2100.38.243

Summary Site Assessment Report
Port of Anchorage Area
Anchorage, Alaska

July, 1992

Petroleum Users Group
Port of Anchorage
2000 Anchorage Port Road
Anchorage, Alaska 99501

SHANNON & WILSON, INC.
5430 Fairbanks Street, Suite 3
Anchorage, AK 99518
(907) 561-2120

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

LIST OF TABLES

LIST OF FIGURES

LIST OF SHEETS

Table of Contents

EXECUTIVE SUMMARY

The Petroleum Users Group, PUG, was founded in an attempt to organize and encourage all Port of Anchorage, POA, vicinity land owners and land users to work in a cooperative effort to manage the environmental concerns related to petroleum hydrocarbon impacted soil and water within a defined POA-PUG area. The PUG hired Shannon & Wilson to gather the existing site assessment data that is available for areas within the POA-PUG area and prepare a summary site assessment report. The objective of this work was to identify existing data gaps within the POA-PUG area where no or little environmental assessment information is available.

Information in which to complete the summary site assessment report was gathered from several sources. Individual PUG members provided copies of site assessment reports and other informative documents to the POA data room and lists of documented spills that have occurred at each of the facilities. Other assessment reports as well as historical documents for geotechnical studies conducted as a result of the 1964 Good Friday Earthquake and for general development within the port area were available for review at the Alaska Department of Environmental Conservation, ADEC, files and the Shannon & Wilson files. Regulatory agency data bases were searched for information regarding historical spills.

To supplement the summary site assessment report, an Autocad basemap of the POA-PUG study area was developed by Tryck Nyman Hayes, Inc. The basemap was developed from existing data gathered from composite drawings, legal descriptions and as-built drawings and includes topographic features, locations of structures, utility easements, locations of former environmental borings and monitoring wells and other pertinent features.

Based on the available information, a total of 187 soil borings and 87 monitoring wells have been drilled within the POA-PUG area for environmental purposes in addition to numerous geotechnical borings. Both soil and water samples have been collected and analyzed for the presence of petroleum hydrocarbons. Documented petroleum hydrocarbon impacted soils and/or water are located within the parcels leased by each of the six bulk fuel facilities within the POA-PUG area and at the Port of Anchorage south transit yard.

Information regarding environmental site assessment activities was not available for about one half of the designated POA-PUG area. Parcels leased by Tote, Lonestar Cement No. 1, Sea-Land, Lonestar Cement No. 2, Chugach Electric, Alaska Resources Corp., North Star Terminal & Stevedore Co., Douglas Management Co., Western Insulfoam, Kyokyu USA Inc., and JoAnn Pickworth have had no assessment work completed on their leased parcels or the information was

not available for review during development of this report. These parcels are located primarily along the northern and southern boundaries of the POA-PUG area. In addition, limited information is available for the Anchorage Fueling & Service Company terminal, the south half of the Tesoro Alaska terminal and the northern portion of the Port of Anchorage facility.

In order to alleviate these identified data gaps within the POA-PUG area, it is recommended that a preliminary site assessment and a field investigation for each parcel with no or little environmental information be conducted. This study will aid in identifying potential petroleum hydrocarbon sources within each of the parcels and assessing if impacted soils and waters are present.

SUMMARY SITE ASSESSMENT REPORT
PORT OF ANCHORAGE AREA
ANCHORAGE, ALASKA

1.0 INTRODUCTION

The Port of Anchorage located north of downtown Anchorage along the east side of Knik Arm is an industrialized area with predominantly bulk fuel and marine based businesses. Due to the nature of these businesses, numerous above and below ground fuel storage tanks and pipelines are located within the area. In addition, fuel is transported by rail car and trucks along the access roads between the port and the city. Petroleum hydrocarbons are also found at the marine type facilities. Releases of petroleum hydrocarbons at locations throughout the port area have been documented and have resulted in the impact of the area's subsurface soils and waters. The Petroleum Users Group was formed in order to address the environmental concerns that have arisen due to the petroleum impacted soils and waters.

The Petroleum Users Group, PUG, was founded in an attempt to organize and encourage all Port of Anchorage, POA, vicinity land owners and land users to work in a cooperative effort to manage the environmental concerns related to petroleum hydrocarbon impacted soil and water within the POA area. It was recognized that a cooperative effort would be more successful and would cost less than if each responsible party attempted their own characterization and/or remediation efforts.

This report presents the results of summary site assessment activities conducted on the PUG-POA area which is shown on Figure 1 and Sheets 1 through 4. The primary focus for the summary site assessment activities included reviewing and summarizing existing environmental reports that had been developed for individual parcels within the PUG-POA area and developing an Autocad basemap of the area showing pertinent site features. The purpose of the work was to compile the known information about the project area, consolidate the information into detailed tables, figures, maps and cross sections and to summarize the findings from previous assessment reports that have been conducted for individual parcels located within the POA-PUG area. Based on this information existing data gaps with regards to environmental issues were identified. This summary report may be used by the POA-PUG Executive and Technical Committees to develop a comprehensive follow-up study to characterize petroleum hydrocarbon impacted soil and water within the areas of existing data gaps. Authorization to proceed with this work was received on March 26, 1992, from the Petroleum Users Group in the form of a signed contract agreement.

2.0 PROJECT DESCRIPTION

This project includes developing a summary site assessment report and an Autocad basemap of the POA area showing pertinent site features. The summary site assessment report was developed from existing information pertaining to both the environmental concerns of the area and the site history. A total of 29 aerial photographs of the port area from the years of 1950, 1959, 1962 to 1965, 1967 to 1968 and 1970 to 1991 were purchased from Aeromap, USA. The majority of the photographs were developed at a scale of 1 inch equal to 800 feet such that the entire POA-PUG area would be included on an 8 by 11 print. Photo quality copies of each photograph are included in Appendix A. Information regarding the port area historical development including the placement of fill within the tidal flats was collected from a review of the photographs. Existing documents including environmental assessment reports were reviewed for information pertaining to past environmental monitoring, sampling and remediation activities conducted in the port area, historical development of the port area and site geology and hydrology. The majority of the reports were available from the POA data room, however, several of the sources were also gathered from the Alaska Department of Environmental Conservation, ADEC, records and Shannon & Wilson's files. Information regarding the documented spill histories for each of the bulk fuel facilities within the POA area was gathered from the individual PUG members.

For additional information that was not available in the existing documents, the ADEC contaminated site data base system was searched for information regarding past spills within the port area. The ADEC Underground Storage Tank (UST) Section in Juneau was contacted for information about the presence of registered USTs within the area. In addition, the United States Coast Guard, USCG, was contacted for information on hazardous release calls that they have responded to in the area. Interviews with the local fire department and utility companies were also conducted in order to gather more information about area development and hazardous responses.

In order to reference the POA area and pertinent site features, an Autocad basemap of the defined POA-PUG area was developed by Tryck Nyman Hayes, Inc. from existing information taken from documents including as-built plans, legal descriptions and composite drawings. The basemap, developed at a scale of 1 inch equal to 100 feet in Sheets 1 to 4 includes pertinent area features such as topographic contours, the PUG boundary, pipeline routes/corridors, lessee boundaries and names, major structures, right of ways/easements and locations of environmental soil borings, monitoring wells and test holes.

A final summary site assessment report was developed which consolidated the information gathered into detailed tables, figures, maps and cross sections and summarized the findings from previous assessment reports that have been conducted for individual parcels located within the POA-PUG area. Based on this information, existing data gaps within the port area were identified.

3.0 SITE DESCRIPTION

The POA-PUG area is located north of downtown Anchorage in a developed industrialized area and is bordered by Knik Arm on the west, Elmendorf Air Force Base (EAFB) to the north and east and Ship Creek along the south as shown on the basemap, Sheets 1 through 4. The area runs about one and a half miles in length along Knik Arm and extends up to a half of mile east of the inlet.

The POA-PUG area is relatively flat lying along the western border adjacent to Knik Arm with a general elevation of about 20 to 30 feet above mean sea level. The topography rises steeply along the east boundary where the study area encompasses bluffs rising about 130 to 140 feet above mean sea level. Numerous minor landslides have occurred along the bluffs resulting in a hummocky like topographic relief throughout some of the bluff area.

The majority of the POA-PUG area is constructed on man made fill areas that were formerly either tidal flats or marsh lands. The fill throughout the area is up to a documented 20 feet in thickness and consists primarily of materials taken from borrow sources within the immediate area including outwash sands and gravels, dredged soils and landslide deposits. It has been stated that demolition debris resulting during cleanup after the 1964 earthquake were used as fill in the area.

The POA-PUG property is divided between federal, municipal and Alaska Railroad ownership with the majority of the land being leased to private companies. These private companies include petroleum, oil and lubricant (POL) tank farms as well as other marine, construction and transportation based businesses. The present day multi-industrial use of the port area includes container freight, construction and marine service businesses in addition to the storage and transportation of petroleum hydrocarbons via truck, rail, tanker and underground pipelines. Over 85 above ground storage tanks are located within the POA-PUG boundaries. In addition, eight bulk fuel underground storage tanks are also located within the study area.

4.0 HISTORY OF THE PORT OF ANCHORAGE

Information regarding the historical land development of the Port of Anchorage area was gathered from the twenty-nine aerial photographs and existing assessment reports developed for each individual leased parcel. The primary focus of the historical overview of the area was to identify major land use development within the port area including the filling of tidelands and marsh areas and the establishment of businesses.

The documented spill histories for each of the bulk fuel facilities were also reviewed for the summary report. Information pertaining to past spills involving petroleum hydrocarbons was received from individual PUG members. Additional information was gathered through the ADEC and USCG records.

4.1 Historical Land Development

From the time that Anchorage was established in 1914 by a group of Alaska Engineering Commission surveyors, the city has expanded to become the population center for the State of Alaska. The early social and economic growth of the city was centered in the vicinity of the lower Ship Creek area. The Alaska Railroad was headquartered in the port area in the 1920s along with dock facilities at the mouth of Ship Creek. Subsequently, canneries, and eventually city and private marine facilities have grown up centered at the creek and within the POA-PUG area. Based on a description from Updike and Carpenter (1986), settlement spread from the flood plain tidal flat area to the adjacent uplands which is now known as Government Hill and south to the Anchorage townsite. The majority of the development in the following 25 years was limited to these areas. The years from the beginning of World War II into the mid-1950s saw even further emphasis on the development of Government Hill and the near sea-level areas to the west and south into what has now become the land and sea transportation hub for south-central Alaska. This area, the Port of Anchorage, has remained central to the growth and well-being of the city and entire region.

A significant portion of the POA-PUG area is constructed on filled tidal flat areas. In addition, low marsh areas within the interior of the area have been historically filled. The beginning of the filling of the area began in about 1921 when the discharge pipe of a dredge operating at the site of Ocean Dock (Army Dock) was emptying dredged sediments landward (Varnes, 1969). In the years that followed, areas along the Knik Arm were filled with local sands

and gravels, landslide debris and soils dredged from the bottom of the inlet. A historical depiction of the fill placement within the former tideland areas is included in Figure 2. This information was taken from the series of aerial photographs from 1950 to 1991. As seen in Figure 2, the shoreline has been extended to the west into the inlet by an average of about 60 feet since 1950. Along the south portion of the POA-PUG area adjacent to Ship Creek, the shoreline has been extended over 140 feet. Although not shown on Figure 2, substantial amounts of fill have also been placed within the parcels located east of the 1950 shoreline.

For additional information regarding the development of the POA-PUG area, the local natural gas and water and wastewater utilities were contacted. The Enstar natural gas company was contacted to determine when the natural gas mains were installed within the POA-PUG area. According to the current gas line maps, the natural gas mains were installed along Ocean Dock, Anchorage Port and a portion of Tidewater Roads in 1965. In 1967, mains were installed along an additional segment of Tidewater Road and Gull Avenue. By 1969, natural gas mains had been placed along the entire length of Tidewater Road. A natural gas main was installed along W. Bluff Drive in 1974. Enstar does not have any documentation showing the existence of mains along Terminal Road located on the northeast portion of the POA-PUG area.

On April 24, 1992, the Anchorage Water and Wastewater Utility (AWWU) was contacted. A request was made for dates that both water and sewer mains were installed within the study area. The earliest water mains installed within the study area were placed in 1961 along Ocean Dock and Anchorage Port Roads. In the following years between 1963 to 1971, water mains were installed along sections of Tidewater, Terminal, Ocean Dock and West Bluff Roads. It appears that the PUG-POA area obtains all drinking water from the AWWU. Most recent installations have included a water main along Western Drive in 1980 located near the south end of the study area. The first sewer main was installed along a portion of Ocean Dock road in 1956. Following between 1967 and 1969, sewer mains were installed along portions of Anchorage Port, Ocean Dock, Tidewater and Terminal Roads and West Bluff Drive. As with the water mains, the most recent sewer main was installed along Western Drive in 1985.

Dave Belyea of the ADEC Registered Underground Storage Tank Division was contacted on March 26, 1992, for information regarding registered USTs within the POA-PUG area. A total of 44 USTs are located within the study area with 36 of the tanks either in use or abandoned in the ground. A summary of the information regarding each tank is listed in Table 1. Detailed information received from the ADEC is included in Appendix B.

As previously mentioned, the Alaska railroad headquarters were developed in the port area in the 1920s. As shown on the basemap, Sheets 1 through 4, railroad spurs currently extend throughout the majority of the POA-PUG area and access several of the individual leased parcels within the area. The railroad system is used for the transportation of goods including petroleum hydrocarbon products. As shown on Figure 1, the north half of the POA-PUG area is owned by the Municipality of Anchorage (MOA) while the south half is owned by the Alaska Railroad. The ownership of the railroad lines located within these two areas of the POA-PUG area are therefore owned and operated by the respective land owner. In addition, several of the spurs accessing the individual leased parcels within the Alaska Railroad property are under ownership of the leaseholder and not the railroad. Historical development and ownership information of the railroad lines located within the Alaska Railroad owned property was not available for review. We understand that tract ownership information can be extracted from Alaska Railroad leasefiles in Anchorage.

With the exception of a small strip of land along the southeast border of the POA-PUG area that is privately owned property, the parcels within the study area are owned by either the Alaska Railroad Corporation, the Municipality of Anchorage or the Federal Government. As shown on Figure 1, the majority of the northern parcels are located on Municipal lands, the southern parcels are located on Alaska Railroad property and the Federally owned parcels are along the east border of the study area. The majority of the parcels within the study area are leased to private businesses which include mainly bulk fuel storage and marine type facilities. A list of each of the current leaseholders as reported in the Ship Creek-Port Area Meriting Special Attention Plan prepared by the Department of Economic Development and Planning (1991) is presented in Table 2. The location of each current leaseholder is also shown on Figure 1 and Sheets 1 through 4. The following sections describe the historical land development of each leased parcel within the study area.

4.1.1 POA Terminals and Transit Areas

The POA terminals and transit areas are located along Knik Arm within the northern portion of the POA-PUG area as shown on Figure 1 and Sheets 2 through 4. The site consists of two POL terminals, three general terminals and five transit areas where supplies are temporarily stored during both loading and unloading operations. The "spaghetti farm", which is owned and operated by the Municipality of Anchorage - Port of Anchorage (MOA-POA) and consists of the valve yard used as both a private and government (Department of Defense, DOD, and MOA-POA) petroleum facility, is located along the north portion of the south transit yard which is located at the south end

of the entire port parcel. POL products to or from the existing docks are loaded/offloaded through this valve yard. Underground pipelines, containing petroleum products, exit the valve yard and continue south along both the eastern and western edges of the property line. The primary functions of the terminals and transit areas are to serve as a mediator between incoming and outgoing fuels and goods for the city of Anchorage. One large structure which houses the POA offices is located on the pier at Terminal No. 1.

In 1919 the original Ocean Dock, also known as Army Dock, was established by the Alaska Engineering Commission and operated by the U.S. Army for the receipt of military cargo. The dock had a connecting spur to the Alaska Railroad terminal yards. Photograghs from 1918 and 1921 that are included in the Varnes (1969) report show the completed connecting spur to the dock. In addition, the earliest available aerial photograph of the port area taken on August 7, 1942, is included in the Varnes (1969) report. This photograph shows the relatively undeveloped elongated triangular shaped flat of the port area. A sewer outfall from Elmendorf Air Force Base crosses the area. The completed Ocean Dock and connecting spur are visible in the photo. In addition, the circular outline of the flow slide in which the Chevron facility is currently located is visible.

In 1956 a report for the development of the POA was completed by Tippetts-Abbett-McCarthy-Stratton, TAMS (1956). The report included recommendations for the port to handle receipts of general cargo by vessel and shipments by rail and truck. The report specifically emphasized the exporting of coal and the importing of petroleum. TAMS completed a development plan for the northern water front area of the port in February, 1961. Within the same year, the new City Dock was constructed and put into operation. As discussed in Section 6.0, the 1964 Good Friday earthquake resulted in the complete destruction of Ocean Dock thus leaving all exporting and importing operations to the City Dock. A temporary POL dock was constructed by the army in addition to pipelines on the City Dock in order to handle off-loading of petroleum products. By 1966 the city had completed a new permanent POL dock. In 1972, TAMS developed a soils and foundation report for proposed marine facilities and storage yards in the POA area. Site plans in the report illustrate the port area in a similar state as it exists today. The report included recommendations for Terminals No. 2 and 3, transit areas and a second POL terminal. Historical development of the additional terminals and transit yards can be seen in the aerial photographs and is explained in the following summary.

In the aerial photograph from 1950, the only structure within the POA area is Ocean Dock. Ocean Dock and Tidewater Roads run along the majority of the west and east boundaries of the

area, respectively. The majority of the area is tidal flats. In the 1962 photo, City Dock with Terminal No. 1 and a connecting road and railroad spur has been constructed north of Ocean Dock. Some minor filling has been completed within the south transit area along Anchorage Port Road. In the 1964 aerial photo taken after the Good Friday earthquake, the temporary POL dock is visible between Ocean and City Docks. A considerable amount of fill material has been placed within the south transit area and just north of currently existing Gull Avenue. A linear feature cutting diagonally through the south transit area is most likely a pipeline constructed by the army for receiving petroleum products from the City Dock. North of City Dock a discharge stream is visible from a drainage system that appears to stem from the Defense Fuels parcels. Ocean Dock was reportedly destroyed in the 1964 earthquake and the dismantling of the dock is visible in a series of photographs from 1964 to 1972. In the 1967 photo, the POL Terminal No. 1 has been constructed and connected just south of Terminal No. 1.

Photographs from the 1970s to 1980s illustrate the sequential filling of the tidal flats in the now current transit areas and the addition of Terminals No. 2 and 3 and POL Terminal No. 2. Terminal No. 2 extending off the north end of the original general terminal in the port area is completed in the 1971 photo. By 1974, the tidal flat areas directly east of both Terminals No. 1 and 2 had been filled thus developing Transit Areas A and B. Following in the 1976 photograph, Terminal No. 3 has been constructed with Transit Area C filled to the east. The South Transit Area was completely filled as it currently exists in 1984 thus covering the diagonal linear feature that most likely was a fuel pipeline. Transit Area D was backfilled in 1985 to the north of Area C. Finally, the second POL terminal was completed to the south of the first POL terminal in the photo taken in 1991.

Throughout the photographs varying activity consisting of predominantly material storage was seen in the transit areas. Within the South Transit Area, soils piles were observed in the 1986 and 1987 photographs. A large soil stockpile is present on the south end of the transit area in the 1991 photo which is the result of the 1990 excavation activities associated with the new POL terminal. Possible road oiling is visible within the transit areas in photographs from 1976 and 1979.

4.1.2 Tote Facility

The Tote facility is located to the east of the Port of Anchorage terminals and transit areas as shown on Figure 1 and Sheets 3 and 4. For the past 15 years, Totem Ocean Trailer Express (Tote)

has leased the parcel from the municipality in order to operate their shipping operation between Tacoma, Washington and Anchorage, Alaska.

The parcels in which the Tote facility occupies remained vegetated and undeveloped until 1964. In the photographs taken prior to 1964, some linear features are visible within the vegetated area which may represent survey lines or a fence. In 1964, the south half of the property was cleared of vegetation and was used for the storage of shipping trailers. In addition, a drainage ditch that originated at the Defense Fuels property was dug along a portion of the east border and then through the property. By 1971, the entire property had been cleared of its vegetation. In the years following, some minor storage of materials was the only apparent activity conducted on the site. By the year 1978, a building was constructed on the site and an increase in storage activity was noted. Additional construction included building a second structure and oiling the road areas in 1979, paving of the majority of the area in 1980, completing the paving of the site in 1986 and the construction of two larger structures in 1990. The original two structures to the site were removed in the 1991 photograph.

4.1.3 Lonestar Cement No. 1 Facility

The Lonestar Cement No.1 facility is located in the northern section of the POA-PUG area as shown in Figure 1 and Sheet 3. The facility consists of four bulk cement storage tanks, a building and a rail loading rack located in the center of the property. Anchorage Sand & Gravel has operated the facility for the Washington based Lonestar Northwest company for the past two years. According to the ADEC UST Registration List, the facility had a 500-gallon gasoline underground storage tank that was 23 years old when it was removed from the ground.

The Lonestar Cement No. 1 parcel was vegetated in the 1950 photograph and was not visible in the 1959 photograph. By 1962, some clearing had been accomplished on the west side of the property with a drainage ditch or trail running east to west from the center of the parcel to the inlet. The entire property was cleared of vegetation by 1964 with some storage of materials in the cleared area. Moderate storage activities continued on the site up to 1970 when the cement storage facility was constructed. The facility included the four cement silos, two buildings and a rail loading rack and spur. Numerous objects have been stored around the yard areas of the facility since it was constructed. In 1975, the neatly placed objects appear to be 55-gallon drums. The yard area has also had several dark colored areas exposed over the years and appeared to be oiled in 1981. By 1983, the unused eastern portion of the site was becoming revegetated. In 1987 an area in the southwest corner of the property is covered with a large white object that is removed in

1988. The white area is comprised of numerous white plastic bags of cement that were temporarily stored in the yard area prior to being shipped to Korea according to an employee of the Sea-Land facility located directly south of the Lonestar Cement No. 1 parcel.

