survey will include a review of any existing air permits, pending applications, and standard operating procedures. Processes and control equipment will be investigated. The Survey will also review any emissions monitoring data for the different sources in the facility, evaluate any existing controls applied to the air contaminant emissions, and assess the need for additional monitoring or emission controls to characterize or reduce the environmental consequences of the emissions.

Areas of particular interest will include emissions of the criteria pollutants (i.e., particulates, sulfur oxides, nitrogen oxides, hydrocarbons, carbon monoxide, and lead) from fuel-burning engines and oil/gas facilities; as well as emissions of radon-222, which is present in trace amounts in wet gas taken from wellheads.

Visitation points and topics of particular interest that will be examined during the Survey include: the four gas plants on NPR-1 (at 3G, 35R, LTS1, LTS2), and the gas plant on NPR-2 operated by Texaco; all compressor stations on NPRC located on DOE-owned land; and typical tank settings in both the Shallow and Stevens Oil Zones.

3.2 Records Required

In addition to those documents reviewed prior to the Survey, the following records will be examined at NPRC:

- Plans for future reductions of NO_X and hydrocarbon emissions;

- Air permits (registrations, construction, and operation);
- Source and emissions inventories (including any tank and vent inventory);
- Emission test data, emission calculations, and emission offset determinations;
- Descriptive documentation on inspection and maintenance of controls;
- Maintenance records for engines, compressors, tanks, and vehicles;
- Environmental inspection records for NPR-1 and NPR-2;
- Standard operating procedures for process and control equipment;
- Correspondence with regulatory agencies and any citizen's complaints relative to air issues;
- Reports on accidental or unplanned releases of airborne substances; and
- Other records as determined on-site.

4.0 SURFACE WATER/DRINKING WATER

4.1 Issue Identification

A review of the present condition of the wastewater collection and treatment systems will be made. NPRC process activities that generate wastewaters will be reviewed through a detailed process tour. Discrete process liquid discharge points will be identified and evaluated to develop an inventory of wastewater sources. Liquid waste treatment, collection, and handling equipment will be examined and records of operations will be reviewed.

The review by surface water and hazardous waste specialists will be performed in unison for most buildings and activities due to a common need to review processes and waste discharge points. Buildings will be examined to view normal activities including maintenance activities generating process wastewaters and other liquid wastes. In addition, a record review session will be scheduled to review drawings and materials pertaining to wastewater and stormwater treatment operations and maintenance.

Extensive reviews will also be made of possible undetected sources of contaminants flowing to interior floor drains, storm drains, and septic disposal systems. This will require review of gas plant production schematic drawings, visits to the respective areas around production facilities and a thorough tour of production buildings, particularly areas where the ground surface is or was known to be contaminated.

Visitation points and topics of particular interest that will be examined during the Survey include: Valley Waste disposal areas; spill prevention control and countermeasures (SPCC) provisions (including the use of gulley plugs) for fuels and hazardous materials at storage facility areas; sewage collection and treatment systems; water quality data for potable water; wastewater sumps; areas where chemical solvents are handled and may enter sewage collection systems such as at gas plants; and areas near the California Aqueduct.

4.2 Records Required

In addition to those documents reviewed prior to the Survey, the following records will be examined at NPRC:

- Wastewater discharge permits (if any);
- Detailed drawings of the process, storm, and sanitary sewer system and the domestic and process water systems both within buildings and in yard areas;
- Detailed drawings of the domestic and process water supply distribution systems;
- Locations of all sewage treatment facilities (i.e., septic tanks, leach fields)
- Additional schematic diagrams and/or descriptions of all production processes;
- SPCC Plan for the site, covering all fuel and hazardous material storage units;
- Procedures for collecting wastewater samples;
- Reports on the potable water systems;
- Records of drinking water quality both on- and off-site;
- Sampling logbooks and laboratory tracking reports;
- Progress reports and/or final reports for previous or on-going waste characterization studies or evaluations of wastewater control and treatment options;
- Small water system permits issued by the Kern County Health Department;

- Internal memos and correspondence relating to surface water/drinking water problems;
- Applicable water quality standards for surface waters in the vicinity of NPRC;
- Basin Water Quality Control Plan and amendments;
- Kern County Health Department requirements for small water system permits;
- Other records as determined on-site.

