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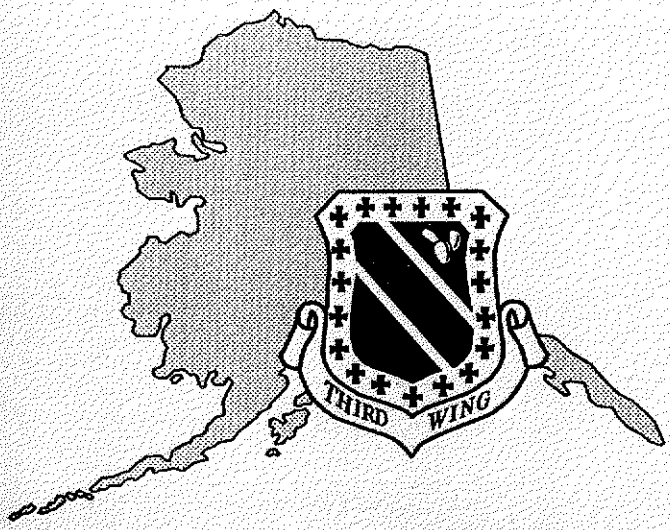

UNITED STATES AIR FORCE
ELMENDORF AIR FORCE BASE, ALASKA

FINAL REPORT
PHASE III - ENVIRONMENTAL AND GEOTECHNICAL MONITORING IN SUPPORT OF PIPELINE REPLACEMENT
PORT OF ANCHORAGE FUEL SPILL

JANUARY 1997

DEPARTMENT OF THE AIR FORCE
PACIFIC AIR FORCES

JUL 22 1997

MEMORANDUM FOR PORT OF ANCHORAGE
Attention: Mr. Burg
2000 Anchorage Port Road
Anchorage AK 99501

FROM: 3 CES/CEC
22040 Maple St
Elmendorf AFB AK 99506-3240

SUBJECT: Final Report, Pipeline Repair, Port of Anchorage Fuel Spill (Your letter, 24 Mar 97)

1. Modifications have been made to page 8 of the final report for the referenced fuel spill project. Attached is a copy of the revised final report. Please note that the newly revised version is still dated January 1997. Please discard the initial copy you received.

2. The final report is also being provided to the Alaska Department of Environmental Conservation (ADEC) to facilitate closure of this effort.

3. Direct ay questions to Mr. William R. Hanson, Chief, Environmental Flight, at 552-1741.

WILLIAM R. REITER, P.E.
Chief of Engineering

Attachment:
Final Report, January 1997

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

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Anchorage, Alaska 99518-1641
907 562 3366 Tel
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800 909 6787 Tel

January 22, 1997

Ms. Sandra J. Davidson
Contracting Officer
Operational Contracting Office/LGCV
P.O. Box 875
Elmendorf AFB, AK 99506-0875

Final Report
Phase III - Environmental and Geotechnical Monitoring in Support of Pipeline Replacement
Port of Anchorage Fuel Spill
Contract No. F65501-93-D0007 (D.O. 7018)
D&M Job No. 01016-474-160

Dear Ms. Davidson:

We are pleased to submit five (5) copies of the Final Report titled *Phase III Environmental and Geotechnical Monitoring in Support of Pipeline Replacement*. This Final Report was prepared per our Revised Proposal dated 4 October 1995, and was performed in general accordance with the terms and conditions outlined in our Contract with the U.S. Air Force (Contract No. F65501-93-D0007) dated 25 June 1993, and Delivery Order 7018.

If you have any comments or questions, or require additional information, please do not hesitate to contact us.

Sincerely,

DAMES & MOORE

Paul R. Dworian
Project Geologist

Gary L. Hayward
Delivery Order Manager

GLH/PRD:jc
PHASEIII.FNL

PHASE III - ENVIRONMENTAL AND GEOTECHNICAL MONITORING IN SUPPORT OF PIPELINE REPLACEMENT PORT OF ANCHORAGE FUEL SPILL

FINAL REPORT

ELMENDORF AIR FORCE BASE
ANCHORAGE, ALASKA

January 22, 1997

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1.0 INTRODUCTION

On 25 August 1994, fuel was reported by Municipality of Anchorage workers to be accumulating in a storm drain manhole near the intersection of Tidewater Road and Gull Avenue (Figures 1 and 2). Several fuel pipelines are located adjacent to this manhole, and it was suspected that a leak in one or more of these pipelines was the source of the observed fuel. The Defense Fuel Supply Center, through their contractor Enterprise Engineering, Inc. (EEI), introduced a tracer compound into the 12-inch diameter JP-8 pipeline, and found detectable amounts of the tracer in the soil vapor near the manhole. This effort appeared to indicate that the source of the fuel was the JP-8 pipeline.