4.1.4 Sea Land Facility

The Sea Land facility is located in the northeastern section of the POA-PUG area as shown in Figure 1 and Sheet 3. Sea Land has been operating their shipping business between Tacoma, Washington and Anchorage, Alaska out of this area since about 1965 or 1966. Although no environmental assessments have been conducted on the property, Sea Land has a total of 8 registered underground storage tanks including two 25,000-gallon diesel tanks and one 10,000-gallon gasoline tank. According to an employee of Sea-Land, in 1985 the 10,000-gallon gasoline tank was taken out of commission due to a potential leak. The tank has been tested twice with the results indicating that no leaks exist within the system, therefore, the tank will be put back into service in the summer of 1992. Two abandoned USTs will also be removed this coming summer. Three of the eight USTs contain waste oil, new oil and overflow from an oil/water separator system and are located beneath the concrete slab floor of the maintenance shop located on the northwest corner of the property.

The parcels which comprise the Sea Land property remained vegetated up to 1962 when some development activity was initiated in the form of minor filling in the southwest corner of the site and a road constructed through the property. By 1963, some materials were being stored along the west boundary. In addition, a drainage route had been constructed through the property. Between the years 1962 and 1972, progressive filling of the low lying marshy areas located in the north and east sections of the site was accomplished. In addition to the filling, increased storage activity occurred during these years. In 1968, one large building was constructed on the property. A second large structure, the maintenance shop, was constructed in 1975 with the entire area paved in 1976. Historical road oiling is visible in the aerial photos in the years of 1971 and 1973.

4.1.5 Texaco Anchorage Terminal

The Texaco Anchorage terminal occupies Lot 7A of the Port of Anchorage Subdivision as shown on Figure 1 and Sheet 2. The facility was constructed in 1964 following the Good Friday earthquake. Since that time it has provided storage and handling services for Texaco and its customer's petroleum products via cargo pipelines and tank truck and rail car loading/unloading racks. Currently, the facility includes an office building, warehouse, truck loading rack, tank car

loading rack, and 19 bulk storage and transfer tanks located within a bermed spill containment area.

As previously mentioned, the Texaco facility was constructed in 1964. Prior to this time, the property was predominantly covered with vegetation. In the 1950 photo, two roads, running southeast to northwest, were located on the site. The original facility was constructed on the west side of the property and consisted of 11 storage tanks, one large building (warehouse), two smaller buildings (offices), truck and rail car loading racks and storage sheds. The facility was expanded with additional tanks in 1968, 1971 and 1974 for a total of 19 storage tanks. Potential road oiling activities were apparent in the areas around the facility as seen in the 1965 and 1975 photographs.

4.1.6 Anchorage Fueling & Service Company Terminal

The Anchorage Fueling & Service Company (AFSC) terminal, operated by Butler Aviation and also known as the AFSC Plant #1, is located near the center of the POA-PUG area adjacent to the northwest boundary of Defense Fuels as shown in Figure 1 and Sheet 2. The facility currently consists of nine bulk fuel tanks containing Jet A fuel, a truck loading rack and a garage building. The facility was originally owned and operated by Shell Oil with AFSC acquiring ownership in July, 1981.

Prior to 1963, the AFSC site was undeveloped and partially vegetated. Two roads angling southeast to northwest through the site had been constructed by 1950 with an additional linear structure running east to west by 1959. This linear feature is a fence. In 1963 the site was cleared of all vegetation and the original facility was constructed with six large storage tanks, the truck loading rack and the garage building. Since that time, three additional above ground storage tanks have been added to the facility in 1964, 1967 and 1968. The yard area around the facility appears oiled in the 1973 photo. Also, by the early 1970s, the area along the east portion of the site has become revegetated. In the 1974 photo, the berms that were constructed around the tank areas are very dark in color and appear to be recently constructed or oiled.

4.1.7 Defense Fuel Terminal

The Defense Fuel terminal, also known as the Army POL terminal, was established in the early 1940s by the U.S. Army and is an unloading and storage facility for handling fuels used in quantity by the military. The primary purpose of the Defense Fuel terminal is to supply jet fuel to

Elmendorf AFB. In addition, some fuel is supplied via truck to Ft. Richardson and Kulis Air National Guard. The location of the Defense Fuel terminal is shown on Figure 1 and Sheet 2.

Fuels handled by the terminal included mogas, diesel fuel, aviation gasoline and jet fuel. The storage capacity of the terminal was 360,000 barrels with 244,000 barrels stored in eight underground tanks. In October, 1989, the mission of the terminal began to change. Ground fuel tanks, both aboveground and underground, were taken out of service. Today, the only fuel stored in the terminal is jet fuel. In addition, the storage capacity has been reduced to 256,000 barrels with 184,000 barrels stored in four underground tanks.

In reviewing the aerial photographs, we confirmed that a portion of the facility had already been partially developed in 1950. A total of nine aboveground storage tanks were present on the site with a group of four ASTs along the east boundary and a group of five ASTs along the south boundary. Several roads were located on the site, however, the majority of the property was either vegetated or what appeared to be marsh or tide lands. By 1959, one additional AST had been added to the group of tanks along the east boundary. Also, four large USTs had been added to the site as is evidenced by the four large circular mounds in the photograph. Clearing of about one half of the vegetation had been conducted as well as several new structures constructed. During the 1960s and 1970s construction activities including the addition of several new buildings and underground storage tanks, filling of low lying areas and vegetation clearing were performed. In addition, three of the ASTs were moved off their foundations, as can be seen in the photos from 1977 and 1979, most likely for some type of repair work and then set back in place by the following year.

4.1.8 Tesoro Alaska Terminal

The Tesoro Alaska terminal is located just south of the South Transit Area of the POA facility as shown in Figure 1 and Sheet 2. The facility has been constructed on approximately 7.6 acres of filled tidelands. Currently, the facility consists of eight bulk storage tanks for petroleum products, an office building, a railroad line for shipping and receiving products, a truck loading rack, and underground pipelines used to transport products. Earthen dikes are located around the perimeters of the bulk storage tanks. The area around the truck loading rack is surrounded with concrete berms and is covered with lined, reinforced, concrete pads.

Dating back to 1950, the parcels that comprise the Tesoro Alaska terminal were primarily undeveloped tidal flats. Ocean Dock Road bordered the west side of the site. By 1959, a small

area along the east border had been filled and was being used for minor material storage. In addition, Anchorage Port Road had been constructed and bordered the east side of the site. In the 1967 photograph, the southern end of the site had been completely filled in and the bulk fuel facility initiated with the construction of one small building and one above ground storage tank. Throughout the following 15 years, the site was filled and the facility expanded with the addition of more above ground storage tanks, buildings and loading racks. By 1970 four tanks had been added to the facility in addition to truck and rail car loading racks and a large building. In the 1971 photo additional fill has been brought to the site and three more tanks were placed at the facility. A small tank was brought to the facility and placed in the southeast corner in 1976. From the years of 1984 to 1988, numerous bright colored objects, drummed POL products, were stored around the structure in the southeastern part of the site. In the 1990 photo, the excavation area that was dug as a result of a pipeline leak is barely visible. In the following 1991 photograph, a rectangular bioremediation area located along the east side of the site is discernable. The pipeline leak and bioremediation project are briefly discussed in Section 7.5.

4.1.9 Lonestar Cement No. 2 Parcel

The Lonestar Cement No. 2 parcel is constructed on filled tidelands along Knik Arm as seen in Figure 1 and Sheet 2. In the 1950 photo, the northern half of the site had already been filled and developed with a cement storage facility consisting of two buildings, two cement silos and a pier. Access to the property was from Ocean Dock Road which borders the east side of the site. The southern half of the parcel was still tidal flats in 1950. Records indicate that the facility was operated by Permanente Cement in the 1950s. By 1959, a third structure was added to the property adjacent to the pier. Filling of the southern half of the parcel appeared to take place between 1963 and 1971. Also in 1971, six additional smaller cement silos were added to the facility on the south side of the cement silos. Throughout the 1960s, 1970s and 1980s, varying numbers of objects were stored throughout the yard areas of the facility. In 1972, 1974 and 1975 the yard areas appeared to have been oiled and then paved in 1976. In the entire set of aerial photographs from 1950 to 1991, a liberty ship was docked either at the very end of the pier off of the site or further east of the pier adjacent to the site. From 1968 to the present, the liberty ship has been moored at the end of the dock.

During the 1964 Good Friday earthquake, a 7000 barrel metal silo, that was constructed in 1960 as part of the Permanente facility, collapsed. Shannon & Wilson conducted a foundation study at the facility in May, 1964 and developed a report with recommendations for the rebuilding of the silo on the original foundation and constructing a new bulkhead. The report states that the

Permanente Cement facility was constructed in 1950. In addition, at that time the plant was built on approximately 15 to 18 feet of fill material that is underlain by silts and the Bootlegger Cove formation.

4.1.10 Chugach Electric Parcel

The Chugach Electric parcel is located along the west boundary of the POA-PUG area adjacent to Knik Arm as seen in Figure 1 and Sheet 1. In reviewing the aerial photographs, the site was tidal flats up to 1964 when filling activities were initiated. Filling of the site to the size it is currently continued through 1972 with the incorporation of a barge slip into part of the fill. The first permanent structures including a building and a dock were constructed on the property in 1972, however, the site appeared to be very active with barges and boats docking at the site and equipment moving in and out of the yard area since 1965. Two more buildings were added to the site in 1977 and 1982.

4.1.11 Chevron Terminal

The Chevron terminal is bordered by Ocean Dock and Bluff Roads to the west and south, respectively, as seen in Figure 1 and Sheets 1 and 2. The Defense Fuel terminal borders the remaining east and north sides of the site. A small strip of property that is a portion of the Chevron leased property is located on the south side of Bluff Road. The facility consists of 24 light fuels storage tanks and approximately 28 asphalt storage tanks, rail car and truck loading racks, an office and warehouse building and a shop building. Three light fuels above ground storage tanks have previously been removed from the facility. An artificially created ponded area is located in the northeast corner of the property.

The facility had already been partially constructed on the southern half of the property by 1950. Two distinct groupings of storage tanks were visible in the photo including five ASTS along the south border on the south side of Bluff Road and four ASTs near the center of the developed portion. Several buildings were also present at the site. The northern portion of the property was vegetated with two cleared areas. By 1959, eight ASTs had been added to the central grouping of tanks while the strip of land on the south side of Bluff Road contained nine ASTs and one structure in the center of the grouping. A berm had been constructed around the central grouping of tanks. Throughout the 1960s several other ASTs were added to the facility to increase the storage capacity. The west border of the ponded area was filled in the 1973 photograph and was used from then on as a storage area for both soil piles and materials that included signs,

drums, piping and miscellaneous fittings. The grouping of tanks along the strip of land south of Bluff Road were subject to much activity in the late 1970s and early 1980s with the removal and addition of several of the tanks. These tanks were used for Chevron's asphalt operation until operations were ceased in 1991. Of the 24 light fuel storage tanks, 11 are presently out of service.

4.1.12 Mapco Alaska Petroleum Inc. Terminal

The Mapco Alaska Petroleum Inc., MAPI, terminal which is the southern most bulk fuel facility within the POA-PUG area is divided into two sections by Ocean Dock Road as seen in Figure 1 and Sheet 1. The western portion is constructed on filled tidelands while the eastern section is located on uplands at the base of the bluff. A brief historical land use description was presented in a Hart Crowser 1987 report. As can be seen in the aerial photographs and according to the report, Union Oil established a petroleum facility in the late 1950s. Prior to the 1964 earthquake, the western site consisted of five large storage tanks, nine intermediate and small tanks, and one unidentified building, and the eastern site consisted of three large storage tanks and six structures. In 1965, Union Oil's bulk plant occupied the eastern site and its asphalt plant occupied the western site, and both retained separate addresses. After 1969, however, the company operated under one consolidated address, with administrative offices located west of Ocean Dock Road.

In 1941, a fish dock was present near the western property. In 1954, a dock was built adjacent to the western property by Rogers Construction. Four years later, a permit was sought to extend the dock with a barge slip, but it had not been constructed by the time of the 1964 earthquake. In May 1959, the permit originally issued to Rogers Construction was transferred to Union Oil and the facility became known as the asphalt dock. By 1960, nearby businesses included Alaska Fish & Farm Products, Anchorage Independent Lumber, Permanente Cement company, Susitna Marine Boats, Tidewater Packing Company and North Star Stevedore. According to Adams, et al. (1967) the Independent Lumber company warehouse was located on the MAPI parcels in the large building located on the south end of the eastern portion of the site. MAPI took over the asphalt plant in 1986 and the POL terminal in 1988 from Union Oil Company of California. According to a 1990 questionnaire document obtained from the Alaska Railroad Real Estate office, subtenants of the MAPI leased property as of 1990 included Alaska Lube and Fuel, Chugach Electric and Pioneer Petroleum.

MAPI will be taking over the leased portion of their property from Chugach Electric. According to a March, 1992 Environmental Site Assessment by Shannon & Wilson on the

Chugach Electric sublease area, Union Oil began leasing the property in April, 1959. The Chugach portion was subleased to Oceaneering International of Santa Barbara, California from 1972 to September, 1979. Chugach then took over the lease in 1979. A large portion of the subleased area was subleased by Chugach to Pickworth and Associates, Inc. in 1983. Currently, both Chugach Electric and Pickworth are sublessees of the northwestern portion of the MAPI property.

Although Union Oil reportedly did not begin construction of the petroleum facility until the late 1950s, some development on the eastern portion of the property is visible in the 1950 photograph. The building that supposedly was once Independent Lumber's warehouse is constructed and a series of ASTs are located to the north of the building. The western portion of the site is mainly tidal flats. By the 1959 photo, the west half of the property has been filled in with nine ASTs placed on the fill. Supplies that appear to be lumber or piping of some type are being stored on the newly filled area. Three buildings have been constructed on the east section with many smaller objects stored around the east yard area. Additional filling of the western section of property continued up to 1979 with the completion of the subleased Chugach Electric property. Also during this time, ASTs were added to both the western and eastern portions of the facility in addition to several structures. The yard and road areas around the facility appear to have been oiled in photographs taken in 1965 and 1968. The old Independent Lumber building was removed in the 1985 photograph. Throughout the photographs, the subleased area to the north of the western section appears to be used as a materials and equipment storage area.

4.1.13 Residential Area

A private residential area is located within the designated POA-PUG area along the southeastern border as shown in Figure 1. In the aerial photographs from 1950 to the present, this area has been developed with residential homes and surrounding trees. The road paralleling the east boundary of the area appears to be oiled in several of the photographs.

4.1.14 Southern Portion of POA-PUG Area

The southern portion of the POA-PUG area consists of the leased properties by Alaska Resources Corp, North Star Terminal & Stevedore, Douglas Management Co., Western Insulfoam, Kyokyu, Inc. and JoAnn Pickworth. Locations of each of the leased properties are shown on Figure 1 and Sheet 1. These leased properties have been placed under one historical

description because no information regarding the historical land use of these parcels was available with the exception of the aerial photographs.

In the 1950 photograph, the southern portion of the POA-PUG area had been partially developed with several large buildings and three dock facilities. The area appears to have been constructed on previously filled tidelands. By 1959, the activity throughout the area had greatly increased. These activities include the extension of the western side of the site by filling, the construction of several additional buildings and the storage of numerous materials and equipment throughout the area. Scrape marks in the yard areas along the western edge are evidence of recent fill activities. This high level of activity has remained constant throughout the following years observed in the aerial photos. The yard areas around the structures in the area typically appear cluttered with materials and equipment and dark colored from possible surface staining. Additional substantial filling activities along the western edge of the area occurred in the mid to late 1980s.

4.2 Spill History

The Alaska Department of Environmental Conservation (ADEC) contaminated site data base system was searched for information regarding past spills within the POA-PUG area. In addition, the ADEC Anchorage office was visited to collect more information. A total of 12 sites located within the boundary were identified. Information regarding each of the sites including the assigned Reckey Number and the local ADEC office file number has been listed in Table 3. The reported spills have occurred at the Tesoro Alaska, Chevron, Texaco, MAPI facilities.

The United States Coast Guard (USCG) office in Juneau, Alaska was contacted on April 2, 1992 for information regarding spills and hazardous materials responses by the USCG within the POA-PUG area. According to the USCG representative, hazardous material responses have been documented in two sources including the Marine Safety Information System and a study on Non-Crude Tank Vessel and Barges by Arthur D. Little (1991).

Information from the Marine Safety Information System was received from the United States Coast Guard (USCG) National Response Center. The information included a summary of all spills located throughout Alaska reported to the National Response Center from 1987 to 1992. Forty-two spills were reportedly located within the Cook Inlet area, which includes Knik Arm, with no more specific information on the location within Cook Inlet. A total of four spills were reported within the Port of Anchorage area. A brief summary on each of these spills follows:

- On 7/6/88 at 6:43, a rainbow sheen about 15 feet in diameter was observed during the loading of a fuel barge at the Port of Anchorage between terminals T-2 and T-3.

- On 9/9/90 at 3:00, International Marine Carriers, Inc. reported a 50 gallon diesel spill. Reportedly, 2 gallons entered the water.

- On 4/3/91 at 9:30, the USCG-MSO Anchorage reported a 100 gallon diesel spill.

- On 4/15/91 at 10:00, the USCG-MSO Anchorage reported an oil spill of unknown quantity.

The summary spill reports for each of the above incidents are included in Appendix B in addition to the cover letter received from the USCG with the spill reports.

The June, 1991 Study of Non-Crude Tank Vessels and Barges by Arthur D. Little was reviewed at the ADEC Anchorage office for information on spills within the POA-PUG area. Out of the twenty-three spills which were discussed in the report, none were located within the Knik Arm vicinity adjacent to the study area. The closest spill reported was located within Turnagain Arm southeast of Anchorage at Latitude 61' 15" and Longitude 149' 55".

In Shannon & Wilson's 1992 Site Assessment, Chugach Electric Association Sub-lease, 1200 Ocean Dock Road, Anchorage, Alaska Report completed for Mapco Alaska Petroleum Incorporated, it was reported that the USCG records show a response to an oil spill in April, 1991 at the Pickworth's northern barge slip located within the MAPI lease area. Petroleum hydrocarbons were released into the Inlet waters due to punctured tanks on the 70 foot aluminum hulled landing craft, "Arctic Fox". A total of 100 gallons of diesel fuel and 5 gallons of lube oil was released into the waters. Reportedly, none of the product was recovered.

The Anchorage Fire Department was contacted on April 1, 1992, for information regarding responses to hazardous situations within the POA-PUG area. The only response listed on the Hazardous Conditions Record data base within the POA-PUG area was to 660 Ocean Dock Road at the location of Western Insulfoam within the railroad right of way on June 1, 1991. A 1,000 pound box of polystyrene pellets used in making insulfoam was spilled when a train side swiped the box. Western Insulfoam salvaged the pellets left on the ground. The fire incident report for this spill is included in Appendix B. The Anchorage Fire Department data base only dates back to January, 1990 and is updated monthly.

Spills and releases of petroleum hydrocarbons have been documented over time at each of the bulk fuel facilities located within the port area. Spills resulting from broken valves, overfilling of trucks, tanks and rail cars, leaking pipelines and other sources may have resulted in the release of an amount greater than 490,000 gallons of petroleum hydrocarbons as documented in spill reports provided by each of the bulk fuel facilities. Recovery efforts of the spilled product have been conducted in order to limit the impact to the site soils and waters.

The information regarding documented petroleum hydrocarbons spills that was provided by each individual bulk fuel facility is discussed in the following sections. This information does not necessarily include all of the spills that have been reported or may have occurred within the POA-PUG study area. In addition, no information regarding releases from trucks and railcars travelling through the POA-PUG area was available for review. Most likely releases of petroleum products may have occurred along the roads and railroad spurs within the study area.

4.2.1 Texaco Terminal

One historical spill has been documented at the Texaco Terminal. An estimated 10 gallons of #2 diesel fuel was spilled on the morning of October 1, 1991. The fuel was discharged while loading a tank car of diesel. Absorbent pads were placed around the bottom of the rail car to contain the fuel that was dripping down the side of the car. A total of about 60 pounds of impacted ballast was removed, placed on a plastic sheeting and covered, then shipped to Northwest EnvironService, Inc. for disposal in Seattle, Washington.

4.2.2 Anchorage Fueling & Service Company Terminal

Anchorage Fueling & Service Company (AFSC) purchased the Anchorage Port Terminal in July, 1981 from Shell Oil Company. Four spills totalling over an estimated 127,000 gallons have been documented during AFSC's ownership of the terminal. No records of spills during the period in which Shell Oil Company occupied the site are available. A brief description of each of the spills is listed below.

March, 1983 - 120,000 gallons of Jet A fuel was spilled within the diked area of Tank 1 at the terminal due to the overfilling of Tank 1. The fuel was completely contained within the diked area with the cleanup reported as thorough. The dike was iced over at the time of the release therefore the contact of the product with the site soils was believed to be minimal.

November 3, 1986 - An unknown amount of Jet A fuel was released when a two-inch cargo take down line rusted through.

March 14, 1987 - About 200 to 250 gallons of Jet A fuel was spilled when a one-inch sample valve was broken off by an employee during a barge transfer. The product was cleaned up with a vacuum and absorbent pads.