5.0 WASTE MANAGEMENT

5.1 Issue Identification

The procedure for the waste management investigation is to review known sources or activities that produce waste (including gases, liquids, and solids) and identify any additional sources or activities which have the potential to result in contamination of environmental media.

The waste management portion of the Survey will concentrate on those facilities and processes with the potential to generate hazardous wastes, toxic substances, and petroleum related wastes. Specifically, the sources of waste streams such as maintenance chemical wastes (lubricants, paints, oils, solvents, etc.), tank bottoms, sodium fluoride, well wastewater, truck and drum cleaning wastes, trash, coolant fluids, compressor oil, and pigging and drilling wastes will be examined. In addition, the Survey team will devote a significant portion of the time on-site to a detailed process-by-process investigation of possible additional hazardous waste generation, treatment, storage, disposal, and release points.

Discussions will be held with individuals knowledgeable of current and past waste management practices. The methods of generation, collection, storage, and disposal of solid wastes will be reviewed to determine if they result in environmental problems. This will be accomplished during the process tour, and by reviewing facility records and documentation.

Visitation points and topics of particular interest that will be examined during the Survey include: LTS1 and LTS2; the 3G gas plant; the 35R dehydration/LACT facility and gas plant; compressor plants; the 35R ponds, sumps, landfills, and truck washout station; the 36S administration area; the 27R waste management facility/trenches/landfarm, truck washout station, and oil recovery impoundment; the 2B chemical drum storage area; the 10G landfill/landfarm; and NPR-2 sumps and the Valley Waste disposal site.

5.2 Records Required

In addition to those documents reviewed prior to the Survey, the following records will be reviewed at NPRC:

- Waste analysis plans;
- Waste analysis results;
- Waste generation/release summaries;
- Waste disposal summaries;
- Inspection documentation (state and Federal);
- Internal facility inspection documentation;
- Any release notification or occurrence documentation;
- Any enforcement action documentation;
- Any additional waste transportation manifests;
- Correspondence with regulatory agencies on solid waste;
- Records dealing with the reuse/recycling of wastes; and
- Other records as determined on-site.

6.0 HYDROGEOLOGY

6.1 Issues Identification

The preliminary review of available information identifies several areas of review for groundwater conditions. The first area focuses on historical practices for disposal of wastewater to sumps and pits. The next area of focus is on current practice for disposal of produced waters by sumping and by injection wells. The third area of focus is abandoned wells. The Survey will focus on these three aspects of wastewater disposal and will also review other potential sources of groundwater contamination including surface spills and releases, drilling and additives, treatment fluids, and others.

Visitation points and topics of particular interest that will be examined during the Survey include: all produced water disposal ponds and typical injection wells including Valley Waste disposal facilities that affect DOE-owned land; water flood areas in NPRC; and typical abandoned wells.

6.2 Records Required

In addition to those documents reviewed prior to the Survey, the following records will be examined at NPRC:

- Historical aerial photographs, as available;
- Well abandonment procedures and records;
- Records on injection operations;
- Chemical additives used in drilling fluids and in well treatment; and
- Other records as determined on-site.

7.0 INACTIVE WASTE SITES/RELEASES

7.1 Issue Identification

The objective of this portion of the Survey will be to identify and summarize environmental problems at or emanating from NPRC which are caused by the following historical activities concerning hazardous wastes and toxic substances, or mixed radioactive and hazardous wastes:

- Past waste disposal areas on-site that have been identified;
- Areas on-site where past undocumented disposal may have occurred;
- Areas on-site where leaks, spills, or inadvertent disposal may have created ongoing sources of contamination or traceable plumes of surface or subsurface contamination.

This effort will also include a review of existing documentation concerning off-site areas that were used during the history of the facility. The results of an inactive waste site investigation and characterization for NPR-1 have been reviewed. However, very little documentation has been provided about buried or spilled hazardous materials on NPR-2. Of particular concern at both NPR-1 and NPR-2 is the potential for continuing releases of pollutants from historical holding or staging areas for waste chemicals, and contaminated areas around well drilling sites.