In October 1994, the U.S. Air Force (Air Force) began excavation and repair of the pipeline at the leak location. The excavation and repair activities were monitored, and soil and groundwater samples were analyzed to determine the level of hydrocarbon contamination within the initial excavation. The results and observations of this field work are documented in Dames & Moore's report titled *Final Report, Phase I - Environmental and Geotechnical Monitoring in Support of Emergency Pipeline Repair, Port of Anchorage Fuel Spill*, dated 22 February 1995.

After repair of the leak, it was decided that the remainder of the JP-8 pipeline should be checked for leaks and overall operational integrity. Additional excavations and smart pigging operations were performed to further evaluate the potential for additional releases from the pipeline. The results of environmental sampling and backfilling of the excavations is summarized in Dames & Moore's *Final Report, Phase II - Environmental and Geotechnical Monitoring in Support of Smart Pigging Operations* dated 22 February 1995. The pigging discovered two anomalies in the pipeline, one on the northwest corner of the intersection between Tidewater Road and Gull Avenue, and one near the entrance of the Tote Warehouse, approximately ½-mile north of Segment 4 (Figure 2).

After completion of the smart pigging operations, it was decided that the 500 feet of JP-8 pipeline between the valve yard ("Spaghetti Works") and the intersection of Gull Avenue and Tidewater Road should be abandoned in place, and that a new segment of pipeline be installed at a depth of approximately eight (8) feet below ground surface (bgs). This work was completed in October of 1995. As part of this work, Dames & Moore installed eight soil borings to document the environmental conditions below the abandoned portion of the pipeline, and collected soil and water samples from the excavation for the new pipeline. The results of this environmental sampling are summarized in Dames & Moore's *Final Report,*

Phase IV - Environmental and Geologic Monitoring in Support of Pipeline Replacement dated 10 January 1995. In summary, fuel contamination was found to be present in the vicinity of the original release near the manhole. Additional fuel contamination was also found in the shallow soil between Tidewater Road and Gull Avenue, near Boring B-4 (Figure 2). The source of this fuel contamination is unknown.

2.0 PURPOSE AND SCOPE OF SERVICES

The purpose of this Phase III investigation was to characterize the extent of the hydrocarbon contamination resulting from the pipeline spill, and to determine, if possible, the origin of the fuel contamination near Boring B-4. Dames & Moore's original scope of services for Phase III of this investigation included the following elements:

- Drilling five soil borings west of the leak location (Figure 2) to evaluate the possible source of the hydrocarbon contamination detected at Boring B-4, and to evaluate the downgradient extent of the known release.

- Drilling two soil borings east of the leak location (Figure 2) to evaluate whether the fuel migrated towards the east.

- Installation of three groundwater monitoring wells near the intersection of Tidewater Road and Gull Avenue (Figure 2). The purpose of these wells was to document the hydrocarbon contamination in the soils near the leak location, and monitor potential groundwater contamination.

- Collection and analysis of soil and groundwater samples from the borings and monitoring wells. The samples were analyzed for diesel range organics (DRO) by EPA Method 8100m, gasoline range organics (GRO) by EPA Method 8015m, and benzene, toluene, ethylbenzene, and xylenes (BTEX) by EPA Method 8010.

- Preparation of this report summarizing the investigative methods and all the findings to date.

During preparation for the project, significant changes in the boring and well locations and overall scope of the investigation proved necessary, as detailed in our addendum to the Work Plan dated 2 August 1996. These changes were due to the presence of underground utilities in

the areas to be sampled. For this reason, the borings north of Gull Avenue as well as those east of Tidewater Road were not installed, and two of the three groundwater monitoring wells were not installed (Figure 2). These changes to the scope were made with Air Force knowledge and approval.

All monitoring and sampling activities were performed in general accordance with the procedures and protocols outlined in the Quality Assurance Project Plan (QAPP), dated 14 October 1994, previously submitted to the Air Force.