October 5, 1988 - 7,000 gallons of Jet A fuel was spilled due to a plant operators inattention to duties allowed fuel to escape from a water draw. At the time of the incident a sump pump was being used to remove water from the dike area. The spilled fuel overfilled a oil/water separator connected to the sump line and discharged fuel to a ditch outside the diked area. The fuel ended up in a nearby pond and was removed with skimmers. Cleanup efforts were assisted by "Clean Alaska".

4.2.3 Defense Fuel Terminal

Documented fuel spills for the Defense Fuel Terminal are available from 1981 to the present. Information regarding several spills that occurred prior to 1981 was collected by interviews with terminal personnel conducted by Ecology and Environment, Inc. (1992). Data available on past spills indicate that over 164,000 gallons of fuel has been spilled at the terminal. The following spill history information was taken directly from the Ecology and Environment report (1992).

1960 - Approximately 80,000 gallons of arctic diesel fuel were released near tanks 20-611, 612 and 613.

1964 - During the Good Friday earthquake, the manifolding to tanks 607 and 609 was damaged. The lines drained and an estimated 1,000 gallons of fuel were released.

1970 - A pressure reducing valve in the Metering Station (building 20-502) failed, causing the manifolding system to tanks 611, 612 and 613 to fail. An estimated 84,000 gallons of diesel fuel were released.

1971 - Tanks 621 and 624 were found to have inventory losses. The tanks were taken out of service and repairs attempted. The amount of diesel fuel lost is unknown. No soil was excavated.

May 5, 1981 - Approximately 175 gallons of diesel fuel were released inside building 20-517 when a valve failed. The fuel was recovered through pumping and using absorbent material.

July 7, 1981 - Two gallons of diesel fuel were released at the tank truck fill stand when the filter on the loading line failed. The product was picked up using absorbent material.

January 11, 1982 - Approximately 21 gallons of transformer fluid were released from an electrical transformer located north of tanks 616 and 617. Absorbent was used to recover it.

March 16, 1982 - A faulty coupling at the valve complex building (building 20-517) which has a gravel floor resulted in the release of 900 gallons. Some of the fuel was recovered by directly pumping it into a tanker truck and using absorbent on the residual fuel.

April 2, 1982 - Approximately 3 gallons of JP-4 were released at the tank truck fill stand due to overfilling a truck. The product was picked up using absorbent material.

April 29, 1983 - During a pressure test of the 6-inch diesel line serving the dock, a hole was discovered and approximately 26 gallons of fuel were lost. The line was excavated and impacted soil was removed.

July 11, 1983 - An estimated 20 gallons of JP-4 were released at Pit 2 when a flange failed. Absorbent was used to pick up the product.

September 15, 1983 - A hose failure at the railcar loading/unloading rack resulted in the release of approximately 100 gallons of JP-4. The fuel was recovered by directly pumping it into a tanker truck and using absorbent on the residual fuel.

January 30, 1984 - An estimated 40 gallons of JP-4 fuel were released at the railcar loading/unloading rack. The railcar had been filled in Fairbanks, where it was -55°F. In Anchorage, the temperature was 30°F and the fuel expanded causing the railcar gasket to rupture. Saturated snow was removed and absorbent used to recover the remaining product.

April 17, 1984 - Approximately 10 gallons of JP-4 were released from the pipeline running from the railcar loading/unloading rack to the storage tanks. The pipe was excavated and absorbent was used to recover the product.

August 8, 1984 - An estimated 25 gallons of JP-4 were released when tank 617 was overfilled. Absorbent was used to recover as much fuel as possible.

April 10, 1985 - Approximately two gallons of JP-4 seeped from a tanker at the tank truck fill stand. The fuel was partially recovered using absorbent.

May 31, 1985 - A hose failed at the truck loading rack, releasing an estimated 10 gallons of fuel on to the concrete. The product was recovered using absorbent material.

January 6, 1986 - An estimated 3 gallons of diesel fuel were released when equipment in pump house 20-517 failed. Absorbent was used to recover the product.

March 15, 1986 - A hose connection on a railcar failed, releasing an estimated 100 gallons of slop fuel. Soils were excavated and taken to a fire burn pit at Fort Richardson. Absorbent was used to recover residual fuel.

April 14, 1986 - A valve at the tank truck fill stand failed, releasing an estimated 25 gallons of diesel fuel. The spill was partially recovered using absorbent material.

March 11-17, 1987 - On three separate occasions, a railcar containing JP-4 vented fuel at the railcar loading/unloading rack. The railcars were overfilled at the MAPCO refinery, the contents expanded due to the warm spring weather, and the pressure relief valve vented the fuel. An estimated 35 gallons of JP-4 were released each time. Drip pans were placed under the car, and absorbent was used to recover fuel, which had dripped onto the ground.

May 6, 1987 - The manway gasket on tank 607 failed, releasing approximately 20 gallons of mogas unleaded regular. The release was contained, the tank drained, and the gasket repaired. Absorbent was used to recover as much fuel as possible.

August 31, 1987 - A leak in sump tank 616-17 was discovered during a soil-gas analysis study at the terminal. The tank holds sump water from tanks 616 and 617. Since this tank leaked for an unknown length of time, the amount of material released cannot be estimated. Soils around the

tank were excavated and removed to determine the exact source of the leak. The tank has since been replaced.

September, 1990 - Tank 20-622 was emptied of arctic diesel fuel for routine cleaning. Numerous "pin-hole" leaks were discovered. The tank cleaner estimated a 5-gallon loss of product daily. The length of time the tank has been leaking is unknown. The tank is no longer in service.

4.2.4 Tesoro Alaska Terminal

The Tesoro Alaska terminal has a total of six fuel spills documented since September, 1974 to the present. Over 18,000 gallons of product including arctic diesel oil, #2 diesel oil and JP-4 jet fuel has been released within the lease boundary of the terminal. Brief descriptions of each of the six spills are presented below.

September 11, 1974 - An estimated 1,500 gallons of #2 diesel oil were spilled onto the ground surface due to an overfill of a railroad tank car.

September 27, 1974 - 400 gallons of arctic diesel oil were released onto both asphalt and soil in the vicinity of the truck rack due to the failure of the automatic meter on the tank truck.

February 1, 1975 - 12,600 gallons of jet fuel (JP-4) were spilled onto the snow within the diked area of Tank No. 3 due to a tank overflow. 3,000 gallons of the product was recovered.

September 23, 1976 - Approximately 3,500 gallons of arctic diesel oil were released onto the ground at the terminal due to an overfill of a railroad tank car. An estimated 1,000 gallons of the spilled product entered Cook Inlet.

April 4, 1978 - 336 gallons of arctic diesel oil (DFA) were spilled at the terminal due to a tank overflow in the vicinity of Tanks Nos. 1 and 2. The fuel was released onto the snow berm between the two tanks.

May 18, 1989 - A diesel line leak was discovered in the vicinity of Tank No. 7 at the Tesoro Alaska terminal. The quantity of released diesel was not estimated. A total of 60 cubic yards of impacted soil were immediately excavated from around the leaking line. Following the excavation of impacted soils, the line was repaired and a program for removing the product that was accumulating on the shallow perched water table in the excavation was initiated.

4.2.5 Chevron Terminal

Information on fuel spills received from Chevron was available from 1978 to the present. Information regarding a fuel spill in 1964 was found in a report by Hart Crowser (1987). A total of eleven spills have been reported including over an estimated 174,000 gallons of product. Information regarding each of these spills is listed below.

March 27, 1964 - an estimated 50,000 gallons of gasoline were released when two 100,000 gallon tanks were ruptured during the 1964 Good Friday Earthquake.

March 29, 1978 - 750 gallons of Jet B fuel were spilled due to an overfill of a tank in the terminal yard. It is not known if any product was recovered.

December 7, 1978 - 15 gallons of Jet A-50 were released due to a tank car overfill. It is not known if any product was recovered.

August 15, 1981 - 2,000 gallons of Jet A-50 fuel were spilled when a fuel hose burst. The entire 2,000 gallons was reportedly recovered.

October 23, 1981 - 12,100 gallons of gasoline were spilled due to an overfill of a tank in the terminal yard. A total of 9,500 gallons of product was recovered from the spill.

April 5, 1983 - 600 gallons of Avgas 100 were released when a tank car valve did not hold. About 550 gallons of the spilled product was recovered.

August 1, 1983 - 178 gallons of gasoline were spilled when a set stop meter failed causing an overfill of a tank car. A total of 10 gallons of product was recovered from the release.

January 18, 1984 - 1,400 gallons of Jet A-50 were spilled when a fuel hose failed during loading. 590 gallons of the spilled product was recovered.

December 18, 1984 - 106,900 gallons of Jet A-50 were released when a 6-inch diameter underground transfer line located between Chevron and Anchorage Fueling & Service Company failed. The line is located underneath the spur tracks of Defense Fuel and is within Chevron s pipeline easement. A total of 82,600 gallons of fuel were recovered.

February 22, 1990 - 55 gallons of Techrolene, an additive, were spilled due to an overfill of the additive tank while filling. Reportedly, all of the 55 gallons was recovered.

January 20, 1992 - 112 gallons of Techrolene, an additive, were spilled due to an overfill of the additive tank while filling. A total of 106 gallons of the additive was recovered.

4.2.6 MAPI Terminal

Mapco Alaska Petroleum Inc. (MAPI) purchased the bulk fuel facility from Unocal in 1986. Information regarding historic petroleum hydrocarbon spills during the period of ownership by Union Oil Company of California cannot be found. Following is a brief description of each of the documented spills that have occurred on the property since the time that MAPI obtained ownership. Over 3,000 gallons of fuel has reportedly been released since 1986.

March 31, 1986 - A leak on Tank #4211 s manway resulted in a release of approximately 100 gallons of Jet A-50 onto the frozen ground. The spill was detected after the snow had melted from around the release area. Sorbent pads were used for recovery of the released product.

September 10, 1986 - Approximately 500 gallons of Turbine Oil #46 were spilled onto the surrounding wet ground surface when a pressure gauge broke. The oil stayed on the wet surface and sorbent pads were used to recover the product.

May 10, 1988 - Approximately 365 gallons of regular gasoline were spilled under the rail car loading rack when a pump was accidentally activated to an open line. The released product was removed by evaporation and sorbent pads.

August 26, 1988 - Approximately 17 gallons of unleaded gasoline were spilled onto a concrete containment pad in the truck loading rack area when a truck overflowed. Sorbent pads were used to clean up the released product.

September 9, 1988 - 300 gallons of heating fuel were released during a truck loading rack spill. The fuel was contained primarily on the loading rack concrete pad. Aurora North, who was responsible for the spill, cleaned up the area and replaced the small amount of gravel that was stained.

October 19, 1988 - Approximately 2000 gallons of diesel #2 were released in the west tank farm due to an overflow at Tank #4210.

June 16, 1990 - About 10 gallons of unleaded gasoline were spilled onto a concrete pad due to a truck movement while connected to the loading rack. The spilled product was cleaned up with sorbent pads.

October 25, 1990 - Approximately 25 to 50 gallons of unleaded gasoline were spilled when a gas pump seal failed. The impacted gravel was removed in accordance with an ADEC plan.

June 15, 1991 - About 25 gallons of JP-4 were spilled near Tank #4236 when a valve leaked. The impacted gravel was removed in accordance with an ADEC approved plan.

5.0 REGIONAL GEOLOGY AND HYDROLOGY

The regional geology and hydrology is relatively consistent throughout the entire POA-PUG area. The existing geologic regime is a result of several glaciation episodes and more recent events including tidal flat deposition, landslide deposition and man-made filling. A cross section depicting the general regional geology and hydrology features within the Anchorage area is shown on Figure 3.

5.1 Description of Regional Geology

The POA-PUG area is located on the eastern margin of a large, northeast trending basin named the Cook Inlet Forearc Basin (Updike and Carpenter, 1986). This tectonic basin is bounded by the Alaska Range to the west and by the Chugach Mountains to the east. Several major northeast trending faults cut through the basin including the Castle Mountain, Border Ranges/Knik and Eagle River faults. Significant seismic activity in the area has resulted from movement along these faults.

Bedrock that underlies the typically 100 to 300 meters of nonlithified materials consists of Tertiary clastic sedimentary rocks which form a wedge lapping up to the east against the predominantly Mesozoic metamorphic rocks of the Chugach Mountains (Updike and Carpenter, 1986). There are no exposures of bedrock within the POA-PUG area.

The nonlithified materials that overlie the bedrock in the POA-PUG area consist of five typical stratigraphic units in which the predominant units resulted from glaciation activities. It has been hypothesized that at least five major glaciations have occurred in the Upper Cook Inlet with the latter two being the Knik and Naptowne glaciations. The five typical stratigraphic units include the Knik Sand and Bootlegger Cove Formation, the Naptowne Sands and landslide, tidal flat and tidal marsh deposits.

Knik glacial outwash sediments consisting of very porous sands and gravels overlie the sedimentary bedrock in the Anchorage area. The highly permeable unit is reportedly up to 1,100 feet in thickness and serves as a confined aquifer.

The Bootlegger Cove formation was also deposited during the Knik glaciation period in a glacially restricted brackish environment. Based on a study conducted by Updike and Carpenter (1986), this formation consists of seven facies ranging from a silty clay and clayey silt to a fine to medium sand. The majority of the formation, however, is composed of a blue gray, medium stiff silt with sand lenses and random small gravels. The formation is up to 250 feet in thickness and due to its impermeable nature, forms the hydraulic barrier for a confined aquifer.

The Naptowne formation is a glaciofluvial deposit laid down directly in front of the Elmendorf Glacier during the Naptowne Glatiation period. The deposit consists of extremely porous, well stratified sands and gravels. Within the POA-PUG area, this glacial outwash unit ranges from 0 to 50 feet in thickness and is typically saturated with perched water due to the underlying impermeable silts.

Most recently in geologic time, landslide deposits and tidal flat and marsh deposits have been laid down on top of the sediments composing the Bootlegger Cove and Naptowne formations. The landslide deposits are a result of slow moving rotational block slope failures. Reportedly, numerous, inactive slides encompass most of the bluff line of the POA-PUG area. The deposits are composed primarily of sandy gravels. The tidal flat and marsh deposits have been laid down in the area seaward from the base of the bluffs and landslide deposits. The tidal flat deposits consist of materials ranging from gravel to silt depending on the environment of deposition. The lower the energy of depositional environment, the finer the sediment deposited. The tidal marsh deposits are distinguished from the tidal flats by the presence of organic material. This deposit typically consists of organic silt interbedded with lenses and beds of peat and fine sand.

Over at least the past 50 years, fill material has been placed within the POA-PUG area specifically within low marshy areas, on the Ship Creek flood plain and along the existing coast line. The fill material typically consists of reworked outwash type soil excavated from nearby borrow pits and of landslide debris generated as a result of the 1964 Good Friday earthquake. In the Ship Creek flood plain area, reportedly the insitu fluvial sands and gravels were excavated, sorted and mixed with binding additives then redistributed across the flood plain.

5.2 Description of Regional Hydrology

The regional hydrology of the POA-PUG area basically consists of a confined aquifer, a near surface water bearing zone and surface water and drainage. The Knik glacial outwash deposits, confined by the impermeable sedimentary bedrock and Bootlegger Cove formation, serves as the principle confined aquifer underlying the area. The direction of groundwater movement in the confined aquifer is questionable although is thought to trend towards Cook Inlet from the east. Recharge of the system occurs through direct infiltration of precipitation and percolation from surface waters near the foothills of the Chugach Range. Smaller confined aquifers are reportedly located throughout the Bootlegger Cove formation within slightly permeable sediment layers consisting of fine sands.

The near surface water bearing zone consists of the glaciofluvial deposits, tidal flats and tidal marsh deposits and deposits associated with modern drainages. The subsurface flow is expressed locally by surface water bodies with the overall flow trending toward Ship Creek and Knik Arm. Recharge of the unconfined system is the same as the confined aquifer with primary sources from rainfall infiltration and percolation from surface waters. Perched water zones are also located within landslide deposits. These zones are discontinuous such that the subsurface drainage emerges as springs and seeps within or at the toe of the slide deposits.

Based on a review of the information provided, it is questionable whether the near surface water located in the glaciofluvial, tidal flats and tidal marsh deposits within the POA-PUG area would be useable as a drinking water source. Recent reports indicate that the salinity content of the near surface water along the west border of the POA-PUG area is greater than 6,000 ppm. Water with a salinity content ranging between 3,000 ppm to 10,000 ppm is considered brackish and not fit for human consumption. In addition, pump tests within the area indicate that the near surface water bearing zone has a relatively low yield ranging from 0.01 to 0.5 gallons per minute (gpm).

The surface waters and drainage throughout the POA-PUG area include open streams, ponds, marshes and the tidal inlet. Ship Creek bordering the south end of the defined POA-PUG area is the primary stream with other minor spring fed streams located throughout the area.

6.0 EFFECTS OF 1964 EARTHQUAKE

On March 27, 1964, Good Friday, an earthquake of high intensity caused extensive damage to a widespread area by ground motion, landslides, fire and seismic sea waves. The epicenter of the earthquake was 80 miles east-southeast of Anchorage at the head of Prince William Sound off the Gulf of Alaska. The recorded magnitude of the quake was between 8.4 and 8.6 on the Richter scale with a duration of approximately five minutes (Selkregg, 1984).

The City of Anchorage was struck by five major landslides in the downtown and residential areas which together accounted for a substantial portion of the total earthquake inflicted damage. Within the POA-PUG area, however, the majority of the damage induced by the quake was caused by ground displacement along fractures. Except for the Government Hill Slide, no major slides along the north bluff of Ship Creek were reported. Several small landslides occurred at locations, however, where fill material had been placed at the top of the slope along the bluff during former development (Shannon & Wilson, Aug. 1964). In addition, ground cracks developed in areas of the port, as shown in Figure 4, with the highest concentrations occurring in the northern portion within those parcels currently leased by Tote, Lonestar Cement No.1 and Sea Land and along Knik Arm within the parcels currently leased by MAPI, Lonestar Cement No. 2 and Chugach Electric (Varnes, 1969). The entire port area reportedly subsided in a non-uniform manner from 1 to 2-1/2 feet (Varnes, 1969).

At the time of the Good Friday earthquake the majority of the port area was developed with associated marine type businesses and POL facilities. Major structures within the area included docks, buildings, cranes and storage tanks. Four POL facilities with bulk underground and above ground storage tanks were constructed at the time of the quake including the facilities presently operated by MAPI, Anchorage Fueling & Service Company, Chevron and Defense Fuels. In addition, Ocean Dock, also known as the Army Dock, and City Dock were the major port facilities. Other businesses operating within the port area at the time of the earthquake include Alaska Fish & Farm Products, Anchorage Independent Lumber, Permanente Cement Company, North Star Stevedore, Susitna Marine Boats, Cook Inlet Tug & Barge and Alaska Aggregate Corp.

The Good Friday earthquake induced damage to buildings, cranes, storage tanks and piers. The Ocean Dock was almost completely destroyed with all pilings, buildings and light poles slumped seaward. The freight and the asphalt docks were relatively untouched, however, two cement storage tanks toppled and a crane was thrown down, causing damage to the Alaska Aggregate Corporation facilities (Selkregg, 1984). In addition, according to Varnes (1969), a cement storage bin overturned at the Permanente Cement Company. At the Standard Oil Co. tank farm, currently operated by Chevron, three storage tanks bulged around the base resulting in reported leaks from two 100,000 gallon tanks. A possible loss of 50,000 gallons of gasoline was estimated. A horizontal tank was thrown from its supports, empty tanks were rocked and catwalks tore from the induced ground motion. Union Oil, currently operated by MAPI, did not report the loss of any petroleum products, although cracks extended through its tank farm. Ground cracking also damaged properties occupied by Alaska Fish & Farm Products and Cook Inlet Tug & Barge.

With the destruction of the Ocean Dock, the oil requirements of Anchorage and Elmendorf Air Force Base fell on the City Dock which at the time of the quake had only one access to shore (Selkregg, 1984). The federal government assisted in repairing the access to the City Dock which had been damaged such that oil operations could continue. In addition, they assisted in building a temporary petroleum, oils and lubricant (POL) dock to the south of City Dock to alleviate some of the demand. Pipelines were installed on the City Dock within 1 month of the quake for off-loading of petroleum products. With assistance from Tippetts-Abbett-McCarthy-Stratton (1972), the city completed a new permanent POL dock by 1966.

Although no loss of petroleum products was reported at the Union Oil (MAPI) facility, the company did rebuild after the quake with replacing damaged tanks, pumps and pipelines. A soils investigation report for an expansion of the facility was completed several months following the quake (Dames & Moore, 1964). This report included recommendations for supports for the five large storage tanks currently located in the west portion of the facility.

Standard Oil Company (Chevron) also had a soils investigation report completed in June, 1964 following the earthquake (Adams, Corthell, Lee, Wince and Associates, 1964). The report provided recommendations for slope stability and bearing capacity.

7.0 SUMMARY OF FIELD EXPLORATIONS AND REMEDIAL ACTIONS

Numerous site assessment reports were available for review for each of the bulk fuel terminals and the Port of Anchorage facility located within the POA-PUG area. These assessment

reports included information about field explorations and remedial actions that had been conducted at each site. Field exploration activities included drilling soil borings, installing monitoring wells, sampling and testing surface and subsurface soils and waters, conducting soil gas surveys and other assessment activities. Following is a description of the assessment and remedial activities that have been conducted at the six bulk fuel terminals and the Port of Anchorage facility located within the POA-PUG area.