The inactive sites and releases portion of the Survey, since it relates to past handling as well as disposal of hazardous chemicals/waste, will be coordinated with the waste management and toxic substances Survey team specialists. To a lesser extent, the surface water portion of the Survey will be included in this coordination to check for storm and surface drainage or unknown/unpermitted subsurface disposal of water that may form a migration pathway for any source of hazardous chemical waste. Lastly, since subsurface water is the primary mode of migration for buried wastes, this portion of the Survey will be coordinated with the hydrogeology specialist.

Visitation points and topics of particular interest that will be examined during the Survey include: identified areas of hazardous material disposal on NPRC including sites of soil contamination with chromium (especially the 13 newly identified sites discovered during routine soil analyses performed under the habitat restoration program), arsenic spills and burial areas, and spills of solvents and drilling additives; areas of surface contamination at NPRC that may have been remediated by removal; landfills and past disposal areas at 26S, 36R, 4G, 10G, 35R and 27R; and areas of potential spills at 36S, 2B, and the five gas plants at NPRC.

7.2 Records Required

In addition to those documents reviewed prior to the Survey, the following records will be examined at NPRC:

- Available soil boring logs from the various buildings constructed on-site;
- Historic aerial photos from the 1983 Survey of NPR-1 and NPR-2 and the 1977 county-wide survey;
- EG&G field notes from the 1979 and 1984 field walks of NPR-1 and NPR-2;
- Notifications and internal records of spills/releases;
- Site topography drawings;
- Records of facility expansion and building destruction;
- Historical local files on waste handling/disposal; and
- Other records as determined on-site.

8.0 TOXIC SUBSTANCES AND QUALITY ASSURANCE

8.1 Issue Identification

The toxic Survey will include all raw materials and process-related chemicals used at NPRC. Use, handling, and disposal of polychlorinated biphenyls (PCBs), pesticides, herbicides, asbestos, and other hazardous substances will be within the scope of this effort.

All toxic and hazardous substances purchased, used, or manufactured on the Petroleum Reserves will be evaluated. Tracking, control, and management of these substances will be reviewed. Records of usage will be evaluated to determine the potential for entering effluent streams.

The inventory of PCB-contaminated electrical equipment in use at the facility will be reviewed for completeness. The condition of this equipment, its potential for leakage, and the quantity of contaminated fluids will be identified during the Survey. Obsolete or used PCB-contaminated items in storage will be inspected for proper container/packaging, adequate storage protection requirements, and inventory controls. Disposal practices will be reviewed for current and past inventories to determine the method of disposal and location of disposal sites. Procedures for PCB analysis, removal, handling, and disposal will be reviewed. Inspection and reporting requirements for PCB transformers will be evaluated in an effort to focus the Survey team's attention on potential problem areas.

Pesticide/herbicide usage on the site will be reviewed including application records, storage and disposal practices, and environmental monitoring to assess risk for environmental contamination.

Aboveground and underground storage tanks will be reviewed for physical appearance, compatibility with stored material, inspection or tightness records, inventory monitoring records, and maintenance records.

A review of the status of the asbestos removal and disposal program including recordkeeping will also be conducted, and disposal sites will be visited to define potential areas of concern.

The quality assurance portion of the Environmental Survey will involve review of the NPRC's sampling and analytical program. The intent will be to verify and review the quality assurance procedures for obtaining environmental samples, performing the analytical work to identify the concentration of pollutants, and the handling and reporting of data.

The procedures for sampling and analysis conducted by the subcontractor laboratories for NPRC will be monitored to ensure proper implementation and conformance to regulatory agency requirements.

Visitation points and topics of particular interest that will be examined during the Survey include: records and inventories of aboveground and underground storage tanks; areas of storage and handling of pesticides and herbicides; and major storage areas for toxic products that are used at NPRC.