3.0 INVESTIGATIVE METHODS

3.1 UTILITY CLEARANCE

Prior to the start of work at the site, Dames & Moore met with various utilities at the site, including the City of Anchorage Water and Wastewater, the Port of Anchorage, Chugach Electric, Alaska Telephone Utility, Signature Flight Support, the City of Anchorage, and Texaco to locate underground utilities in the area. The utilities were marked with spray paint and stakes, and the proposed drilling locations adjusted to accommodate the utilities and access. As previously mentioned, significant conflicts were found between the proposed boring locations and underground utilities. For this reason, many of the boring locations were relocated, and two of the monitoring wells were not installed.

3.2 SOIL BORINGS

A total of four soil borings were drilled as part of the Phase III investigation at the site (Borings B-8 to B-11, Figure 2). The borings were drilled into the top of the Bootlegger Cove Clay, which was found at approximately 6 feet bgs. During drilling, undisturbed soil samples were collected every 2 feet using a split-spoon sampler lowered through the hollow stem auger. The sampler was driven 30 inches (or until refusal) with a 30-inch drop of a 340-pound hammer. Hammer blow counts were recorded every 6-inches over the 30-inch interval. After collection, the soil was geologically logged, and placed in appropriate glass jars with Teflon-lined caps. Sample labels were affixed to each sample jar with the boring number, sample number, sample name, depth, date, time of collection, sample name, and project identification.

The soil was screened in the field for the presence of organic vapors using a photoionization detector (PID). A small amount of soil was collected from the sampler and disaggregated in a ziplock bag. The soil was allowed to volatilize for approximately 30 minutes in a warm area. The PID probe was inserted into the bag to measure the resulting organic vapors. The PID

was calibrated to the appropriate gas standards before use each day.

Boring logs were maintained for each boring by the field geologist, and include the PID results, a description of the materials encountered in accordance with the Unified Soil Classification System (USCS), and all pertinent sampling information. Copies of the boring logs are attached in Appendix A.

The soil samples were stored in an ice chest cooled with blue ice, for delivery to an Alaska Department of Environmental Conservation (ADEC)-certified analytical laboratory, CT&E of Anchorage, Alaska (CT&E) for analyses. Selected soil samples from each boring, and all the groundwater samples, were analyzed for DRO, GRO, and BTEX. The results of these analyses are attached in Appendix B and discussed in Section 5.0. Proper chain-of-custody procedures were maintained for all the samples collected.

All sampling equipment was thoroughly cleaned between sampling events using a dilute Alconox and water solution, double rinsed with fresh water, and final rinsed with distilled water. The sampler was then air-dried. The augers were steam-cleaned between borings. Following completion of soil sampling, the borings were backfilled with the soil cuttings.

3.3 GROUNDWATER MONITORING WELL

Dames & Moore installed only one of the three planned groundwater monitoring wells at the site (MW-1, Figure 2). The well was drilled using a truck-mounted drill rig equipped with an 8-inch diameter, hollow stem auger. Relatively undisturbed soil samples were collected at approximately 2 foot intervals from the surface to the bottom of the well boring, using a split-spoon sampler. Following retrieval, a small portion of the soil from each of these samples was placed in a plastic bag for screening with the PID. The geology of the soil and the PID results were recorded on a boring log, and the remaining soil placed in glass jars with Teflon-lined caps.

Each soil sample was labeled with the well number, sample location, depth, date, time of collection, samplers name, and project identification. The soil samples were stored in an ice chest cooled with blue ice, for delivery to an ADEC-certified analytical laboratory (CT&E) for analyses. The soil samples from the well boring were analyzed for DRO, GRO, and BTEX. Proper chain-of-custody procedures were maintained for all the samples collected. The analytical results are attached in Appendix B and discussed in Section 5.0.

The well boring was drilled to top of the Bootlegger Cove Clay, approximately 7 feet bgs.

Soil cuttings were placed in a 55-gallon drum and temporarily stored on-site. After reaching the final depth, the monitoring well was installed through the hollow stem auger. The well was constructed of 2-inch diameter PVC screen and casing. The screened portion of the well was 10 feet long with 0.010-inch slots. A clean sand filter pack was placed around the screened interval, and extended 2 feet above the screened interval. Hydrated bentonite chips were used to seal the well from the top of the sand pack to within 2 feet of the surface. At the surface, the well was completed with a locking cap, and a cemented in place, flush-mount, well box.