The majority of the documents reviewed were available at the Port of Anchorage data room. Several documents, however, were located in the ADEC files and Shannon & Wilson's files. Information regarding past assessment activities conducted on the parcels leased by Tote, Lonestar Cement No. 1, Sea-Land, Lonestar Cement No. 2, Chugach Electric, Alaska Resources Corp., North Star Terminal & Stevedore, Douglas Management Co., Kyokyu USA Inc., and JoAnn Pickworth was not available. A 1991 questionnaire for the Western Insulfoam facility was obtained from the Alaska Railroad Real Estate office. According to the questionnaire, there has never been a site assessment conducted on the Western Insulfoam property. In addition, according to Mr. Dale Nelson of the Alaska Railroad, there has been no site assessments conducted on the railroad easements extending throughout the Alaska Railroad owned portion of the POA-PUG area with exception of studies conducted by individual lease holders that may have included portions of the rail spur located on the leased parcel.

The site specific surface and subsurface soils encountered at each of the bulk fuel facilities and the Port of Anchorage are described in the following sections. Two cross sections, illustrated in Figures 5 and 6, running approximately north-south and east-west through the POA-PUG area, depict the typical soil strata encountered during drilling of the soil borings and monitoring wells. The cross sections are developed from selected boring and well points located along the section line. Several geotechnical soil borings from previous foundation reports were used to complete the cross sections because of their deeper penetration into the subsurface. With the exception of these geotechnical borings, the numerous borings that have been drilled throughout the POA-PUG area for geotechnical purposes have not been plotted on the Autocad basemap, Sheets 1 through 4. Since no information regarding the presence or absence of petroleum hydrocarbons is available for these geotechnical borings, areas where these borings were drilled are be considered a data gap unless an environmental soil boring or monitoring well was drilled in the vicinity.

7.1 Port of Anchorage Facility

In conjunction with a transportation improvement project and the construction of the new POL terminal, two environmental assessment reports have been completed for the Port of Anchorage facility. These reports include the February, 1990 Geotechnical Report and the August, 1990 Soil Quality Assessment report both developed by Shannon & Wilson. According to the information contained in these two reports, a total of sixteen soil borings have been drilled within the Port of Anchorage boundaries. Soil boring details and results of soil analyses conducted on collected samples are tabulated in Tables C-1 and C-2 included in Appendix C. Site plans from each of the assessment report showing pertinent site features and locations of soil borings are included as Attachments D-1 and D-2 in Appendix D.

Additional information available for review included the July, 1990, Stabilization of Contaminated Soils and Utility Trench Restoration workplan, the May, 1991, Soil Excavation and Stockpile Plan and the October 11, 1991, Evaluation of Stockpiled Soils in South Transit Yard letter report. All three previous documents were developed by Shannon & Wilson.

7.1.1 Field Explorations

Shannon & Wilson conducted a combined environmental and geotechnical field investigation in December, 1989 for a transportation improvement project within an area encompassing a portion of Anchorage Port Road, Tidewater Spur Road and Gull Avenue. The field investigation included drilling and sampling eight soil borings, designated Borings B-1 through B-8, located randomly throughout the improvement area. Soil samples were analyzed for petroleum hydrocarbon constituents in order to determine if impacted soils would be encountered during the improvement activities.

Petroleum hydrocarbon impacted soils were discovered during the 1989 combined field investigation. As a result, a soil excavation and stockpile plan was prepared by Shannon & Wilson in May, 1991 for the Transportation Improvement Project. A five task work plan was developed to characterize the soils left in the road excavations, to control the level of impacted of soils reused on the project and to properly store unusable excavated soils. The second task in this work plan included characterizing three proposed storage sites for background petroleum hydrocarbons. In a Shannon & Wilson May 16, 1991, Storage Site Characterization, Transportation Improvement Project letter report, the results of the task 2 work is reported. The task 2 work included collecting

surface soil samples from three potential storage sites and analyzing selected samples for total petroleum hydrocarbons and aromatic volatile organics. The three potential storage sites and surface soil sample locations are located on the Anchorage Fueling & Service Company leased parcels to the east of the Port of Anchorage as shown on the site plan from the letter report included as Attachment 3 in Appendix D. Additional information regarding the remaining tasks is not available.

A portion of the construction of the new POL terminal at the Port of Anchorage included the installation of new fuel lines and underground electric lines extending from the valve yard (spaghetti farm) to the proposed new POL terminal. Also, the installation of a new water line from Anchorage Port Road, east of the valve yard, to the terminal was planned. On June 28, 1990, impacted soils were encountered in an excavation that had been made within the valve yard for the connection of a new fuel pipeline. Shannon & Wilson sampled the impacted soils at the base of the excavation for total petroleum hydrocarbons and included the results of the sampling in their August, 1990 Soil Quality Assessment report that was completed as a result of the presence of petroleum impacted soils within the project construction area.

Shannon & Wilson conducted the soil quality assessment in July, 1990 within the vicinity of the south transit yard of the POL Terminal facility. The assessment included drilling and sampling eight soil borings, designated Borings B-1 through B-8. Soil samples were analyzed for petroleum hydrocarbon constituents in order to determine if impacted soils would be encountered during the utility improvement activities.

7.1.2 Subsurface Conditions

The surface and subsurface materials generally encountered consist of asphaltic concrete pavement, road base aggregate and fill and native soils, including sands and gravels as well as fine-grained and organic silts, clays and peat. The asphaltic concrete pavement and road base aggregate were encountered in those borings located within the existing roadways. The fill material typically extends to depths of 4.5 to 11.0 feet and consists primarily of medium dense to very dense, clean to silty, sandy gravel and gravelly sand. Underlying the predominantly granular fill material, organic materials consisting of fibrous peat with woody fragments were encountered in several test holes at depths ranging from 4.5 to 8.5 feet. This organic layer either extended to the depth explored by the borings or contacted a medium stiff to stiff, clayey silt. This fine grained confining layer contained some sand lenses and organic material.

Water was encountered in about one half of the borings during drilling at depths ranging from 3.5 to 8.0 feet. The water appears to be perched on the silty confining layer within the fill and organics above.

7.1.3 Discussion of Analytical Results

Soil samples collected from each boring drilled during the December, 1989 investigation were tested for total petroleum hydrocarbons by EPA 418.1 and aromatic volatile organics, BTEX, by EPA 8020. The sample from each of the eight borings with the highest headspace reading based on screening with a Photovac TIP photoionization detector was selected for analytical testing. Based on the results of the laboratory testing, elevated levels of petroleum hydrocarbon constituents are present in most of the area explored. The upper limit of total petroleum hydrocarbons, total BTEX and benzene was found in a sample collected from Boring B-7 located near the intersection of Gull and Anchorage Port Roads at 1610 ppm, 211.94 ppm and 1.74 ppm, respectively. With the exception of the sample from Boring B-7, the remaining samples analyzed contained only trace or non-detectable BTEX compounds although background to elevated levels (21 ppm to 640 ppm) of TPH were detected in each sample.

In the July, 1990 assessment, one soil sample from each boring drilled was analyzed for total petroleum hydrocarbons by EPA 418.1 and aromatic volatile organics, BTEX, by EPA 8020. The sample selected for testing had the greatest headspace reading based on screening for volatile organic compounds with a HNu model PI-101 photoionization detector. In addition, the sample collected from the base of the valve yard excavation, designated VY Exc., was tested for the type of petroleum product and total petroleum hydrocarbons by modified EPA 8015. Trace to elevated levels of petroleum hydrocarbon constituents were detected in the soils around the south transit yard of the POL facility. The sample collected from the base of the excavation had 14,800 ppm TPH that was identified as a diesel, aviation fuel or kerosene. The highest concentrations of TPH and BTEX were found in samples collected from borings B-5 and B-1 at 444 ppm and 0.046 ppm, respectively. All other samples analyzed from the borings had non-detectable BTEX and less than 100 ppm TPH.

In May, 1991, five surface soil samples were collected from each of the three proposed long term storage sites for petroleum impacted soils excavated during the transportation improvement project. The five samples from each site were composited into three samples, designated S-1 through S-3, by the laboratory and analyzed for total petroleum hydrocarbons, TPH, by EPA 418.1 and aromatic volatile organics, BTEX, by EPA 8020. All three composite

samples contained elevated levels of TPH ranging from 386 ppm to 4150 ppm. The only BTEX compounds were detected in the composite sample from Lot 1 with 0.074 ppm total xylenes.

7.1.4 Remedial Actions

In 1990, the new water, electric and fuel lines were installed as part of the construction of the new POL terminal. About 2500 cubic yards of potentially impacted soils were stockpiled on the asphalt pavement within the south transit area during the installation of the new utilities. To characterize the petroleum hydrocarbons in the stockpiled soils, the 2500 cubic yard stockpile was segregated into 50 individual 50 cubic yard piles and sampled by Shannon & Wilson. Soil samples collected were analyzed for total petroleum hydrocarbons by EPA 418.1, gasoline range organics by EPA 5030/8015, diesel range organics by EPA 3550/8100 and aromatic volatile organics, BTEX, by EPA 8020. The results of the sampling are reported in Shannon & Wilson's October 11, 1991, Evaluation of Stockpiled Soils in South Transit Yard, Port of Anchorage, Anchorage, Alaska letter report. All samples analyzed contained levels of petroleum hydrocarbons below the most stringent ADEC cleanup guidelines, therefore, Shannon & Wilson recommended that the stockpiled soils be used for non-regulated fill material within the Port of Anchorage boundaries.

7.2 Texaco Anchorage Terminal

One environmental assessment report for the Texaco Anchorage terminal has been completed and was available for review. The report, titled Environmental Assessment, Anchorage Bulk Terminal, Texaco Refining and Marketing Inc., 1601 Tidewater Road, Anchorage, Alaska was prepared by ENSR Consulting and Engineering in September, 1991. A total of eleven soil borings with five completed as monitoring wells were drilled for the assessment. Additional information included results of a water sampling round reported in the September 30, 1991, ENSR letter report and a October 5, 1991 letter from Anchorage Sand and Gravel to the ADEC concerning the receival of 901.28 tons of fuel stained soils from the Texaco Anchorage terminal. Boring and monitoring well details and results of soil and water analyses conducted on collected samples are tabulated in Tables C-3 through C-5 and included in Appendix C. A site plan from the assessment report showing the site features and locations of soil borings and monitoring wells is included as Attachment D-4 in Appendix D.

7.2.1 Field Explorations

ENSR Consulting and Engineering conducted a field exploration program in June, 1991 consisting of drilling six borings, designated TB-6 through TB-11, and installing five monitoring wells, designated TB-1/MW-1 through TB-5/MW-5, sampling and testing soil and water samples and performing an agricultural and biological analyses on select soil samples. Five of the borings, TB-1 through TB-5, were drilled for an assessment of the general subsurface soils and were completed as monitoring wells to assess shallow water table conditions. The remaining six borings, TB-6 through TB-11, were drilled along the tank car loading rack and adjacent to an underground storage tank, UST, used for spill containment located to the east of the warehouse. In September, 1991, a second round of water sampling and static water level measurements was conducted by ENSR.

7.2.2 Subsurface Conditions

The subsurface conditions at the Texaco terminal consist of a surficial granular fill material overlying a silty clay. The surficial granular fill material consists primarily of clean to silty, sandy gravels and extends to a depth ranging from 8 to 14 feet across the site. Underlying the fill material, a fine grained silty clay with organic materials was encountered to the depth explored, 10 to 17.5 feet. A perched water table was encountered throughout the site at depths ranging from 3 to 8.5 feet.

7.2.3 Discussion of Analytical Results

Soil samples collected from all of the soil borings were analyzed for aromatic volatile organics, BTEX, by EPA 8020, gasoline range organics, GRO, by EPA 5030/8015 and diesel range organics, DRO, by EPA 3550/8100. In addition, select samples collected from Borings TB-6 through TB-11 were analyzed for halogenated volatile organics, HVO, by EPA 8010, polychlorinated biphenyls, PCBs, by EPA 8080, toxic characteristic leaching procedures for BTEX by EPA 1311/8020, total petroleum hydrocarbons, TPH, by EPA 418.1 and total metals including arsenic, lead and chromium by EPA 6000/7000 Series. The highest concentrations of BTEX, GRO and DRO in samples collected from the background borings, TB-1 through TB-5, were 1 ppm, 23 ppm and 35 ppm, respectively. The samples collected from Borings TB-6 through TB-11 located along the tank car loading rack and adjacent to the UST contained elevated levels of petroleum hydrocarbons. The highest levels of GRO, DRO and TPH were 5,800 ppm,

4,900 ppm, and 4,400 ppm, respectively. In addition, the highest levels of total BTEX compounds and benzene were 1295.6 ppm and 6.2 ppm, respectively, from samples collected in Borings TB-7 and TB-11. Non-detectable levels of HVO and PCBs were found in the samples tested in addition to only background levels of arsenic, chromium and lead. The results of the TCLP for BTEX indicated that the soils would not be considered a RCRA hazardous waste.

The water samples collected from MW-1 through MW-5 in the June and September, 1991 sampling round were tested for aromatic volatile organics, BTEX, by EPA 602 and gasoline range organics, GRO, by EPA 5030/8015. The water samples were also tested for diesel range organics, DRO, by EPA 3550/8100 in the September, 1991 sampling round. Elevated levels of BTEX and GRO were found in the samples from MW-1 and MW-2. The highest concentrations were found in MW-1 at 2.1 ppm BTEX and 6.0 ppm GRO. Samples collected from Monitoring Wells MW-3 through MW-5 contained either non-detectable or extremely low levels of BTEX and GRO. No detectable levels of DRO were found in the samples collected from both sampling rounds.

The general shallow water flow direction at the Texaco terminal is to the north to northwest.

Agricultural and biological analyses were conducted on several soil samples in order to assess the potential for biological treatment of petroleum hydrocarbon impacted soils and water at the Texaco terminal. Results of an analyses by CET Environmental Services, Inc. indicate that a biostimulation approach may be considered appropriate for diesel-impacted areas reflected by the evaluated samples. In addition, based on the limited number of biodegraders for gasoline and crude oil impacted areas, a bioaugumentation approach using selected indigenous microorganisms may also be considered.

7.2.4 Remedial Actions

During September, 1991, rail upgrade activities were conducted at the Texaco terminal. Although no report documenting the cleanup work that was conducted in the vicinity of the rail area was available, information contained in a letter from Anchorage Sand & Gravel to the ADEC indicates that 901.28 tons of fuel stained soils from the Texaco terminal were removed from the site and treated by AS&G. Information regarding the exact locations of the excavated impacted soils was not available for review.

In a letter dated July 13, 1990, from Texaco to the ADEC that was reviewed in the ADEC Texaco site file No. L25.11, a 6,000-gallon UST was removed from the terminal. About 80 cubic yards of soil were excavated during the tank removal. The soils were stockpiled on site and sampled for petroleum hydrocarbon characterization. Results of the analyses indicated that the stockpiled soils contain 3000 ppm TPH, 135.01 total BTEX compounds and non-detectable benzene. The waste soils were disposed of through Anchorage Sand & Gravel.

7.3 Anchorage Fueling & Service Company Terminal

Two environmental assessment studies have been conducted at the Anchorage Fueling & Service Company (AFSC) terminal. Information regarding the installation of two monitoring wells at the terminal is contained in a February 23, 1985, letter report by Ryan & Haworth Co. for the Anchorage Fueling & Service Company, Anchorage Terminal, Plant #1, Subsurface Water Surveillance Wells. Additional information was collected from Anchorage Fueling & Service Company personnel. The monitoring well details and results of water analyses are listed in Tables C-6 and C-7 included in Appendix C. Two site plans showing the locations of the two monitoring wells and the locations of an additional eleven wells installed by Shell Oil are included as Attachments D-5 and D-6 in Appendix D.

7.3.1 Field Explorations

Prior to AFSC obtaining ownership of the terminal, Shell Oil installed a total of eleven monitoring wells throughout the site. Although no assessment report containing information about the wells is available, a site plan showing the locations of the wells and a table with depth to water and thickness of product measurements was provided by Anchorage Fueling & Service Company. One half inch of floating product was measured on the water table in Well 1 located in the southwest corner of the site. No product was noted in any of the other wells. Only three of the eleven wells, Wells #1, #3 and #5, are still present at the facility, however, Well #3 is severely bent and most likely unusable.

Documented field exploration activities that have been conducted at the Anchorage Fueling & Service Company terminal include the installation of two monitoring wells, designated South Well No. 1 and North Well No. 2, and a monitoring well sampling program. In February, 1985, two monitoring wells were installed on the north and south sides of Tank #1 as a result of the overfilling of the tank on March 27, 1984. Installation activities were monitored by a

representative of Ryan & Haworth Company. Although soil samples were collected, no information regarding analytical testing is available.

Anchorage Fueling & Service Company has been sampling the water from the two wells since May, 1985. Sampling is generally conducted in the late spring and early fall of each year. North Well No. 2 has not been sampled since August, 1988 due to the installation of an oily waste sump pit directly adjacent to the well.

7.3.2 Subsurface Conditions

The subsurface conditions at the location of Tank #1 consist of granular fill material overlying fine grained silts. About 4 to 6 feet of surficial washed gravel fill material covers the area around Tank #1. The soils located below the fill material consist of silty gravel and gravelly silt. This layer may be a continuation of the overlying fill material and extends to a depth of 12 to 20 feet in the boring south of the tank. Underlying the gravel/silt layer, a soft, wet silt was encountered in the boring for the well north of the tank to the depth explored, 18 feet. Odors of oil were noted in the soils from both borings from depths of about 4 to 8 feet. A perched water table was encountered during drilling at a depth of 6 to 6.5 feet.

7.3.3 Discussion of Analytical Results

A total of eleven water sampling rounds have been conducted since the installation of the two wells in February, 1985. Water samples were analyzed for oil and grease by EPA 413.2. Elevated levels of oil and grease are present in both wells and range from 0.5 ppm to 6.29 ppm in the south well and 3.7 ppm to 41 ppm in the north well.

7.3.4 Remedial Actions

No information regarding any remedial actions conducted at the Anchorage Fueling & Service Company terminal is available for review.

7.4 Defense Fuels Terminal

Two environmental assessment reports for the Defense Fuels Terminal were available for review including the 1990 Installation Restoration Program, Stage 1, Site 1, Anchorage Fuel Terminal Report by Woodward-Clyde Consultants and the 1992 Anchorage Fuel Terminal Site

Investigation Project Report by Ecology & Environment, Inc. Between the two assessments, a total of 108 soil borings and 21 monitoring wells were drilled and sampled within the Defense Fuel terminal. In addition, extensive soil gas surveys, surface water sampling and risk assessments have been conducted at the site. Boring and monitoring well details and results of soil and water analyses conducted on collected samples are tabulated in Tables C-8 through C-10 and included in Appendix C. Details about the 106 soil borings drilled for the 1992 Ecology and Environment assessment report are not included in Table C-8 due to lack of information available in the report. Site plans from each of the assessment reports showing pertinent site features and locations of soil borings and monitoring wells are included as Attachments D-7, D-8 and D-9 in Appendix D.

7.4.1 Field Explorations

Woodward Clyde Consultants conducted a soil gas survey at the Defense Fuel terminal in 1987 to determine the lateral extent of BTEX impacted soil and water throughout the facility. No specific information regarding the soil gas survey is available. Based on brief comments from assessment reports, the survey was used to determine the probability of high, moderate and low concentrations of petroleum hydrocarbons on the site. Other comments from assessment reports indicate that other site assessment activities have been conducted within the Defense Fuels facility however, no information regarding these assessments is available.

Woodward Clyde Consultants conducted a field exploration program in 1988 that included conducting a limited geophysical survey, drilling and installing soil borings and monitoring wells, sampling site soils and water, measuring flow rates and sampling surface water from streams, drainage ditches and an abandoned sewer line, and running pilot studies to determine the feasibility for using a product recovery system through water drawdown, bioremediation and vapor extraction.

The geophysical survey work included a ground penetrating radar (GPR) survey and an electromagnetic survey. The GPR survey was conducted primarily as a tool to locate a subsurface french drain system, but was unsuccessful. The electromagnetic survey was conducted using an Metrotech 480 in order to locate site subsurface pipelines and utilities. The abandoned french drain system was located during this survey.

A total of nine soil borings were drilled within the facility in which 1 was completed as a vapor extraction system, VES, well and six were completed as monitoring wells. The

borings/wells were designated AFT-1 through AFT-8. Soil and water samples collected from the borings/wells were tested for petroleum hydrocarbon constituents.

Flow rates were measured from surface streams, drainage ditches and an abandoned sewer line in October, November and December, 1988. In addition, surface water samples were collected from these sources. Results of the surface water sampling and testing were used to perform a risk assessment on the facility.

Three pilot tests were conducted for the 1988 study to evaluate different options of soil and water remediation. These tests included determining the feasibility of using water table drawdown to recover free product that may be present on the shallow water table. Results of this test indicated that this procedure for recovery of product was not feasible. A pilot test was conducted to determine if in-situ volatile extraction would be practical for decreasing levels of volatile organics from subsurface soils and shallow perched water. The results of the test indicate that a low potential at several locations throughout the facility for remediation of volatile organics is present. The bench scale test conducted for determining the compatibility of enhanced bioremediation indicated that land treatment of petroleum hydrocarbon impacted soils can be an effective method of remediation at the facility.

A site investigation was conducted by Ecology and Environment, Inc. in 1991 to generate sufficient and appropriate information to develop detailed plans and specifications for remediation at the site. The 1991 study included conducting an extensive soil gas survey, drilling and sampling soil borings, installing and sampling monitoring wells, addressing and screening several remedial alternatives for soil, shallow perched water, surface water and off-site migration control and performing a risk assessment on the facility.