8.2 Records Required

In addition to those documents reviewed prior to the Survey, the following records will be examined at NPRC:

- Toxic substances labeling and tracking system;
- Procedures for handling, control, and management of toxic substances;
- Inventory of toxic substances and purchasing records of chemical substances;
- PCB annual inventory documents;
- Inventory of current PCB-contaminated electrical equipment;
- Records of inspections of PCB transformers;
- Storage records of PCB items;

- Disposal records for PCB items;
- PCB handling, storage, and disposal procedures;
- Correspondence with fire department on PCB transformers;
- Pesticide/herbicide training, handling, storage, disposal records, and environmental monitoring;
- Standard operating procedures for pesticides/herbicides;
- Storage tank inventory records;
- Storage tank maintenance records;
- Asbestos handling, removal, disposal procedures, and environmental monitoring;
- Records of asbestos use in process equipment and support facilities and locations of buildings containing asbestos;
- QA/QC records received from contractor labs;
- Sampling and sample handling procedures; and
- Environmental monitoring data.

9.0 RADIATION

9.1 Issue Identification

Normally, the radiation investigation involves an assessment of the facility-wide radioactive emissions, emissions control and monitoring, and the associated impact on the environment. It includes discharges to the atmosphere, surface water, groundwater, soils, and off-site disposal.

Based on information available to the Survey, it appears that NPRC does not now, and has never in its history of operations, processed, treated, or stored radiological material. The radiation portion of the Survey will be a review of records to verify this information. This review will be performed by the Waste Management specialist.

Wet gas, as taken from the wellhead, always contains trace amounts of radon-222, a radioactive gas, which is concentrated in the gas plants into the ethane and propane fractions. Any potential environmental hazard caused by this occurrence will be reviewed by the air specialist.

9.2 Records Required

- Reports, studies or records concerning the presence and control of radon-222 gas at NPRC.

10.0 SAMPLING AND ANALYSIS

10.1 Issue Identification

The Toxic Substances and Quality Assurance specialist from the Environmental Survey team will serve as the S&A team liaison and will coordinate sampling requests with the DOE Assistant Team Leader George Detsis. Requests for sampling will be prepared during the week of May 16-20, 1988.

If sampling is required at NPRC, representatives from Idaho National Engineering Laboratory (INEL) will perform the S&A phase of the Survey.

10.2 Records Required

There are no records review requirements for S&A.

TABLE 1
ENVIRONMENTAL SURVEY ON-SITE AGENDA
NAVAL PETROLEUM RESERVES IN CALIFORNIA (NPRC) MAY 9-20, 1988

	Air	Surface Water/ Drinking Water	Waste Management	Hydrogeology	Inactive Waste Sites/Releases	Toxic Substances & Quality Assurance
Monday 5/9						
A.M	Orientation and facility tour	Orientation and facility tour	Orientation and facility tour	Orientation and facility tour	Orientation and facility tour	Orientation and facility tour
P.M						
Tuesday 5/10						
A.M	35R Gas Plant 3G Gas Plant	LTS 1&2 (with waste mgmt)	LTS 1&2 (with surface water)	Review EG&G aerial photos and field walk notes	Review EG&G aerial photos and field walk notes, all day.	PCBs Tour of 2B, 36S, 3G gas plant transformers
P.M	LTS 1&2	Septic tank records NPR-1&2	35R - dehydration/LACT facility compressor plant	Well abandonment record review		PCBs - records review (11G)
Wednesday 5/11						
A.M	Gas plant revisits	Wastewater disposal sumps and wells 14Z, 24Z, 26Z, 8G, 10G, 18G (with hydrogeology), all day.	35R ponds, sumps, landfills, truck washout stations (with inactive waste sites/releases)	Wastewater disposal sumps and wells 14Z, 24Z, 26Z, 8G, 10G, 18G (with surface water), all day.	35R ponds, sumps, landfills, truck washout stations (with Waste Mgmt)	Pesticides/herbicides tour of storage sites & documentation review (11G)
P.M	compressor stations (17R, 30R, 32R, 33R, 33S) vapor recovery systems VT3-60, VT1 86, etc		36S Administration Area (with inactive waste sites/releases)		36S Administration area (with Waste Mgmt)	Underground storage tanks - tour & records review, 36S Administration Area
Thursday 5/12						
A.M. & P.M.	NPR-2 site inspection including Texaco gas plant	NPR-2 site inspection including Texaco gas plant	27R (trenches/waste management facilities, truck washout area, landfarm area, oil recovery impoundment)	Injections/water floods programs and records	NPR-2 site inspection including Texaco gas plant	NPR-2 site inspection including Texaco gas plant
Friday 5/13						
A.M	Observe maintenance & installation of compressor engine exhaust controls and examine testing records of engine exhaust	Fresh water chlorination, pumping, and storage: records review, tour of facilities, observe sampling and analysis.	27R waste sampling and analysis procedures and data review	Waterflood tour	26S east & west landfills 10G disposal site	Aboveground storage tanks 18G, 25S, etc.
P.M	Records review	Records review	2B chemical drum storage 10G landfill/landfarm and records review	Waste disposal 27R, 10G, 35R and records review	4G, 36R disposal sites and records review	Records review