A boring log was maintained for the well boring by the field geologist, and include the PID results, well construction details, a description of the materials encountered in accordance with the USCS, and all pertinent sampling information. Copies of the boring/well log are provided in Appendix A.

All sampling equipment was thoroughly cleaned between sampling events using a dilute Alconox and water solution, double rinsed with fresh water, and final rinsed with distilled water. The sampler was then air-dried. The augers were steam-cleaned between borings.

3.4 WELL DEVELOPMENT AND SAMPLING

The groundwater monitoring well was developed more than one day after installation. The water level in the well was gauged to the nearest 0.01 feet using a water level indicator. Measurements of the water level were obtained, recorded, and repeated until reproducible results were achieved. The volume of water in the monitoring well was calculated, and the well developed using a 1-inch diameter Teflon disposable bailer. Purge water was placed in a 55-gallon drum. At least five well volumes were removed during well development. The pH, temperature, conductivity, and turbidity of the purged water were monitored until they stabilized. The well parameters were considered stabilized when the recorded values showed less than 10% variability.

After development, the well was allowed to recover for more than 24-hours before sampling. On 29 October 1996, the monitoring well was sampled. The depth to water in the well was gauged, and the volume of water in the well calculated. The well was purged using a disposable bailor until at least three well volumes were removed and the pH, temperature, conductivity, and turbidity of the water stabilized.

After purging, a groundwater sample was collected and placed in the appropriate laboratory-supplied containers with preservatives. The sample container was labeled with the well number, sample number, project number, job location, sample date, time, and name of the sampler. The sample was kept cold in an ice chest with blue ice prior to shipment to the analytical laboratory under standard chain-of-custody procedures. The groundwater sample was analyzed by an ADEC-approved laboratory (CT&E) for GRO, DRO, and BTEX. The analytical results are attached in Appendix B and discussed in Section 5.0.

3.5 QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

As per our QAPP, dated 14 October 1994, Dames & Moore collected quality assurance/quality control samples from the site. One duplicate soil sample was collected per ten soil samples (for a total of five duplicate samples). The samples were handled and analyzed for the same parameters (DRO, GRO and BTEX) as the original samples. One field blank sample (consisting of analyte-free water passed over the decontaminated soil sampling equipment) was collected and analyzed for BTEX compounds. One trip blank were submitted with the groundwater sample, and analyzed for BTEX compounds only.

3.6 DISPOSAL OF SOIL CUTTINGS AND GROUNDWATER

Soil cuttings from the well borings and purged groundwater were generated at the site. These materials were drummed and labeled. Due to the small amount of such materiels generated, and the relatively small cost for disposal, Dames & Moore arranged for disposal of these materiels by our subcontractor, Alaska Soil Recycling. A copy of the letter confirming disposal of these materials is presented in Appendix C.

4.0 FIELD OBSERVATIONS

4.1 SOILS

The soil from 1 to 2 feet bgs in the soil borings was observed to consist of gravel/sand fill. Below this surface layer was approximately 4 to 5 feet of mixed silt, sand, and traces of gravel. This soil is believed to be disturbed native soil. Underlying this soil was dark gray silt, with varying amounts of clay and occasional roots. This soil is believed to be Bootlegger Cove Clay.

During installation of monitoring Well MW-1, refusal was encountered at a depth of approximately 2 feet bgs on several attempts to install the well. During refusal, metal fragments were observed in the drill cuttings. This refusal is believed to be due to debris buried in the fill. The location of the well was moved a few feet, and the well successfully installed. Refusal was not encountered in the remaining borings drilled at the site.

4.2 GROUNDWATER

Groundwater was encountered in all the borings drilled at the site; however, only the water from the monitoring well and Boring B-10 were observed to have a hydrocarbon odor. Insufficient water was encountered in the soil borings for sampling. The groundwater from Well MW-1 appeared to be very dark, with a high organic content. A trace of sheen was observed in the groundwater purged from this well.

5.0 ANALYTICAL RESULTS

5.1 SOIL BORINGS

5.1.1 Soil Above Groundwater

The analytical results for the soil samples analyzed as part of this investigation are summarized on Table 1, and the complete analytical results are presented in Appendix B. Many of the soil samples collected above the shallow groundwater (approximately 6 feet bgs) were found to contain significant concentrations of hydrocarbons. DRO concentrations ranged from 62 to 4,660 milligrams per kilogram (mg/kg) in the 2-3 feet bgs samples from the borings and GRO concentrations ranged from 1.52 to 15,400 mg/kg. Benzene concentrations ranged from below the analytical detection limit to 43.4 mg/kg in the shallow soil samples from the borings, and total BTEX compounds ranged from nondetectable to as high as 1,476 mg/kg. The shallow hydrocarbon contamination appeared to be concentrated in the vicinity of Boring B-10.