A total of 106 soil borings, designated 1 through 111 omitting numbers 25, 26, 27, 51 and 87, were drilled throughout the site. A total of 484 soil gas samples were collected from the borings for headspace analyses at an on-site field laboratory using a Photovac 10S50 gas chromatograph equipped with a PID. In addition, 65 soil samples collected from the soil borings were analyzed for several compounds at an off-site laboratory. A total of 14 monitoring wells, designated MW1 through MW16 omitting numbers 8 and 9, were installed at selected locations based on the results of the field laboratory headspace analyses. The water was sampled in May and June, 1991.

The risk assessment concluded that the risk for potential excess cancer risk posed by vapor emissions from environmental contamination at the site is about 2 x 10-6 which is at the lowest end of the transitional range at which EPA generally regards as acceptable of marginal concern.

As an addendum to the 1991 Ecology & Environment study, surface soil samples were collected from an area where transformer fluid had been spilled and analyzed for polychlorinated biphenyls (PCBs). Results of the sampling are included in Ecology & Environments April 1,1992 letter report and are discussed in Section 7.4.3.

7.4.2 Subsurface Conditions

The surface soils at the defense fuels site consist primarily of sands and gravels that either originated from landslide deposits, the Naptowne sediments or manmade fill. The granular soils range from 0 to 50 feet in thickness throughout the site with the thicker sediments located along the southern boundary. Underlying the sands and gravels, the fine grained nonpermeable clays with some silt and peat were encountered. The clay layer was present to the depth explored in all borings.

A shallow water table underlies about two-thirds of the site. The water is perched within the granular sediments on top of the impermeable clays. The greatest thicknesses of the saturated granular soils exist along the eastern portion of the facility and range up to 31 feet. The shallow water is flowing in a northwest direction across the site with exception of local fluctuations due to topography and stratigraphy.

7.4.3 Discussion of Analytical Results

Soil samples collected in the Woodward-Clyde 1988 study from Borings AFT-1, 2, 4, 5, 7 and 8 were analyzed for volatile organics including benzene, toluene, ethylbenzene and xylene, BTEX, by EPA 8240, semi-volatile organics (base/neutral/acid extractables, BNAs) by EPA 8270, total lead by EPA 239.1 and total petroleum hydrocarbons, TPH, by EPA 418.1. In addition, soil samples collected from adjacent Borings AFT-2A and 5A were tested for TPH by EPA 418.1 and BTEX by EPA 8020. A soil sample collected from AFT-5 contained the highest concentrations of TPH at 29,000 ppm and total extractable BNAs at 5,800 ppm. The results of the volatile organics analysis by EPA 8240 indicated non-detectable quantities for each of the samples tested. The only positive results of BTEX compounds were in samples collected from AFT-5A with a concentration

of 0.013 ppm. Out of each of the samples analyzed, lead was detected in only one sample from AFT-7A at 20 ppm.

Soil samples collected in the Ecology & Environment 1992 study were tested for volatile organics by EPA 8240, semi-volatile (base/neutral/acid extractables, BNAs) by EPA 8270 and total petroleum hydrocarbons, TPH, by the Corps' modification of EPA 8015 for fuel identification. Volatile organics detected in the soil samples included methylene chloride, acetone, carbon disulfide, 2-butanone, trichloroethene, tetrachloroethene, benzene, toluene, ethylbenzene and xylenes. The greatest BTEX and benzene concentrations were found in a sample from Boring BH-23 located on the north side of the railroad spur about 100 feet northwest of the transfer pump house. The sample contained 81.3 ppm BTEX with 2.8 ppm benzene, 5.2 ppm ethylbenzene, 6.3 ppm toluene and 67 ppm total xylenes. The semi-volatiles detected in the samples included naphthalene, 2-methylanphthalene, phenanthrene, di-n-butylphthalate, pyrene, fluoranthrene, bis(2-ethylhexyl)phthalate and chrysene. The highest concentration of extractable BNAs was found adjacent to an above ground tank in the southwestern portion of the facility in a sample collected from BH-86 at 46.47 ppm. The highest concentration of TPH of 9,400 ppm quantified as K-1 kerosene was also found in the sample from BH-86.

A total of 9 surface soil samples were collected and analyzed for polychlorinated biphenyls, PCBs, by EPA 8080. The samples were taken from a 225 square foot area around an overhead power pole where 21 gallons of transformer fluid was released in 1982. The results indicated that all samples had non-detectable PCBs.

Water samples were collected from four of the six wells installed in the 1988 study by Woodward-Clyde in September, 1988. The water samples were tested for total petroleum hydrocarbons, TPH, by EPA 418.1, aromatic volatile organics, BTEX, by EPA 8020 and total lead and dissolved lead by EPA 239.2. Ecology & Environment resampled all six of the 1988 installed wells in addition to the thirteen wells that they installed in the 1992 study in May and June, 1991. The water samples collected were analyzed for total petroleum hydrocarbons, TPH, by EPA 8015 fuel identification method, volatile organics by EPA 624, semi-volatiles (base/neutral/acid extractables, BNAs) by EPA 625 and total and dissolved lead by EPA 239.2.

In addition to BTEX compounds, other volatile organics identified in the water samples included methylene chloride, 1,1-dichloroethene, 1,1-dichloroethane, trans-1,2-dichloroethane, chloroform, 1,1,1-trichloroethane and trichloroethene. The highest concentration of BTEX compounds of 0.856 ppm with 0.69 ppm benzene, 0.036 ppm ethylbenzene, non-detectable

toluene and 0.13 ppm total xylenes was found in the sample collected from MW-4 located about 250 feet northeast of the end of the railroad spurs near the Defense Fuels and Anchorage Fueling & Service Company boundary. The greatest concentration of extractable BNA compounds of 0.165 ppm was detected in a sample collected from MW-501 (also known as AFT-2). The highest TPH concentration was also detected in the sample from this well at 140 ppm quantified as jet fuel. Other high levels of TPH detected in water samples from MW-500 and MW-503 (also known as AFT-1 and AFT-5) were 47 ppm quantified as jet fuel and 40 ppm quantified as 14 ppm jet fuel and 26 ppm gasoline, respectively. Corresponding with the high TPH concentrations, lead levels were greatest in samples collected from MW-500, MW-501 and MW-503 at concentrations ranging from 0.13 to 0.21 ppm.

7.4.4 Remedial Actions

No information regarding any remedial actions that have taken place at the Defense Fuels terminal is available.

7.5 Tesoro Alaska Terminal

An environmental assessment of the Tesoro Alaska terminal which included the drilling of 25 soil borings and the installation of five monitoring wells was conducted by Environmental Strategies Corporation in two phases. Results of the assessment are reported in Environmental Strategies Corporation's August 21, 1989, Report on Phase I, Field Investigation, Tesoro Alaska Petroleum Company, Anchorage, Alaska and their January 16, 1990, letter report to the Alaska Department of Conservation on Sampling Results for the Tesoro Terminal Site, Anchorage, Alaska. Results of a complete round of water sampling conducted by Hart Crowser is reported in their January 8, 1992, letter report on Anchorage Terminal Water Quality Data. Boring and monitoring well details and results of soil and water analyses conducted on collected samples are tabulated in Tables C-11 through C-13 included in Appendix C. Site plans from the Environmental Strategies Corporation reports are included as Attachments D-10 through D-13 in Appendix D.

7.5.1 Field Explorations

In July, 1989 Environmental Strategies Corporation, ESC, conducted a field investigation at the Tesoro terminal in order to determine the lateral and vertical extent and concentration of petroleum hydrocarbon impacted soil and water. A total of 22 soil borings and 2 monitoring wells were drilled and installed with: 12 of the borings, designated TB1EX through TB7EX, TB10EX,

and TBA through TBD, located in the area around a pipeline leak near tank No. 7; two of the borings, designated TB8RD and TB9RD, located along a drainage ditch east of tank No. 7; eight of the borings, designated TB1TR through TB8TR, located within the truck loading rack area; and 2 monitoring wells, designated MW1 and MW2, located along the eastern site boundary. The borings drilled in the vicinity of tank No. 7 were drilled in response to a pipeline leak that occurred in the area and were located around an excavated area where about 375 cubic yards of soil had been removed. Soil and water samples were collected and tested in order to assess the extent and concentration of petroleum hydrocarbons at the site. In addition, a sample of product floating on the water table in Boring TB5EX was collected and tested for fingerprinting. A temporary recovery well, designated RW1, was installed to remove some of the product encountered.

In August, 1989 ESC performed additional assessment activities including the drilling and installation of three soil borings, designated TB11EX through TB13EX, in the vicinity of tank No. 7 and three monitoring wells, designated MW3 through MW5, within the truck loading rack area. Soil samples were collected and tested for petroleum hydrocarbons at the time of drilling. Water samples were collected from each of the five monitoring wells located at the site in November, 1989. A second recovery well, designated RW2, had been previously installed in the pipe leak excavation when the excavation was backfilled in October, 1989.

A second complete round of water sampling and static water level measurements was completed in October, 1991 by Hart Crowser. In addition to the monitoring wells, a water sample was collected from a shallow water recovery system, designated NS-1, located on the north end of the truck loading rack.

7.5.2 Subsurface Conditions

The surface soils within the truck loading rack area were covered with either a concrete pad or asphalt. Underlying the paved surface and within the vicinity of tank No. 7 and the pipeline leak, about 1 to 7.5 feet of granular fill material was encountered during drilling. The fill material ranged from a medium coarse sand material to a gravel fill material. The bottom of the fill material contacted a dark blue/gray silty clay and clayey silt layer with varying amounts of sand, peat and wood fragments. This fine grained silt/clay layer extended to the depths explored and graded into a tight silty clay with depth. In areas where the surficial fill material was not encountered, this fine grained clayey silt and silty clay material extended the entire depth explored.

Specific information about the depth in which water was encountered during drilling of the soil borings is not available. Generally, about 1 foot of saturated soils are present above the confining fine grained silt/clay layer. Shallow water was encountered in the monitoring wells and recovery wells at depths ranging from 1.2 to 5.9 feet below the ground surface.

7.5.3 Discussion of Analytical Results

Soil samples collected from the borings and monitoring wells were analyzed for total petroleum hydrocarbons, TPH, by EPA modified 8015 and aromatic volatile organics, BTEX, by EPA 8020. Generally, based on headspace readings through screening with a HNu photoionization detector, two samples from each boring were selected for analytical testing. One sample from the zone of potentially impacted soils and one sample from directly beneath the potentially impacted zone was tested. Results of the analyses indicated that petroleum hydrocarbon impacted soils are present within the truck loading rack area, in the vicinity of tank No. 7 and the pipeline leak and along the drainage ditch area. The highest levels of TPH detected in these areas are 16,600 ppm with 7,100 quantified as gasoline and 9,500 quantified as diesel, 290,000 ppm quantified entirely as diesel and 3,700 ppm also quantified as diesel, respectively. In addition, maximum elevated total BTEX levels for each of the areas include 59.0 ppm, 306 ppm and 369 ppm, respectively. The area along the eastern boundary where the two monitoring wells were installed also has slightly elevated levels of petroleum hydrocarbons in the soils and water. The greatest levels were detected in samples collected from MW-1 and include 870 ppm TPH quantified entirely as gasoline and 12.19 ppm total BTEX. The water sample collected from this well had 24 ppm TPH quantified as gasoline and 2.6 ppm total BTEX.

The results of the fingerprinting of the product collected from the excavation indicated that the source was a No. 2 diesel. However, the results of product testing from a sample collected from boring TB5EX located northeast of tank No. 7 indicated that the floating product that was encountered in the majority of the borings in this area is a No. 1 diesel. The source may possibly be from tank No. 7 and not the pipeline leak.

The results of the water sampling that was conducted in November, 1989 and October, 1991 indicate that the shallow water within the truck loading rack area has been impacted by petroleum hydrocarbons. The greatest quantities of dissolved petroleum hydrocarbons are present in MW-1 in which 33.6 ppm TPH quantified as 30 ppm gasoline and 3.6 ppm diesel and 4.68 ppm total BTEX where detected in the sample collected during the November, 1989 sampling round. The shallow water flow direction was not discussed in the reports for either sampling round.

7.5.4 Remedial Actions

Two remedial events including a passive bioremediation project and a Bolsing Process treatment of petroleum hydrocarbon impacted granular soils have been conducted at the Tesoro terminal. Information regarding these activities was obtained from several sources including two letters from Tesoro Alaska to the ADEC dated June 15, 1990 and September 4, 1990 explaining the truck loading rack rehabilitation and impacted soil remediation/stabilization project. In addition, a September, 1990 Remedial Action Plan for Organic Soils and two letter reports dated January 7, 1991 and January 8, 1992 developed by Hart Crowser were reviewed concerning the bioremediation project, as well as a photographic documentary of the project developed by Tesoro Alaska (1990-1991). For specific information concerning the Bolsing Process treatment, an August 15, 1990 Treatability Study Results report and two letter reports dated November 29, 1990 and December 20, 1991 developed by Sound Environmental Services, Inc. were reviewed.

As previously discussed, about 375 cubic yards of diesel impacted soils were excavated as a result of a pipeline leak near tank No. 7 in May, 1989. These soils were stockpiled on a plastic liner within the bermed area of tank No. 6 and 7. In July and August, 1990 the truck loading rack area was rehabilitated for both frost and drainage induced concrete slab and asphalt damage. At this time, a fuel resistant liner serving as a secondary containment was installed beneath the truck loading rack and about 700 cubic yards of primarily diesel impacted soils were excavated. Approximately 670 cubic yards of the excavated materials consisted of organic soils. The remaining 30 cubic yards were granular in nature and were stockpiled with the previously excavated 375 cubic yards.

In the August, 1990 report by SES, results of a Bolsing Process Treatability Study for the approximately 400 cubic yards of granular stockpiled soils were reported. According to SES, the Bolsing Process should result in an effective fixation of the petroleum hydrocarbons in the granular soils. The Bolsing Process and CaO Lime procurement were completed in September, 1990. Subsequent testing of stockpiled soils by SES in November, 1990, and June, 1991, indicated that the hydrocarbons in the soils had been stabilized and that the remediation was a success. Bolsing treated soils were utilized onsite for grading, drainage, berm rehabilitation and for pipeline ramp construction.

At Tesoro's direction, a passive bioremediation plan was prepared by Hart Crowser for the 670 cubic yards of primarily diesel impacted organic materials was implemented in September,

1990. The soils were treated with PES-31 and nutrients and tilled once before winter. Sampling of the treated soils in October, 1990 indicated that no significant reduction in the quantity of hydrocarbons in the soils had occurred. The treated soils were seeded with Alaskan wild flowers for revegetation in July, 1991. Results of a second round of testing by Hart Crowser in October, 1991 showed again that no significant reduction in the hydrocarbon levels had occurred over the year of passive bioremediation. The maximum total petroleum hydrocarbons present in soil samples collected during the October, 1991 sampling round were 260 ppm determined by EPA Modified 8015.

7.6 Chevron U.S.A. Anchorage Terminal

Several environmental assessments have been conducted at the Chevron U.S.A. Anchorage terminal including the October 12, 1983, Data Report on Observation Well Installation, Chevron Tank Farm report by A. W. Murfitt Company; the February, 1990, Site Characterization, Chevron Anchorage Terminal report by Hart Crowser; the February 7, 1992, Water Quality Monitoring, Chevron Anchorage Terminal letter report by Hart Crowser and the April 9, 1991, Final Report of Soil Sampling Activities in the Vicinity of Tanks 1, 29, and 30, Anchorage Terminal letter report by American North Inc. According to the information contained in these reports, a total of 15 soil borings and 24 monitoring wells have been drilled and sampled within the Chevron terminal. Boring and monitoring well details and results of soil and water analyses conducted on collected samples are tabulated in Tables C-14 through C-16 in Appendix C. Site plans from the assessment reports showing pertinent site features and locations of soil borings and monitoring wells are included as Attachments D-14, D-15 and D-16 in Appendix D.

7.6.1 Field Explorations

In October, 1983 A.W. Murfitt Company installed 13 monitoring wells, designated 1 through 13, at the Chevron Anchorage terminal. No information regarding the analyses of soil and water samples collected from the A.W. Murfitt Company study was available. Hart Crowser installed an additional 9 monitoring wells in September, 1989, to supplement the existing network of 13 wells and one monitoring well in December, 1989. Three wells were abandoned due to improper construction. Therefore, a total of 21 monitoring wells, designated MW1 through MW21, were available for sampling.

In December, 1991, Hart Crowser performed a second round of water level measurements and sampling at the Chevron Anchorage terminal. All samples were analyzed for gasoline range

organics by EPA 5030/8015, diesel range organics by EPA 3510/8100, BTEX by EPA 602 and total petroleum hydrocarbons by EPA 418.1.

The soils around Tanks 1, 29 and 30 were evaluated for petroleum hydrocarbon concentrations by American North Inc. in April, 1991 prior to the replacement of the bottoms of each of the tanks. A total of fifteen borings, five borings around the perimeter of each tank, were drilled and sampled. The borings were designated T1-1 through T1-5, T29-1 through T29-5 and T30-1 through T30-5. Soil samples collected from each boring were analyzed for total petroleum hydrocarbons by EPA 418.1 and gasoline and diesel range hydrocarbons by EPA 3550/Modified 8015.

7.6.2 Subsurface Conditions

The Chevron Anchorage terminal is underlain by a sequence of surficial fill material, gravelly sand/sandy gravel, well sorted sand and silty clay/clayey silt. The surficial fill material is present throughout the majority of the site and extends up to 12 feet in depth. The fill material consists of clean to silty gravelly sand and sandy gravel with occasional wood or other debris. Underlying the fill material, a gravelly sand/sandy gravel layer was encountered and ranges from 0 to 23 feet in thickness. This unit rests on the well sorted sand layer or the top of the silty clay/clayey silt layer in the absence of the well sorted sand. The clean well sorted sand layer with predominantly uniform particle sizes ranges from 9 to 11 feet in thickness where present throughout the site. The sand layer was not encountered in the shop area in the northwest corner of the site and along the bluff near the southeast corner of the site. Encountered in all wells to the depth explored, was the lowermost silty clay/clayey silt layer. This fine grained soil layer was encountered at depths ranging from 3 to about 31 feet. Organic material is found in the upper few feet of the silt/clay layer.

Shallow water was encountered throughout the Chevron Anchorage terminal at depths ranging from 1 to 21.6 feet below the ground surface. The saturation thickness of granular materials overlying the confining silty clay/clayey silt layer is generally less than 10 feet.

7.6.3 Discussion of Analytical Results

Results of the field explorations were reported in Hart Crowser's February, 1990 report. Soil samples collected during the well installations were tested for total petroleum hydrocarbons, TPH, by EPA 418.1, aromatic volatile organics, BTEX, by EPA 8020 and halogenated volatile

organics by EPA 8010. In zones where field screening with an HNu photoionization detector indicated the presence of hydrocarbons, generally three samples per boring were submitted for testing in order to identify the upper and lower extent of hydrocarbon occurrence. When no evidence of hydrocarbon occurrence was observed, one sample from slightly below the water table was submitted for analysis. The laboratory results indicate that elevated levels of TPH and BTEX are present throughout the Chevron Anchorage terminal, specifically near the intersection of Bluff and Ocean Dock Roads, the lower tank compound, along the eastern property line, north end of the railcar loading rack, near the asphalt loading rack and in the warehouse yard. The highest concentrations of TPH and BTEX were found in a sample collected from MW13A located near the Bluff and Ocean Dock Road intersection at 15,900 ppm and 1,322 ppm, respectively. A total of five samples were analyzed for halogenated volatile organics in which all compound concentrations were below the method detection limits except for 0.314 ppm tetrachloroethylene (PCE) in MW19 located by the asphalt loading rack.

A total of two water sampling rounds have been completed at the site by Hart Crowser in October/December, 1989 and in December, 1991. The water samples from the 1989 sampling round were analyzed for aromatic volatile organics, BTEX, by EPA 602 and halogenated volatile organics by EPA 601. The samples from the 1991 sampling round were tested for BTEX by EPA 602, gasoline range organics, GRO, by EPA 5030/8015, diesel range organics, DRO, by EPA 3510/8100 and total petroleum hydrocarbons, TPH, by EPA 418.1. Petroleum hydrocarbons have been found in all monitoring wells except for MW15 located about 100 feet north of Tank 9. The highest concentration of BTEX was found in the water sample collected in the 1989 sampling round from MW19 located adjacent to the asphalt loading rack at 17.2 ppm. The highest concentrations of TPH and DRO were found in the sample from MW10 located directly north of Tank A-3 at 110 ppm and 86 ppm, respectively. The sample collected from MW16 located in the warehouse yard had the greatest GRO concentration of 23 ppm. A total of four samples collected during the 1989 sampling round were analyzed for halogenated volatile organics in which all compounds were non-detectable except for 0.0718 ppm 1,2-dichloroethane in the sample collected from MW13A located at the intersection of Bluff and Ocean Dock Roads.

The shallow water flow direction at the Chevron Anchorage terminal is generally to the northwest, however, local variations exist due to ponded surface water at the site, a drain located in the truck loading rack parking lot area and the topography of the underlying confining silt/clay layer.

Results of the field explorations conducted in April, 1991 were reported in American North's letter report. Soil samples collected from each boring at a depth of 5 to 6.5 feet were tested for total petroleum hydrocarbons by EPA Methods 418.1 and 8015 Modified. Elevated levels of petroleum hydrocarbons quantified either as gasoline, diesel or hydraulic oil were detected in borings T1-2, T1-3, T30-1 and T30-2. The soil sample collected from boring T1-2 contained 160 ppm gasoline while the samples collected from borings T1-3 and T30-2 had up to 67 ppm diesel. Petroleum hydrocarbons quantified with a hydraulic oil standard were detected in samples from borings T30-1 and T30-2 at concentrations of 730 ppm and 25 ppm, respectively. No petroleum hydrocarbons were detected in any of the other samples collected.