TABLE 1 (Continued)
ENVIRONMENTAL SURVEY ON-SITE AGENDA
NAVAL PETROLEUM RESERVES IN CALIFORNIA (NPRC) MAY 9-20, 1988

	Air	Surface Water/ Drinking Water	Waste Management	Hydrogeology	Inactive Waste Sites/Releases	Toxic Substances & Quality Assurance
Monday 5/16						
A M	Tank leak test methods record and procedure review - tank testing program	NPR-2 sumps and Valley Waste facilities (with waste mgmt & hydrogeology)	NPR-2 sumps and Valley waste Facilities (with surface water and hydrogeology).	NPR-2 sumps and Valley Waste Facilities (with surface water and waste mgmt).	review waste disposal and spill records, including chromium (Cr), arsenic (As) site records, 27R, 18R, and inspect selected Cr, As spills	Tank leak test methods record and procedure review - tank testing program. Proprietary materials storage tank tour and record review
P M	Tank settings 1-7R STV, 18G pond	30R compressor plant 35R area 25S tank farm 36S admin area			30R compressor plant 35R area 25S tank farm	
Tuesday 5/17						
A M	Vehicle emissions inspection and maintenance program review	Asbestos removal program record review	Hazardous and non-hazardous waste generation and manifest records review	NPR-2 continued	NPR-2 revisits	Quality Assurance/Quality Control records review (11G)
P M	Observe sampling and analysis	35R and 3G gas plants SPCC review	35R and 3G gas plants, review waste handling training	Review historical groundwater sampling and analysis procedures	35R and 3G gas plants	Toxic chemical storage tour and procedures review 36S admin area, 2B
Wednesday 5/18						
A M	Findings development Sampling and analysis needs development	Tour of Taft wastewater irrigations fields Findings development & Sampling and analysis needs development	Findings development Sampling and analysis needs development	Tour of Taft wastewater irrigations fields Findings development & Sampling and analysis needs development	Findings development & Sampling and analysis needs development	Findings development & Sampling and analysis needs development
P M	Debrief Team Leader and Asst Team Leader	Debrief Team Leader and Asst Team Leader	Debrief Team Leader and Asst Team Leader	Debrief Team Leader and Asst Team Leader	Debrief Team Leader and Asst Team Leader	Debrief Team Leader and Asst Team Leader
Thursday 5/19						
A M	Records review and revisits	Records review and revisits	Records review and revisits	Records review and revisits	Records review and revisits	Records review and revisits
P M	Closeout briefing	Closeout briefing	Closeout briefing	Closeout briefing	Closeout briefing	Closeout briefing