5.1.2 Soil Below Groundwater

The soil samples collected from below the shallow water table were found to be contaminated with 23.4 to 3,940 mg/kg DRO, 3.98 to 7,260 mg/kg GRO, <0.0427 to 35.0 mg/kg benzene, and from nondetectable to 320.2 mg/kg total BTEX (Table 1). The hydrocarbon concentrations were highest in the soil samples collected from the boring for MW-1, and Borings B-9 and B-10. The concentrations were lowest in soil samples collected from Borings

B-8 and B-11 (Figure 1).

5.3 GROUNDWATER RESULTS

The groundwater sample collected from Well MW-1 was analyzed for GRO, DRO, and BTEX. The sample was found to contain 52.7 milligrams per liter (mg/L) of GRO, 20.3 mg/L of DRO, 3.55 mg/L of benzene, and 16.5 mg/L of total BTEX compounds. Free product was not present in the well, but traces of sheen were noted.

5.4 QA/QC RESULTS

In accordance with our ADEC-approved QAPP, Dames & Moore collected duplicate samples of the soil at the site for analyses (Table 1). The results of these analyses are consistent with the results of the original samples in all cases. Contaminants were not detected in the field blank or trip blank samples.

6.0 DISCUSSION

6.1 SOIL

The identity of the hydrocarbons appears to vary significantly between the different soil samples. The soil samples collected above groundwater from the well boring for MW-1 and Boring B-8 appear to most closely resemble motor or lube oil (Appendix D). The chromatograms for Boring B-10 appear to indicate the presence of middle distillate fuel, similar to JP-8 or JP-4, but with a higher proportion of light fraction hydrocarbons and BTEX compounds than would normally be expected. Contamination observed in soil samples collected from above the water table in Borings B-9 and B-11 appear to be consistent with traces of heavy hydrocarbons such as motor oil or lube oil. In addition, the samples from Boring B-11 contain traces of what may be degraded diesel fuel.

Based on these results, there appears to be at least four distinct areas of contamination present at the site (Figure 3). The first is the release of JP-8 near the manhole at the intersection of Gull Avenue and Tidewater Road. This contamination appears to have moved down the pipeline right-of-way (Figures 3 and 4). The second release identified during this investigation appears to be adjacent to the railroad tracks, in the vicinity of MW-1 and Boring B-8, and consists of motor or lube oil (Figures 3 and 5). The third release appears to consist of jet fuel or diesel/gasoline in the vicinity of Borings B-4, B-5, and B-10 (Figures 3 and 6). This

release appears to have migrated along the pipeline corridor. Based on the concentration of light hydrocarbons in the samples from this area, the release appears to be relatively recent. This release does not appear to be physically connected with the release in the vicinity of the manhole, as evidenced by the lack of jet fuel contamination detected in Borings B-8, B-9, and along the pipeline corridor east of Boring B-5. The presence of shallow contamination indicates that it probably originated from a higher elevation.

The fourth possible release was identified in the vicinity of Boring B-11 (Figures 3 and 7). Samples from this boring were found to contain what appears to be weathered diesel fuel, and perhaps some motor oil. The origin and extent of this release is unknown. It appears that the diesel contamination may have reached groundwater at this location, based on the detection of DRO concentration in the soils collected below groundwater.

Dames & Moore has reviewed a 1990 geotechnical investigation performed by Shannon & Wilson in the vicinity of the release. This investigation was performed as part of a transportation improvement project for the Port of Anchorage, and involved the installation of several geotechnical borings along Gull Avenue and Tidewater Road. One of these borings (SWB-7, Figure 2) was located just southeast of Boring B-3, and another (SWB-4, Figure 2) was located south of Boring B-6. While the Shannon & Wilson investigation was intended to solely address geotechnical issues, hydrocarbon contaminated soil was encountered in the borings, and samples were submitted to the analytical laboratory and analyzed for total petroleum hydrocarbons (TPH) by EPA Method 418.1 and BTEX compounds. The samples collected from 6 feet bgs at SWB-7 were found to be contaminated with 1,610 mg/kg of TPH, 1.74 mg/kg benzene, and 212 mg/kg of total BTEX compounds. The 6-foot bgs sample from Boring SWB-6 was found to contain 46.3 mg/kg TPH, but no BTEX compounds. It should be noted that the depth to groundwater reported in these borings was 3.5 feet bgs. The results of this previous investigation imply that the contamination in the vicinity of Borings B-3, B-4, and B-10 was present before the JP-8 release near the manhole, and confirm that it probably had a separate origin.