7.6.4 Remedial Actions

No information regarding any remedial actions conducted at the Chevron Anchorage terminal is available for review.

7.7 Mapco Alaska Petroleum Incorporated Terminal

Numerous field exploration activities and assessments have been conducted for the Mapco Alaska Petroleum Incorporated terminal. These explorations include a series of environmental assessments conducted by Hart Crowser involving drilling and installing borings and wells, soil gas surveys and shallow water table monitoring. Information regarding these activities was obtained from the following documents developed by Hart Crowser: the December 1987, Soil and Groundwater Investigation, Union Oil Terminal report; the April 1988, Phase 2, Subsurface Petroleum Product Assessment, Task 2 - Soil Gas Survey, Union Oil Terminal report; the July 1988 Phase 2, Subsurface Petroleum Product Assessment, Task 3 Monitoring Well Network and Expanded Soil Gas Survey, Union Oil Terminal report; the July 28, 1989 Water Quality Sampling/Water Level Measurements, Former Union Oil Terminal letter report; the August 28, 1989, Water Level Measurements, Former Union Oil Terminal letter report; the February 5, 1990, Former UNOCAL Fuel Terminal Water Quality Sampling letter report; and the May 1, 1990, Former UNOCAL Fuel Terminal Water Quality Sampling letter report.

Additional assessments were conducted by Shannon & Wilson in conjunction with the proposed expansion of the Mapco terminal. Information regarding these assessment activities is included in Shannon & Wilson's December, 1991, Geotechnical and Environmental Report, Mapco Tank Site, Port of Anchorage, Anchorage, Alaska and March 13, 1992, Site Assessment, Chugach Electric Association Sub-lease, 1200 Ocean Dock Road, Anchorage, Alaska report.

A total of 17 soil borings and 19 monitoring wells have been drilled and installed on the Mapco terminal site. Boring and monitoring well details and results of soil and water analyses conducted on collected samples are listed in Tables C-17 through C-19 in Appendix C. Site plans showing site features and locations of soil borings and monitoring wells are included as Attachments D-17 and D-18 in Appendix D.

7.7.1 Field Explorations

Results of a Phase I soil and water investigation conducted by Hart Crowser, Inc. were reported in a December, 1987 document titled Soil and Groundwater Investigation, Union Oil Terminal, Anchorage, Alaska. The Phase I soil and water investigation included performing a review of the site history and environmental records, drilling and installing 6 soil borings, designated BH-1 through BH-6, and 5 monitoring wells, designated MW-1 through MW-5, and sampling and testing subsurface soils and water.

Based on the results of the Phase I field investigation, Hart Crowser developed and performed a soil gas survey in April, 1988 on the former Union Oil Terminal site in order to characterize the extent and relative quantity of petroleum hydrocarbons at the site. A total of 93 soil vapor probes were sampled throughout the site. At the time of the survey, 8 trenches, designated EX-1 through EX-8, were dug in conjunction with tie-in piping fabrication and installation purposes. The subsurface conditions of the trenches were observed by Hart Crowser. A water sample was collected and analyzed from Trench EX-1.

In order to further characterize the extent and concentration of petroleum hydrocarbons at the site, additional assessment work was conducted in May, 1988. An additional 55 soil vapor probes were sampled at select locations based on the results of the April, 1988 survey. The monitoring well network was expanded with the addition of 14 monitoring wells designated MW-6 through MW-19. In addition, three soil borings were drilled and sampled within the western portion of the site. The assessment activities also included limited testing to assess the suitability of the site soils for soil vapor extraction as a remedial option.

A water monitoring program was established by Hart Crowser after the installation of the 19 monitoring well network. The program included taking measurements of the static water levels and product thicknesses on a monthly basis and sampling of the water at each well location on a quarterly basis in March, June, September and December 1989.

In a combined geotechnical and limited environmental field exploration program, Shannon and Wilson drilled and sampled a total of eight soil borings, designated B-1 through B-8, in December 1991. The borings were drilled in conjunction with a proposed expansion program for the MAPI facility on a sublease property located north of the existing facility.

Based on the results of the December, 1991 exploration program, Shannon and Wilson conducted a site assessment including a historical document research and site reconnaissance survey on the subleased property and presented the results in their March 13, 1992 report. The historical review and site reconnaissance report concluded that there are both on-site and off-site sources for petroleum hydrocarbon and hazardous substances that have affected the proposed tank expansion area. Former waste oil and fuel cargo barging services that once were conducted from the site have the highest potential for being the sources of known petroleum hydrocarbon impacted soils at the site. Additional on-site sources include road oiling for dust control, imported petroleum hydrocarbon impacted fill material and the storm drain pipe carrying impacted water from the east of the property. Off-site sources are possible from the northeast, east and southeast due to the direction of water flow prominently from the east to west.

7.7.2 Subsurface Conditions

The subsurface soil conditions encountered in the borings and monitoring wells completed at the MAPI terminal typically consist of a surficial layer of granular fill material overlying silt materials. Throughout the property, a granular fill material consisting of medium dense to dense clean to silty, gravelly sands and sandy gravels was encountered. This fill material ranged from 4 to 12 feet in thickness with an average of about 6 feet. Underlying the fill material, a gray, soft to stiff, silty clay and clay silt layer was typically encountered to the depths explored by the borings and monitoring wells from 11 to 52 feet. This silty layer contained varying amounts of organics with the greatest concentrations in the upper zone of the silts near the contact of the fill material. The moisture contents of the silty layer ranged from moist to wet. Along the east and south boundaries of the property, the borings/monitoring wells encountered a sand layer in between the surficial fill and silts. This clean to silty sand layer ranged from 3 to 13 feet in thickness and may be an extension of the surficial fill pad encountered in all of the test holes.

A shallow water table was encountered in the majority of the test holes throughout the site at depths ranging from 2 to 25 feet with an average of about 4 feet. Based on static water level

monitoring during both high and low tide cycles by Hart Crowser, the extreme tides of the Upper Cook Inlet do not appear to effect the levels of the static water table.

7.7.3 Discussion of Analytical Results

The results of the December, 1987 soil and water investigation indicate that petroleum hydrocarbon impacted soils and water exist beneath the site. Elevated levels of up to 8000 ppm of petroleum hydrocarbons determined by EPA 503C were detected in soil samples collected from the site. In addition, elevated levels of aromatic volatile hydrocarbons, BTEX, determined by EPA 8020/602 were detected up to 1249 ppm total BTEX in the soil samples and up to 47.9 ppm in the water samples.

The April, 1988 soil gas survey was conducted to determine the extent and concentration of petroleum hydrocarbon impacted soil and water at the site. Elevated soil gas concentrations of petroleum hydrocarbons were present throughout the area explored. The source of the soil gas concentrations is thought to be a thin product layer floating on the shallow water table. This product layer was observed in existing monitoring wells on the site and in trench excavations conducted for piping tie-ins. Concentration highs in the soil gas were detected in the East Tank Farm area (up to 886 ppm total hydrocarbons and 16.4 ppm total BTEX) and near the rail loading rack.

The results of the May, 1988 field investigation combined with the results of the two previous investigations indicate that both dissolved and free product is present in elevated concentrations in several areas within the facility. The areas with the highest concentrations are present in the East Tank Farm near MW-5. BTEX concentrations in monitoring wells bordering the west boundary of the facility indicate that outflow into the marine waters of Cook Inlet, the only apparent receptor of dissolved petroleum hydrocarbons in the shallow water table , is very dilute. Results of capillary pressure-desaturation testing indicate that soil vapor extraction may be an effective remedial technique for the impacted soils in the East Tank Farm. In addition, a pump and treat remedial system would be a viable remedial option for impacted water near MW-5.

Results of the 1989 water monitoring program indicate that the shallow water flow direction under the East Tank Farm is in a northwest to west direction. The water beneath the western portion of the facility, however, has a flow direction of west to southwest. Measurable product on the shallow water table (0.96 inches) was found in Monitoring Well MW-14 during the September, 1989 monitoring. No other measurable product was encountered throughout the

monitoring program, however, a sheen and/or strong hydrocarbon odor was noted during water level measurements and sampling of monitoring wells MW-2, MW-3, MW-5, MW-6, MW-7, MW-14 and MW-19. The configuration of the impacted water plume of elevated BTEX suggests that the petroleum hydrocarbons are from multiple sources.

The results of the December 1991 combined environmental and geotechnical studies indicated that the soils within the proposed tank expansion area are impacted with low to elevated levels of total petroleum hydrocarbons (up to 14,100 ppm). Benzene was detected only in one soil sample at 0.083 ppm. Total BTEX concentrations up to 2.567 ppm were detected in the samples. Methyl pentanone, a halogenated volatile organic compound, was also detected in one soil sample collected from Boring B-5.

7.7.4 Remedial Actions

Information regarding remedial activities that have ensued as a result of petroleum hydrocarbon releases was obtained from two reports produced by Shannon & Wilson. These reports include Shannon & Wilson s July, 1991, Gasoline Spill Cleanup report and their August, 1991, JP-4 Spill Cleanup report.

An unleaded gasoline spill occurred on October 25, 1990, from Pump G-5 located in the facility s pump yard. An estimated 50 gallons of fuel was released due to a failed pump seal. Following the spill, Shannon & Wilson conducted field and laboratory work in support of the removal, stabilization and characterization of soils impacted by the spill. About 70 tons of soil were excavated within the immediate spill area in attempt to remove the impacted soils. The excavation was filled in following sampling of the inplace soils. Soils left in place contained elevated levels of gasoline range organics, 22,000 ppm, and total BTEX, 10,420 ppm.

A JP-4 spill occurred on June 15, 1991, from a flange for a cargo line connected to Tank No. 4236. An estimated 25 gallons of JP-4 was released. In attempt to remove the fuel impacted soils, about 40 tons of soil was excavated from the spill area. Shannon & Wilson was retained to monitor the excavation activities, sample the inplace soils in the bottom of the excavation and sample the stockpiled soils. Samples collected from the soils left in place had total petroleum hydrocarbon concentrations up to 16,000 ppm and total BTEX concentrations up to 9420 ppm. The 70 tons of soil excavated from the gasoline spill area and the 40 tons of soil recovered from the JP-4 release area were eventually recycled into asphalt at Anchorage Sand and Gravel's facility.

8.0 CONCLUSIONS

Based on the information gathered for this summary site assessment effort, there are numerous areas with known petroleum hydrocarbon impacted soils and water are located within the POA-PUG area. The petroleum hydrocarbon levels at many of these areas exceeds the current Alaska Department of Environmental Conservation, ADEC, maximum contaminant levels for petroleum hydrocarbons in soil and water. Copies of the most current ADEC guidelines, the July 17, 1991 Interim Guidance For Non-UST Contaminated Soil Cleanup Levels and the September 26, 1990 Interim Guidance For Surface and Groundwater Cleanup Levels, are included in Appendix E.

The petroleum hydrocarbon impacted near surface waters within the POA-PUG area would most likely not be considered a viable source for drinking water. This position is supported when considering the existing brackish condition of the near surface water, the low yield and relatively shallow depth (less than 20 feet throughout the majority of the POA-PUG area) of the near surface water bearing zone, and the existing AWWU potable water supply system located throughout the POA-PUG area.

The known areas of petroleum hydrocarbon impacted soil and/or water include all six of the bulk fuel facilities within the study boundary and the south transit yard of the Port of Anchorage facility. The majority of the impacted soil and water within these areas are in the vicinity of truck and rail car loading racks, underground fuel lines and areas where fuel releases from spills have occurred in the past. In order to assess the quantity and extent of petroleum hydrocarbons in the soil and/or water within the study site, a total of 187 soils borings and 87 monitoring wells have been drilled and installed. In addition to the borings and wells, numerous soil gas surveys, surface soil and water sampling, excavations and risk assessments have been conducted throughout the area.

The completed environmental assessment studies have been concentrated within the central portion of the POA-PUG area. As illustrated on Figure 7, the parcels that are occupied with the Mapco, Chevron, Defense Fuels and Texaco terminals have had numerous soil borings and monitoring wells drilled and installed on them, in addition to the analytical testing of soil and water samples. The south transit area of the Port of Anchorage and the northern half of the Tesoro facility have also had extensive studies conducted on them. Limited to no information was available regarding environmental studies at the remaining parcels within the POA-PUG area. These parcels include those bordering the northern and southern ends of the study area in addition

to the south portion of the Tesoro terminal, the Anchorage Fueling & Service Company terminal and the parcels reportedly leased to Lonestar Cement No. 2 and Chugach Electric.

Although no known environmental assessments have been conducted on several of the parcels within the POA-PUG area, several sources of petroleum hydrocarbons that may impact the soils and waters are located in these areas. These sources include the current or former presence of a total of eleven registered underground storage tanks, USTs, with eight of the USTs located on the Sea-Land parcel and the remaining three of the USTs located at the Port of Anchorage facility, the Lonestar Cement No. 1 leased parcel and the Douglas Management leased parcel. Several registered USTs are also located at the Defense Fuel, Chevron and Texaco terminals. Other sources of petroleum hydrocarbons within the unstudied areas include underground fuel pipelines, bulk fuel storage tanks, road oiling and past handling of petroleum products.

Information regarding accidents and spills along the roads and railroad spurs was not available for review. Historically, spills from trucks and railcars have most likely occurred within the POA-PUG area. Release of petroleum hydrocarbons from these spills would contribute to the impacted soils and possibly water in the area.

The Autocad basemap prepared for this project was developed from a surveyed composite drawing of the Port of Anchorage facility, legal descriptions of each of the leased parcels and as-built drawings of each facility. The as-built drawings were primarily pictorial illustrations with limited dimensioning control. With the exception of the Port of Anchorage facility and a portion of the MAPI terminal, limited to no survey control information was available for the POA-PUG area. The autocad data file of the basemap is available on a floppy disk. An explanation of the basemap autocad file format has been prepared by Tryck Nyman Hayes, Inc. and is included in Appendix F.

9.0 RECOMMENDATIONS

Based on the information collected for this summary site assessment report, data gaps exist for approximately one half of the defined POA-PUG area. The majority of these identified gaps exist along the northern and southern ends of the study area. Leased parcels including the Tote, Lonestar Cement No. 1, Sea-Land, Lonestar Cement No. 2, Chugach Electric, Alaska Resources Corp., North Star Terminal & Stevedore Co., Douglas Management Co., Western Insulfoam, Kyokyu USA Inc., and JoAnn Pickworth parcels have either not had any environmental assessment work conducted on them or did not have any available assessment reports for review.

In addition, only limited information is available for the Anchorage Fueling & Service Company terminal and the south half of the Tesoro Alaska terminal.

We recommend that environmental assessment work be conducted at the parcels listed above. This assessment work should be conducted in a two phase effort including a preliminary assessment and a field exploration study. The preliminary assessment would involve a historical document review and site walkover. This information would be gathered in order to identify any potential sources of petroleum hydrocarbons within each of the leased parcels. Portions of a typical preliminary site assessment have already been conducted as part of the effort for this summary site assessment work including the aerial photograph review, the USCG and ADEC data base search and the interviews with the local public utilities and fire department. The primary focus of the preliminary site assessment would be a site walk over and personal interviews such that information regarding past and present sources of petroleum hydrocarbons can be identified and a scaled site map developed.

Based on the results of the preliminary site assessment study conducted for each of the parcels, a field exploration program would be developed. The program should include the drilling of soil borings, the advancement of test holes, the installation of wells, sampling of surface and subsurface soil and water, analyses of soil and water samples and soil gas surveys. The scope of the field investigation would be dependent of the sources of petroleum hydrocarbons identified at each of the parcels during the preliminary site assessment study.

10.0 LIMITATIONS/CLOSURE

This report was prepared for the exclusive use of our client and their representatives, in the study of this site. The analyses, conclusions, and recommendations contained in this report are based on information provided through the client, the observed site conditions, limited research and other information described herein. They should not be construed as a definite conclusion regarding the soil and water quality at this site. If conditions different from those described in the report are observed, encountered or known, we should be advised at once so that we can review these conditions and reconsider our conclusions and recommendations where necessary.

If there is a substantial lapse in time between the submittal of this report and the start of additional work at the site, or if conditions or site layout have changed due to natural causes or operations at/or adjacent to the site, we recommend this report be reviewed to determine the

applicability of conclusions and recommendations considering the changed conditions and time lapses.

We appreciate this opportunity to be of service. Please call the undersigned with any questions or comments concerning the contents of this report.

Sincerely,

SHANNON & WILSON, INC.

Prepared By:

LeeAnne Osgood
Geotechnical/Environmental Engineer

Reviewed By:

Timothy M. Terry
Engineering Geologist

Approved By:

Fred R. Brown, P.E.
Vice President

REFERENCES

Adams, Corthell, Lee, Wince and Associates, June 8, 1964, Standard Oil Company of California Terminal Yard Tank Additions, Ref. November 1961 Report, for Standard Oil Company of California, Anchorage, Alaska.

Adams, Corthell, Lee, Wince and Associates, February 20, 1967, Slope Stability Studies in the Port Industrial Area at Anchorage, Alaska, for the U.S. Department of Interior, Alaska Railroad.

Alaska Railroad Real Estate Office, December 27, 1990, Questionnaire for Mapco Alaska Petroleum Inc. facility.

Alaska Railroad Real Estate Office, January 9, 1991, Questionnaire for Western Insulfoam facility.

American North Inc., April 9, 1991, Final Report of Soil Sampling Activities in the Vicinity of Tanks 1, 29 and 30, Anchorage, Terminal, Alaska, for Chevron U.S.A. Inc.

Anchorage Sand and Gravel Co., Inc., October 5, 1991, Letter concerning the receival of fuel stained soils, for State of Alaska Department of Environmental Conservation, Anchorage/Western District Office, Anchorage, Alaska.

A.W. Murfitt Company, October 12, 1983, Data Report on Observation Well Installation, Chevron Tank Farm, Anchorage, Alaska, for Denali Drilling, Inc., Anchorage, Alaska.

Barnwell, William W. and et al., 1972, Water for Anchorage: An Atlas of the Water Resources of the Anchorage Area, Alaska, for the U.S. Department of the Interior, Geologic Survey, Water Resources Division, Alaska District.

Dames & Moore, June 19, 1964, Report of Soils Investigation, Anchorage Terminal Expansion, Anchorage, Alaska, for Union Oil Company of California.

Department of Economic Development and Planning, City of Anchorage, May 1991, Ship Creek - Port Area Meriting Special Attention Plan.

Ecology and Environment, January 1992, Anchorage Fuel Terminal Site Investigation Project Report, for the U.S. Army Corp of Engineers, Alaska Division, Anchorage, Alaska.

Ecology and Environment, April 1, 1992, Contract No. DACA85-88-D-0014 Delivery Order No. 16, Anchorage Fuel Terminal, Anchorage, Alaska letter report, for U.S. Army Corp of Engineers, Alaska District, Anchorage, Alaska.

ENSR Consulting and Engineering, September 1991, Environmental Assessment, Anchorage Bulk Terminal, 1601 Tidewater Road, for Texaco Refining and Marketing, Inc., Anchorage, Alaska.

ENSR Consulting and Engineering, September 30, 1991, Groundwater Sample Results, 1601 Tidewater Road, Anchorage, Alaska, for Texaco Environmental Services, Universal City, California.

Environmental Strategies Corporation, August 21, 1989, Report on Phase I Field Investigation, for Tesoro Alaska Petroleum Company, Anchorage, Alaska.

Environmental Strategies Corporation, January 16, 1990, Letter Report to ADEC Regarding Sampling Results, for Tesoro Alaska Pipeline Company, Anchorage, Alaska.

Hart Crowser, December 1987, Soil and Groundwater Investigation, Union Oil Terminal, Anchorage, Alaska, for MAPCO Petroleum, Inc.

Hart Crowser, April 1988, Phase 2 Subsurface Petroleum Product Assessment and Task 2 Soil Gas Survey, Union Oil Terminal, Anchorage, Alaska.

Hart Crowser, July 1988, Phase 2 Subsurface Petroleum Product Assessment and Task 3 Monitoring Well Network and Expanded Soil Gas Survey, Union Oil Terminal, Anchorage, Alaska.

Hart Crowser, July 28, 1989, Water Quality Sampling/Water Level Measurements, Former Union Oil Terminal, Port of Anchorage, Alaska, for UNOCAL Refining and Marketing Division, Seattle, Washington.

Hart Crowser, August 28, 1989, Water Level Measurements, Former Union Oil Terminal, Port of Anchorage, Alaska, for UNOCAL Refining and Marketing Division, Seattle, Washington.

Hart Crowser, February 1990, Site Characterization, Chevron Anchorage Terminal, Port of Anchorage, Alaska, for Chevron USA, Inc.

Hart Crowser, February 5, 1990, Former UNOCAL Fuel Terminal Water Quality Sampling, Port of Anchorage, Alaska, for UNOCAL Refining and Marketing Division, Seattle, Washington.

Hart Crowser, May 1, 1990, Former UNOCAL Fuel Terminal Water Quality Sampling, Port of Anchorage, Alaska, for UNOCAL Refining and Marketing Division, Seattle, Washington.

Hart Crowser, September 4, 1990, Remedial Action Plan For Organic Soils, for Tesoro Alaska Petroleum Company Anchorage Terminal, Anchorage, Alaska.

Hart Crowser, January 7, 1991, Anchorage Terminal Organic Soil Bioremediation, for Tesoro Alaska Petroleum Company, Anchorage, Alaska.

Hart Crowser, January 8, 1992, Anchorage Terminal Water Quality Data, for Tesoro Alaska Petroleum Company, Anchorage, Alaska.