APPENDIX D

LIST OF CHEMICAL SYMBOLS, ABBREVIATIONS, AND ACRONYMS

LIST OF CHEMICAL SYMBOLS, ABBREVIATIONS, AND ACRONYMS

AQCR	Air Quality Control Region
AST	aboveground storage tank
bbl	barrel(s)
bbl/day	barrel(s) per day
bbl/yr	barrel(s) per year
bhp	brake horsepower
BOD	biochemical oxygen demand
BOPD	barrel(s) oil per day
BPOI	Bechtel Petroleum Operations, Inc.
BS&W	basic sediment and water
Btu	British thermal unit(s)
BWPD	barrel(s) water per day
°C	degree(s) Centigrade
CARB	California Air Resources Board
CDFA	California Department of Food and Agriculture
CDHS	California Department of Health Services
CEARP	Comprehensive Environmental Assessment and Response Program
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cm/sec	centimeter(s) per second
cm^3	cubic centimeter(s)
CO	carbon monoxide
DEIS	Draft Environmental Impact Statement
DOE	U.S. Department of Energy
DOG	Division of Oil and Gas
DHS	Department of Health Services
EG&G	EG&G Energy Measurements, Inc.
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ERDA	Energy Research and Development Administration
EUD	Electrical Utilities Department
°F	degree(s) Fahrenheit
FEIS	Final Environmental Impact Statement
FFL	Fireman's Fund Laboratories
ft^2	square foot
ft^3	cubic foot
ft^3/min	cubic foot per minute
ft^3/sec	cubic foot per second
ft^3/yr	cubic foot per year
FWS	U.S. Fish and Wildlife Service
FY	Fiscal year
g	gram(s)
gal	gallon(s)
g/hp-hr	grain(s) per horsepower hour
gal/hr	gallon(s) per hour

gpd	gallon(s) per day
gpm	gallon(s) per minute
HC	hydrocarbon
Hi-Vol	High Volume Air Sampler
hp	horsepower
HPI	High Pressure Injection
HW	hazardous waste
IH	Industrial Hygiene
in./hr	inch(es) per hour
IWE	Industrial Waste Engineering
KCAPCD	Kern County Air Pollution Control District
KCHD	Kern County Health Department
k	kilo (1000)
kg	kilogram(s)
km	kilometer(s)
L	liter
LACT	Lease Automatic Custody Transfer
lb	pound
lb/day	pound(s) per day
LPG	Liquefied Petroleum Gas
LTS	Low Temperature Separation (gas plants 1 and 2)
m	milli (1/1000)
m^3	cubic meter(s)
MCL	maximum contaminant level
µ	micro (10^{-6} gram)
µg	microgram(s) (10^{-6} gram)
$\mu g/m^3$	microgram(s) per cubic meter
mg	milligram (1/1000 gram)
mgd	million gallons per day
mg/L	milligram(s) per liter
MMBtu/hr	million British thermal units per hour
mmcf	million cubic feet
mmcfd	million cubic feet per day
mmscfd	million standard cubic feet per day
mL	milliliter(s)
mph	mile(s) per hour
mr/hr	millirem per hour
mR/hr	milliroentgen per hour
MSCF	thousand standard cubic feet
mscfd	thousand standard cubic feet per day
MSDS	Material Safety Data Sheet
MW	mixed waste
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NOAA	National Oceanic and Atmospheric Administration
NO_x	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System

NPRC	Naval Petroleum Reserves in California
NPR-1	Naval Petroleum Reserve-1
NPR-2	Naval Petroleum Reserve-2
OSHA	U.S. Occupational Safety and Health Administration
O_3	ozone
PCB	polychlorinated biphenyl
PCC	precombustion chamber
POTW	publicly owned treatment works
ppb	part(s) per billion
PM_{10}	airborne particulate matter with an aerodynamic diameter less than or equal to 10 micrometers
ppm	part(s) per million
PSC	pre-stratified charge
PSD	Prevention of Significant Deterioration
psi	pound(s) per square inch
psig	pound(s) per square inch gauge
PWI	Petroleum Waste, Incorporated
QA	quality assurance
QC	quality control
RCRA	Resource Conservation and Recovery Act of 1976
RSCL	recommended soil cleanup level
SARA	Superfund Amendments and Reauthorization Act
SO_2	sulfur dioxide
SOZ	Shallow Oil Zone
SPCC	Spill Prevention, Control, and Countermeasure Plan
STLC	Soluble Threshold Limit Concentration
STV	Stevens Zone
T	temperature
TCA	trichloroethane
TCE	trichloroethylene
TDS	total dissolved solids
TSD	transportation, storage, and disposal
TSP	total suspended particulates
TTLC	Total Threshold Limit Concentration
UPC	Unit Plan Contract
USGS	U.S. Geological Survey
USPCI	U.S. Pollution Control, Incorporated
UST	underground storage tank
VRT	Vapor Recovery Tank
WBEC	Williams Brothers Engineering Company
WKCWD	West Kern County Water District
WWTP	wastewater treatment plant
yd^3	cubic yard(s)

END

DATE FILMED

11/16/90