Hart Crowser, January 8, 1992, Anchorage Terminal Organic Soil Bioremediation, for Tesoro Alaska Petroleum Company, Anchorage, Alaska.

Hart Crowser, February 7, 1992, Water Quality Monitoring, Chevron Anchorage Terminal, Port of Anchorage, Alaska, for Chevron U.S.A. Inc.

Little, Arthur D., June 1991, Study of Non-Crude Tank Vessels and Barges, for the Alaska Department of Environmental Conservation, Anchorage, Alaska.

Ryan & Haworth Co., February 23, 1985, Anchorage Fueling & Service Company, Anchorage Terminal, Plant #1, Subsurface Water Surveillance Wells, for Anchorage Fueling & Service Company, Anchorage, Alaska.

Selkregg, Lidia L., et al., 1984, Earthquake Hazard Mitigation: Planning and Policy Implementation, The Alaska Case, University of Alaska, Anchorage pp. 23, 50-51.

Shannon & Wilson, Inc., May 1964, Report on Foundation Studies, Permanente Cement Plant, Anchorage, Alaska, for Kaiser Engineers, Oakland, California.

Shannon & Wilson, Inc., August 28, 1964, Report on Anchorage Area Soil Studies, Alaska, for U.S. Army Engineer District, Anchorage, Alaska.

Shannon & Wilson, Inc., February 1990, Geotechnical Report, Transportation Improvement Project, Port of Anchorage, Anchorage, Alaska, for Alaska Development Consultants, Anchorage, Alaska.

Shannon & Wilson, Inc., July 1990, Stabilization of Contaminated Soils and Utility Trench Restoration, Port of Anchorage, Alaska, for Tryck, Nyman and Hayes, Anchorage, Alaska.

Shannon & Wilson, Inc., August 1990, Soil Quality Assessment, POL Terminal Facility, Anchorage, Alaska, for Tryck, Nyman & Hayes, Anchorage, Alaska.

Shannon & Wilson, Inc., May 1991, Soil Excavation & Stockpile Plan, Transportation Improvement Project, Port of Anchorage, Anchorage, Alaska, for Alaska Development Consultants, Anchorage, Alaska.

Shannon & Wilson, Inc., May 16, 1991, Storage Site Characterization, Transportation Improvement Project, Port of Anchorage, Alaska letter report, for Alaska Department of Environmental Conservation, Anchorage, Alaska.

Shannon & Wilson, Inc., July 1991, Gasoline Spill Cleanup, 1076 Ocean Dock Road, Anchorage, Alaska, for Mapco Petroleum, Inc., Tulsa, Oklahoma.

Shannon & Wilson, Inc., August 1991, JP-4 Spill Cleanup, 1076 Ocean Dock Road, Anchorage, Alaska, for Mapco Alaska Petroleum Inc.

Shannon & Wilson, Inc., October 11, 1991, Evaluation of Stockpiled Soils in South Transit Yard, Port of Anchorage, Anchorage, Alaska letter report, for Alaska Department of Environmental Conservation, Anchorage, Alaska.

Shannon & Wilson, Inc., December 1991, Geotechnical and Environmental Report, Mapco Tank Site, Port of Anchorage, Anchorage, Alaska, for Alaska Anvil, Inc., Anchorage, Alaska.

Shannon & Wilson, Inc., March 13, 1992, Site Assessment, Chugach Electric Association Sub-lease, 1200 Ocean Dock Road, Anchorage, Alaska, for Mapco Alaska Petroleum Incorporated, Anchorage, Alaska.

Shell Oil Dock Plant Storage, Site Plan of Anchorage Fueling & Service Company Terminal with locations of 11 monitoring wells.

Sound Environmental Services, Inc., August 15, 1990, Tesoro Terminal Treatability Study Results, for Tesoro Alaska Petroleum Company, Anchorage, Alaska.

Sound Environmental Services, Inc., November 29, 1990, Tesoro Anchorage Terminal Remediation Project, for Tesoro Alaska Petroleum Company, Anchorage, Alaska.

Sound Environmental Services, Inc., December 20, 1991, Tesoro Anchorage Terminal DCR Remediation Project - 1991 Analytical Results, for Tesoro Alaska Petroleum Company, Anchorage, Alaska.

Tesoro Alaska Petroleum Company, June, 1990 to September, 1991, Photographs of Anchorage Terminal PES-31 Bioremediation/Revegetation Project.

Tesoro Alaska Petroleum Company, June 15, 1990, Truck Loading Rack Area Rehabilitation and Contaminated Soil Remediation/Stabilization, for Alaska Department of Environmental Conservation, Anchorage Western District Office, Anchorage, Alaska.

Tesoro Alaska Petroleum Company, September 4, 1990, Tesoro Alaska Petroleum Company Anchorage Terminal, for Alaska Department of Environmental Conservation, Anchorage Western District Office, Anchorage, Alaska.

Tippetts-Abbett-McCarthy-Stratton, January 1956, Development Plan for the Port of Anchorage, for the City of Anchorage, Alaska.

Tippetts-Abbett-McCarthy-Stratton, February 1961, Development Plan Northern Waterfront Area, Tide Lands Use Study - Phase II, for the City of Anchorage, Alaska.

Tippetts-Abbett-McCarthy-Stratton, March 1972, Soils and Foundation Report Proposed Marine Facilities and Storage Yards, for the City of Anchorage, Alaska.

Updike, Randall G. and Carpenter, Bruce A., 1986, Engineering Geology of the Government Hill Area, Anchorage, Alaska, U.S. Geological Survey Bulletin 1588, pp. 2-5, 8-24.

Varnes, David J., 1969, Stability of the West Slope of Government Hill Port Area of Anchorage, Alaska, Geological Survey Bulletin 1258-D, for the United States Department of the Interior Geological Survey.

Woodward-Clyde Consultants, February 1990, Installation Restoration Program, Stage 1 Report, Site 1, Anchorage Fuel Terminal, for the United States Air Force, Occupational and Environmental Health Laboratory, Brooks Air Force Base, Texas.

TABLE 1. REGISTERED UNDERGROUND STORAGE TANKS IN PORT OF ANCHORAGE AREA

Location	Owner	Number of Tanks	Tank Contents	Use Status	Capacity (Gallons)	Age (Years)
2000 Anchorage Port Road	Port of Anchorage	1	Heating Oil	Currently in Use	12000	18
Ocean Dock and Bluff Road	Chevron U.S.A Inc.	4	Used Oil	Removed From Ground	1000	15
			A-50/Jet B	Removed From Ground	2000	25
			A-50/Jet B	Removed From Ground	550	15
			Never Used	Temporarily Out of Use**	1000	7
660 Ocean Dock Road	Douglas Management Company	1	Diesel	Removed From Ground	5000	15
Lot 4A Port of Anchorage Subdivision	Lonestar Northwest	1	Gasoline	Removed From Ground	500	23
1601 Tidewater Road*	Texaco Refining & Marketing	3	Kerosene	Currently in Use	550	10
			Gasoline	Currently in Use	6000	18
			Gasoline	Currently in Use	12000	8
Defense Fuel Anchorage Terminal	Defense Fuel Supply Center	26	Used Oil	Permanently Out of Use	4000	33
			Used Oil	Permanently Out of Use	4000	33
			Used Oil	Permanently Out of Use	4000	33
			Gasoline	Currently in Use	6800	?
			Gasoline	Currently in Use	6800	?
			Unknown	Currently in Use	Unknown	?
			JP4	Currently in Use	2000000	?
			JP4	Currently in Use	2000000	?
			JP4	Currently in Use	2000000	?
			Diesel	Currently in Use	500000	?
			Diesel	Currently in Use	500000	?
			Diesel	Currently in Use	500000	?
			Diesel	Currently in Use	500000	35
			SLOP	Currently in Use	3000	?
			SLOP	Currently in Use	3000	?
			SLOP TANK	Currently in Use	5000	3
			SLOP TANK	Currently in Use	300	?
			SLOP TANK	Currently in Use	500	?
			SLOP TANK	Closed in Ground	2500	?
			JP4 & H20	Removed From Ground	2500	?
			SLOP	Currently in Use	500	24
			SLOP TANK	Currently in Use	500	?
			JP4	Temporarily Out of Use	2000000	?
			JP4 & H20	Removed From Ground	2500	?
			Water	Currently in Use	10000	2
			Unknown	Currently in Use	Unknown	?
1717 Tidewater Road	Sea-Land Freight Service	8	Used Oil	Currently in Use	2500	17
			New Oil Storage	Currently in Use	2500	17
			Waste Water	Currently in Use	250	17
			Diesel	Currently in Use	20000	17
			Diesel	Currently in Use	20000	17
			Gasoline	Permanently Out of Use	10000	17
			Gasoline	Currently in Use	1000	8
			Waste Oil	Permanently Out of Use	300	27

*Texaco Refining & Marketing removed the 550 gallon kerosene and the 6000 gallon gasoline tanks in 1989 and 1990, respectively.
**1000 gallon tank reportedly removed from ground.

TABLE 2. PROPERTY OWNERS AND LEASEHOLDERS IN PORT OF ANCHORAGE AREA*

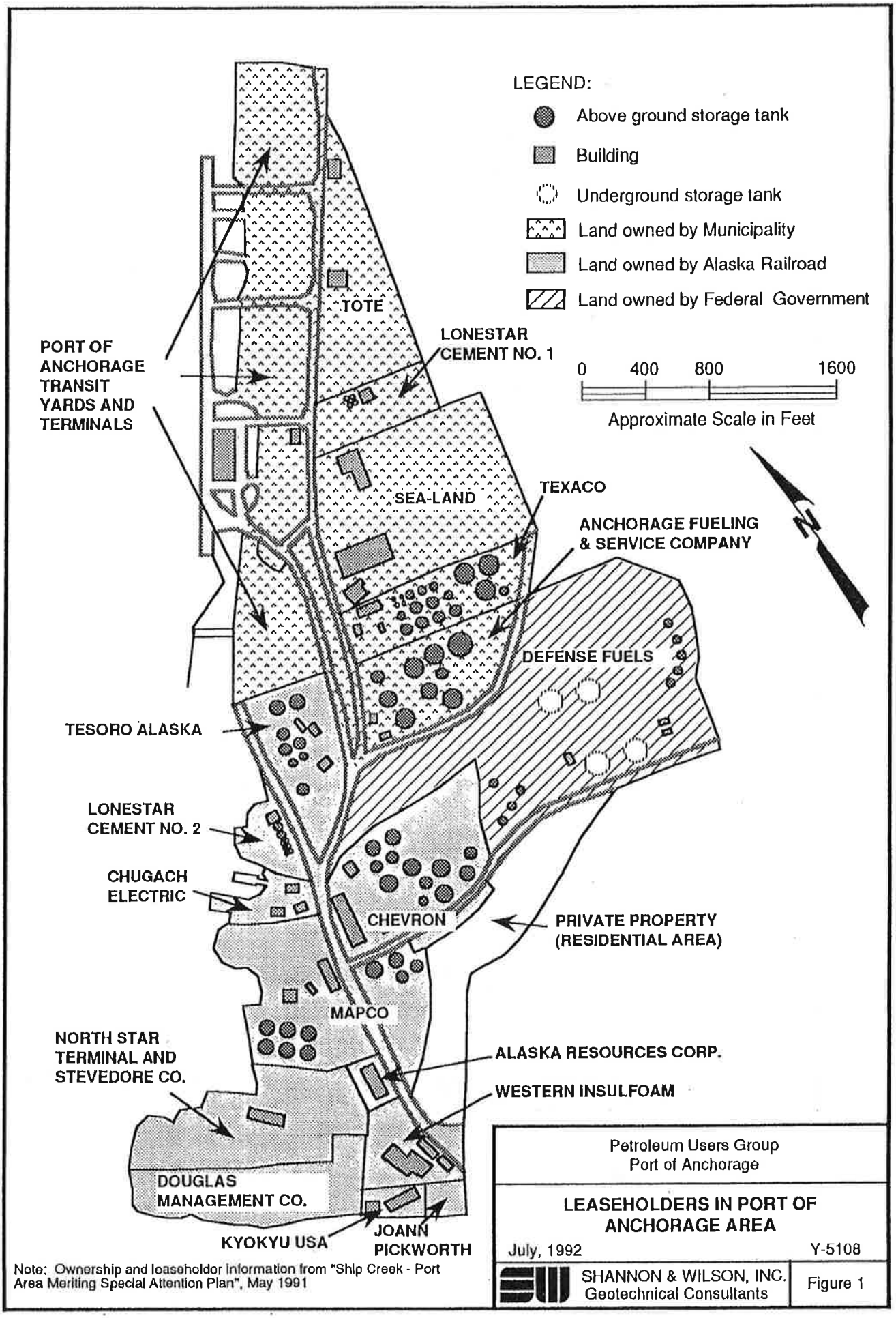
PROPERTY OWNER	LEASEHOLDER	CURRENT TYPE OF OPERATION
MUNICIPALITY	PORT OF ANCHORAGE TRANSIT YARDS AND TERMINALS	TRANSPORTATION OF GOODS
MUNICIPALITY	TOTE	TRANSPORATION OF GOODS
MUNICIPALITY	LONESTAR CEMENT NO. 1	BULK CEMENT PLANT
MUNICIPALITY	SEA-LAND	TRANSPORATION OF GOODS
MUNICIPALITY	TEXACO	BULK FUEL FACILITY
MUNICIPALITY	ANCHORAGE FUELING & SERVICE COMPANY	BULK FUEL FACILITY
FEDERAL GOVERNMENT	DEFENSE FUELS	BULK FUEL FACILITY
ALASKA RAILROAD	TESORO ALASKA	BULK FUEL FACILITY
ALASKA RAILROAD	LONESTAR CEMENT NO. 2	BULK CEMENT PLANT
ALASKA RAILROAD	CHUGACH ELECTRIC	ELECTRICAL EQUIPMENT STORAGE & REPAIR
ALASKA RAILROAD	CHEVRON	BULK FUEL FACILITY
ALASKA RAILROAD	MAPCO ALASKA PETROLEUM INC.	BULK FUEL FACILITY
ALASKA RAILROAD	ALASKA RESOURCES CORP.	TRANSPORATION OF GOODS
ALASKA RAILROAD	NORTH STAR TERMINAL & STEVEDORE CO.	TRANSPORATION OF GOODS
ALASKA RAILROAD	DOUGLAS MANAGEMENT CO.	TRANSPORATION OF GOODS
ALASKA RAILROAD	WESTERN INSULFOAM	EXPANDED POLYSTYRENE PROCESSOR
ALASKA RAILROAD	KYOKYU USA INC.	FISH PROCESSOR
ALASKA RAILROAD	JOANN PICKWORTH	BOAT REPAIR

*Ownership and leaseholder information from "Ship Creek - Port Area Meriting Special Attention Plan", May 1991.

TABLE 3. ADEC CONTAMINATED SITES

* Reckey Number	ADEC File No.	Owner	Stated Address	Stated Problem
(99) 89210113801	CS92.16	Tesoro Alaska	1522 Anchorage Port Road	Diesel fuel leak in pipeline on 5/18/89 contaminates surface soils. Historic spillage at the site has entered sewerline adjacent to bulk plant. Quantities and extent of contamination significant. Potential health concern for workers. Contaminated soils excavated and long term remediation facilities installed in 1990.
(98)88210102601	CS92.07	Chevron U.S.A.	Bulk Plant at POA	Site investigation in December 1987 identified soil & groundwater contamination from petroleum bulk plant facility. Amount and date(s) of release, extent of contamination and health impact unknown.
(97) 89210124302	CS92.07	Chevron U.S.A.	Bulk plant #2 POA	Petroleum contamination & chlorinated solvents present at site. Impact to human health unknown. Dates of release unknown.
(325) 88210111901	---	---	Fuel Depot POA	Underground tanks leaking, documented fuel surfacing on the hillside below buried 100,000 gallon fuel tank. The fuel has contaminated the shallow groundwater and a small creek nearby. Dates of release, quantity, extent of contamination, and health impact unknown.
(310) 89210136417	OU6 WP14	Elmendorf AFB	D-15	Initial assessment shows total petroleum hydrocarbon contamination in POL sludge disposal area. Extent, amount and human risk unknown.
238 88210132401	OU2 ST41	Elmendorf AFB	Elmendorf AFB	Bulk fuel storage tanks #601-604 site of numerous spills since installation in the 1940's. 60000 gallons of Avgas known to have spilled in the mid 1960's when U.S. Army managed site. Estimated that 33,000 gallons of JP-4 spilled on 8/30/74. Total extent of contamination or impact to human health unknown.
(243)88210932501	CS77-1.37	Elmendorf AFB	Elmendorf AFB Tank Farm	Oil and solvent contaminated water table. Drinking water well (BW#1) has quantitites trichloroethylene (TCE) at and above the MCL. There are also oil industrial dry wells nearby. Quantity and date(s) of release, extent of contamination, and health impact unknown.
(245) 88210031503	L77-1.01	Elmendorf AFB	Elmendorf AFB USTs	Several underground tanks are known to be leaking. Extent and type of contamination and human health impact unknown.
(708) 90210120401	CS25.11	Texaco	1601 Tidewater Road	6000 gallon underground storage tank removed with soil contaminated from leaks, spills, overfills. Impact to human health unknown.
(718) 92210001304	L77-1.38		Tank Farm on Elemendorf AFB	300 gallon underground storage tank containing waste JP-4 fuel. Failed tank tightness test & total amount of contamination\ & extent is unknown.
90210129801**	CS92.14	MAPI	1076 Ocean Dock Road	---
91210116601**	CS92.14	MAPI	1076 Ocean Dock Road	---

* The Reckey Number is an Alaska Department of Environmental Conservation (ADEC) site identification code.
** Reckey Number was not listed in ADEC 3/17/92 contaminated sites print out. Number obtained during visit to Anchorage ADEC office.



Note: Ownership and leaseholder information from "Ship Creek - Port Area Meriting Special Attention Plan", May 1991

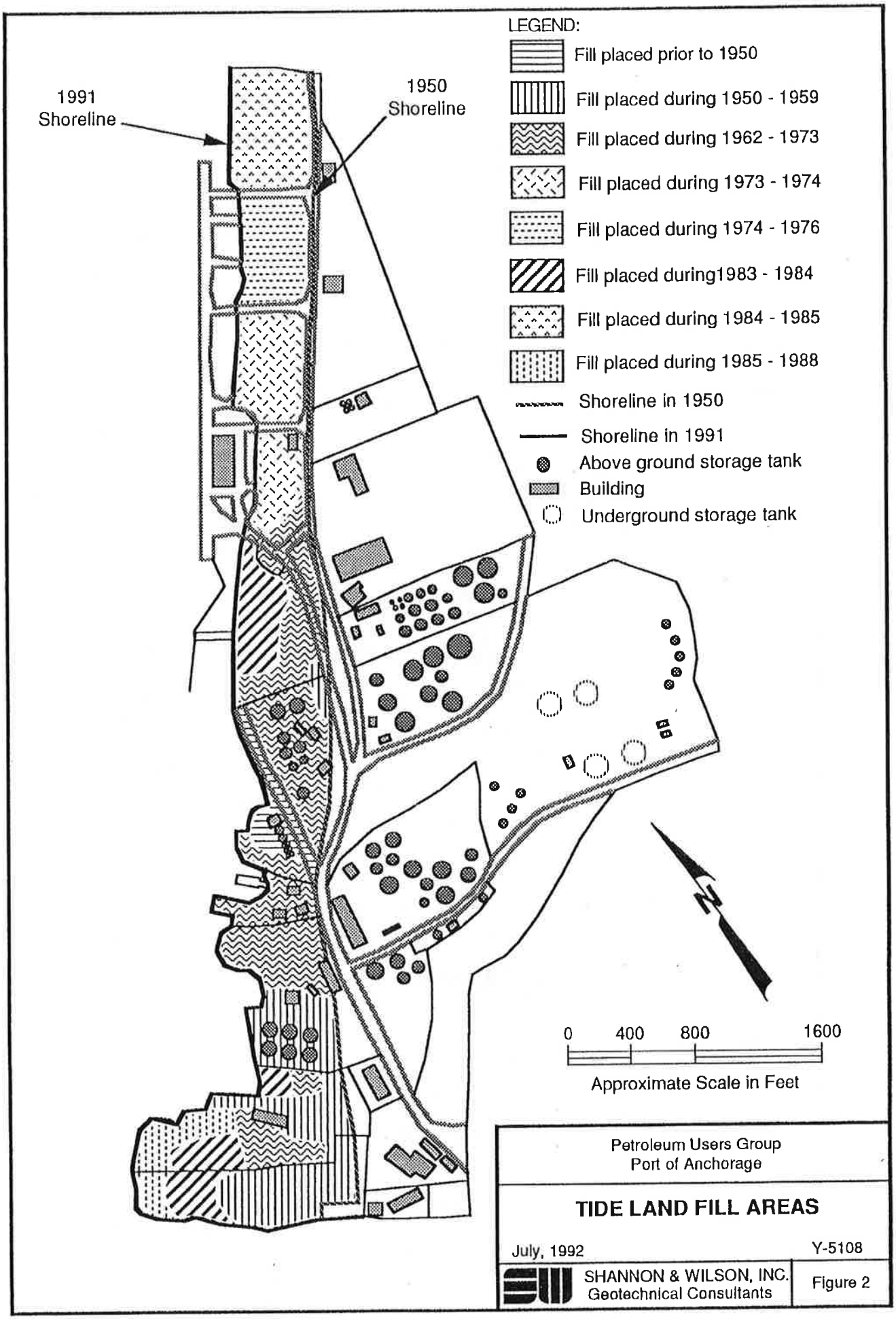
Petroleum Users Group
Port of Anchorage

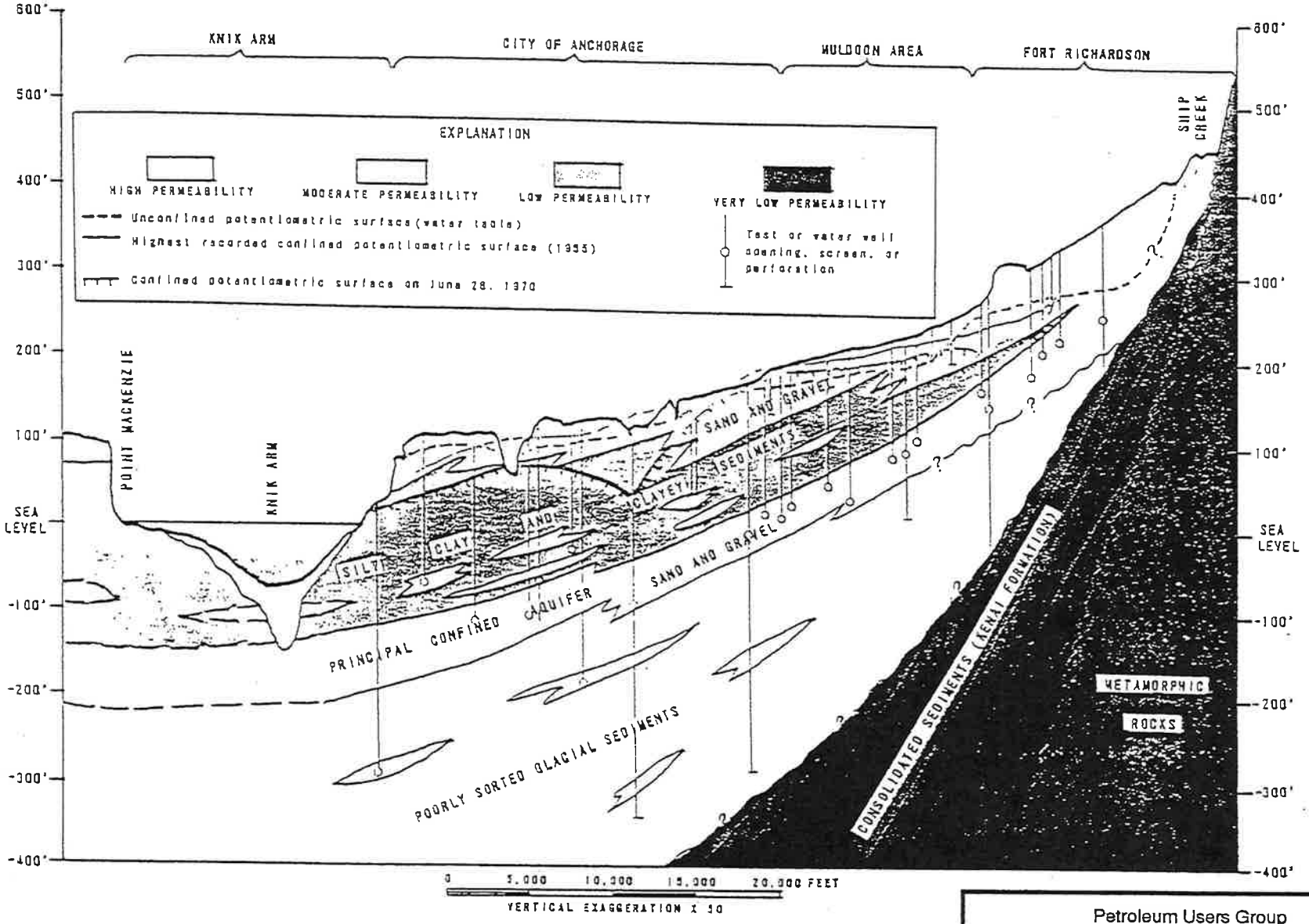
LEASEHOLDERS IN PORT OF ANCHORAGE AREA

July, 1992 Y-5108

SHANNON & WILSON, INC.
Geotechnical Consultants

Figure 1


LEGEND:
Fill placed prior to 1950
Fill placed during 1950 - 1959
Fill placed during 1962 - 1973
Fill placed during 1973 - 1974
Fill placed during 1974 - 1976
Fill placed during1983 - 1984
Fill placed during 1984 - 1985
Fill placed during 1985 - 1988
Shoreline in 1950
Shoreline in 1991
Above ground storage tank
Building
Underground storage tank
1991 Shoreline
1950 Shoreline
0
400
800
1600
Approximate Scale in Feet
Petroleum Users Group
Port of Anchorage
TIDE LAND FILL AREAS
July, 1992
Y-5108
SHANNON & WILSON, INC.
Geotechnical Consultants
Figure 2



Cross Section taken from Water for Anchorage: An Atlas of the Water Resources of the Anchorage Area, Alaska by William W. Barnwell and et al., 1972.

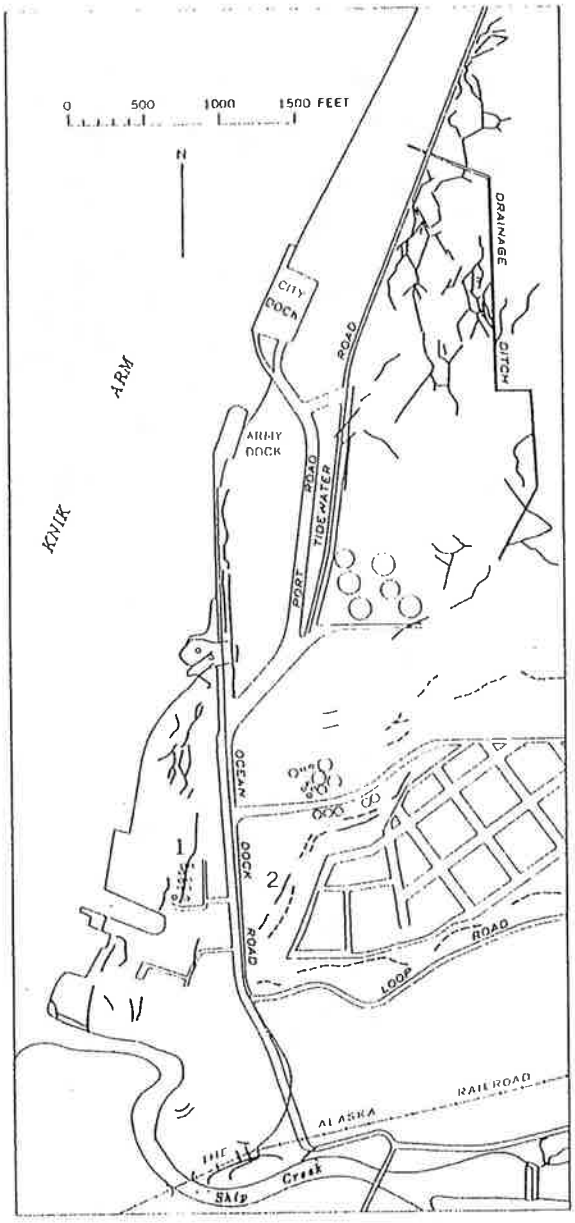
Petroleum Users Group
Port of Anchorage

REGIONAL GEOLOGY AND HYDROLOGY CROSS SECTION

July, 1992 Y-5108

SHANNON & WILSON, INC.
Geotechnical Consultants

Figure 3



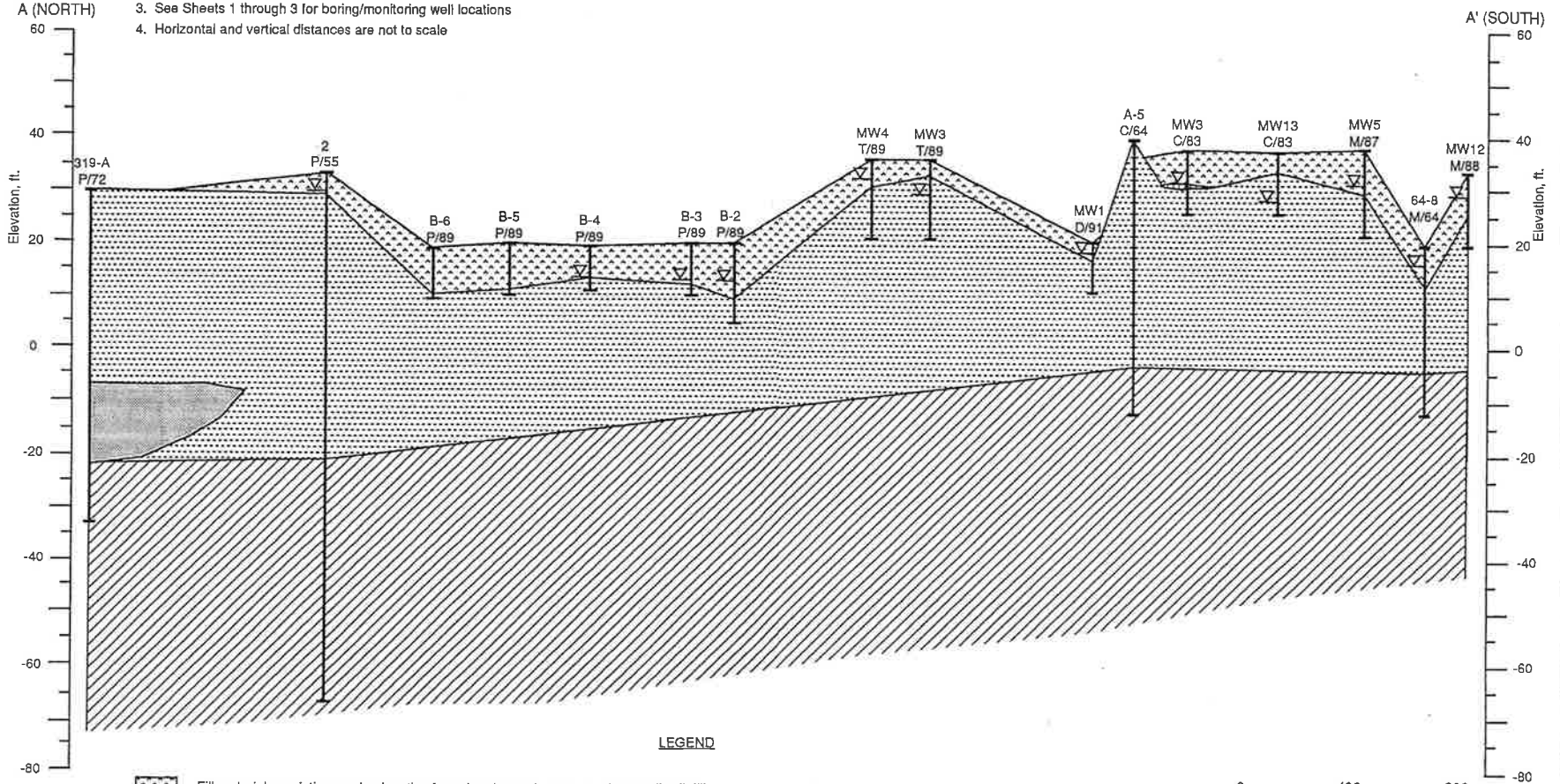
Ground cracks caused by the March 27, 1964, earthquake (solid lines) and scarps of old landslides (dashed lines), port of Anchorage and vicinity.

Figure taken from Stability of the West Slope of Government Hill Port of Anchorage, Alaska, Geological Survey Bulletin 1258-D, by David J. Varnes, for the United States Department of the Interior Geological Survey, 1969.

Petroleum Users Group Port of Anchorage
GROUND CRACKS FROM 1964 EARTHQUAKE July, 1992 Y-5108
SHANNON & WILSON, INC. Geotechnical Consultants — Figure 4

NOTES

1. The profile is generalized from materials encountered in the borings and variations between the profile and actual conditions may exist.
2. Elevation datum: M.S.L.
3. See Sheets 1 through 3 for boring/monitoring well locations
4. Horizontal and vertical distances are not to scale



LEGEND

- Fill material consisting predominantly of sand and gravel; some sandy gravelly silt fill.
- Estuarine (tidal flat) silts consisting predominantly of gray, clayey silt with some organics near upper surface of layer.
- Black peat.
- Potential channel deposit consisting of gray, clean to silty sand.
- Bootlegger Cove formation consisting predominantly of gray silty clay with some interlayers of silt.

- Groundwater
- B-6 P/89 Location and number of boring/monitoring well completed in 1989 at the request of the Port of Anchorage
- P Port of Anchorage
- T Tesoro Alaska
- D Defense Fuels
- C Chevron U.S.A.
- M Mapco Alaska Petroleum Incorporated

0 400 800
Scale in Feet

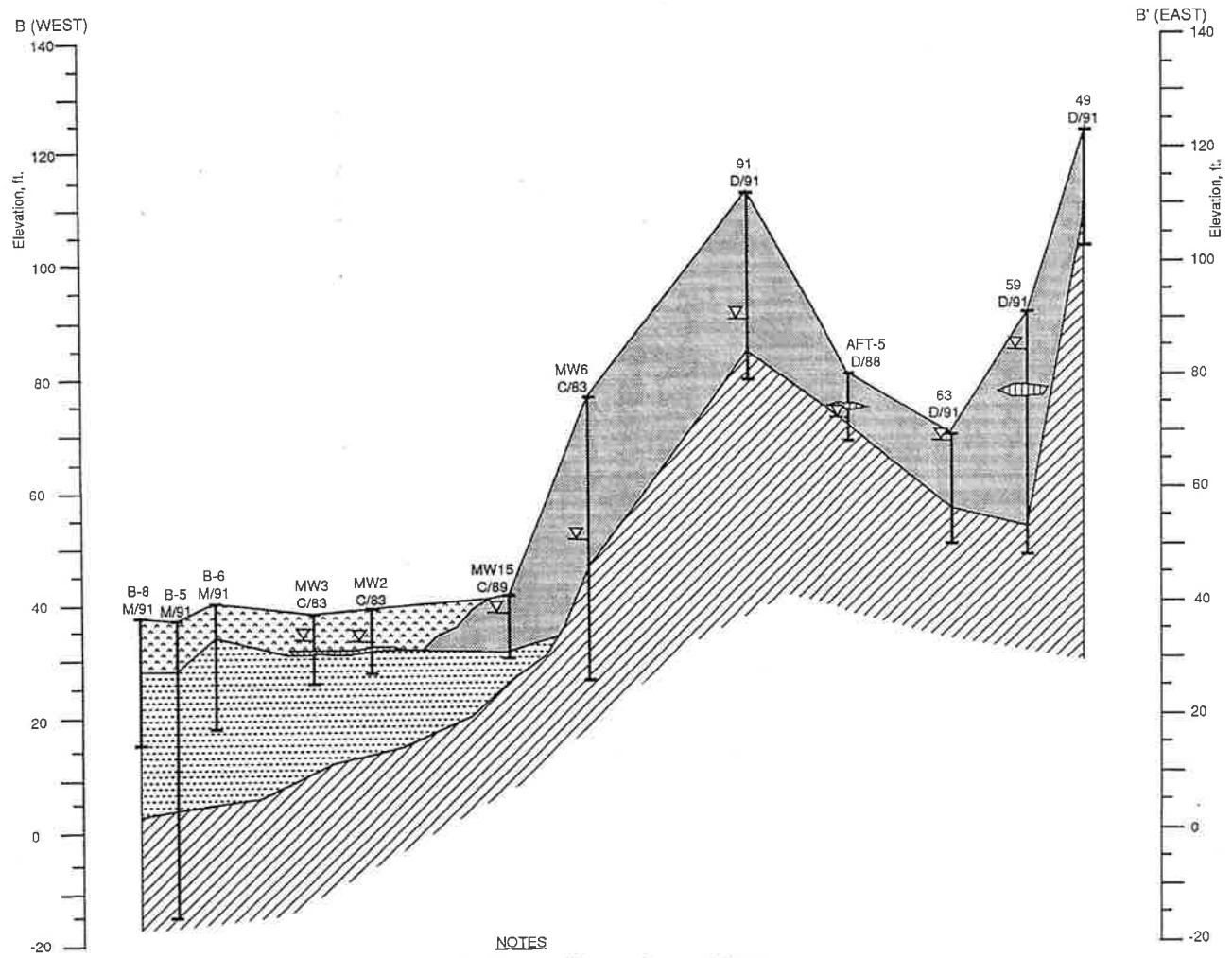
Petroleum Users Group
Port of Anchorage

NORTH TO SOUTH SUBSURFACE PROFILE A-A'

July, 1992 Y-5108

SHANNON & WILSON, INC.
Geotechnical Consultants

Figure 5



LEGEND

- Fill material consisting predominantly of sand and gravel; some sandy gravelly silt fill.
- Naptowne sediments consisting predominantly of outwash clean gravel and sand.
- Estuarine (tidal flat) silts consisting predominantly of gray, clayey silt with some organics near upper surface of layer.
- Black peat.
- Bootlegger Cove formation consisting predominantly of gray silty clay with some interlayers of silt.
- ▽ Groundwater
- B-8 M/91 Location and number of boring/monitoring well completed in 1991 at the request of Mapco
- P Port of Anchorage
- T Tesoro Alaska
- D Defense Fuels
- C Chevron U.S.A.
- M Mapco Alaska Petroleum Incorporated

0 400 800

Scale in Feet

NOTES

1. The profile is generalized from materials encountered in the borings and variations between the profile and actual conditions may exist.
2. Elevation datum: M.S.L.
3. See Sheets 1 through 2 for boring/monitoring well locations
4. Horizontal and vertical distances are not to scale

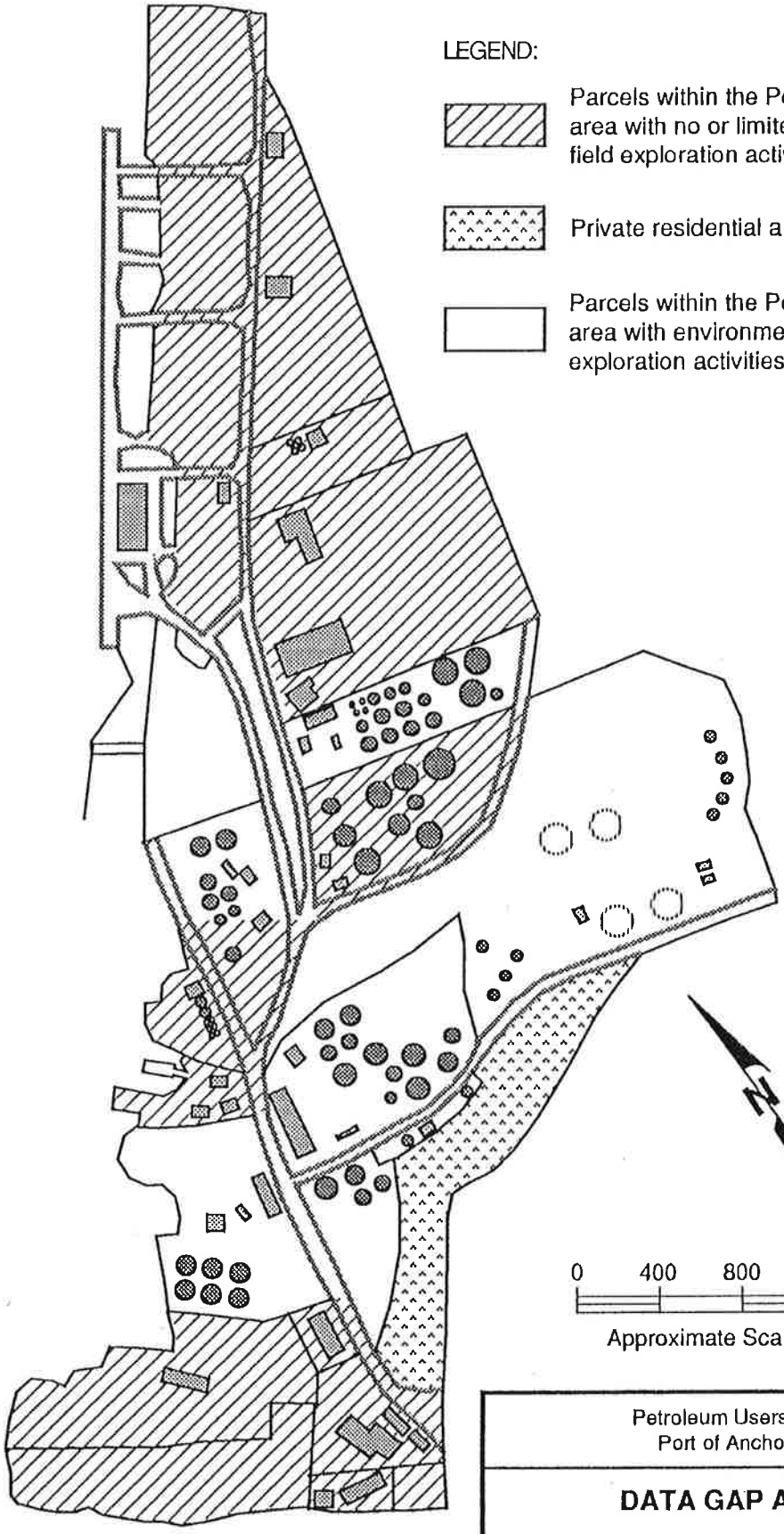
Petroleum Users Group
Port of Anchorage

EAST TO WEST SUBSURFACE PROFILE B-B'

July, 1992 Y-5108

SHANNON & WILSON, INC.
Geotechnical Consultants

Figure 6



Petroleum Users Group
Port of Anchorage

DATA GAP AREAS

July, 1992 Y-5108

SHANNON & WILSON, INC.
Geotechnical Consultants

Figure 7