6.2 GROUNDWATER

Soil samples collected from below the groundwater (approximately 6 feet bgs in most of the borings) can be used to provide some insight as to the extent of the groundwater contamination detected in Well MW-1. Of the borings in the site vicinity, Borings B-2, B-3, B-4, B-7, B-8, and B-9 all were found to contain significant concentrations of hydrocarbons in soils below the shallow water table. A review of the chromatograms for these samples (Appendix D) suggest that the hydrocarbons present consist of jet fuel. Soil samples collected from below the water table in Boring B-8 were found to contain only traces of possible jet fuel.

Based on these results, it would appear that the groundwater plume with jet fuel extends southwest from the leak location and merges with a second contaminant plume in the vicinity of Boring B-10 (Figure 8). It should be noted that specific information on the direction of groundwater flow at the site is not available from the single well installed. It is our assumption that the contaminated groundwater present at the site is flowing toward Cook Inlet to the southwest.

6.3 REGULATORY FRAMEWORK

The cleanup levels for the soil at the site have been calculated using the ADEC matrix score sheet for non-UST hydrocarbon releases (ADEC, 1991). The calculated matrix score for the site was 34 (Figure 9). In calculating this score, Dames & Moore made certain assumptions. The groundwater elevation at the site was measured at around 5 feet bgs, but previous investigations at the site have shown that it can occur as shallow as 3.5 feet bgs. The soil type at the site appears to vary significantly but, in general, consists of coarse-grained soils with fines. The groundwater at the site is considered non-potable. The volume of contaminated soil is unknown, however, if both the manhole release and the second release near Boring B-10 are counted together, the volume of contaminated soil is probably in excess of 500 cubic yards.

Based on this matrix score, the cleanup level for the soils at the site would be 100 mg/kg GRO, 200 mg/kg DRO, 2,000 mg/kg for residual range hydrocarbons (RRO), 0.5 mg/kg benzene, and 15 mg/kg total BTEX. The soil samples collected above the groundwater during this investigation indicate that DRO concentrations in the vicinity of MW-1 and at B-10, and GRO concentrations in the vicinity of B-10, would require remediation. BTEX concentrations in the vicinity of B-10 are also considerably higher than cleanup levels and would require remediation. Previous analytical results indicate that the DRO and GRO concentrations in the shallow soil along the pipeline corridor near Borings B-3 and B-4, as well as near the manhole, are above ADEC cleanup levels. It should be noted that RRO was not quantified in the soil samples, since this range of hydrocarbons was not released from the pipeline. Based on the chromatograms for the samples analyzed, the samples collected from the borings for Well MW-1 and Boring B-8 may contain concentrations of RRO above regulatory cleanup levels.

Only limited information is available on the groundwater contamination present at the site. In general, hydrocarbon contamination in the groundwater is required by ADEC to be cleaned up to 1 mg/L TPH. The cleanup levels for BTEX compounds in groundwater are 0.005 mg/L for benzene, 2 mg/L for toluene, 0.7 mg/L for ethylbenzene, and 10 mg/L for xylenes (ADEC,

1990). The concentrations of hydrocarbons reported in Well MW-1 exceed all these groundwater cleanup criteria, with the exception of xylenes. Analytical results for the soil samples collected below the water table suggest that the groundwater at Boring B-8 probably exceeds state cleanup levels for benzene, and that groundwater at Borings B-9 and B-10 probably exceeds state cleanup levels for DRO, GRO, and benzene.

It should be noted that ADEC is reportedly developing alternate cleanup levels for the Port of Anchorage, and that the cleanup levels calculated on the matrix score sheet may be more conservative than these alternate cleanup levels.

7.0 CONCLUSIONS AND RECOMMENDATIONS

The following conclusions can be made based on the results of this investigation, as well as previous investigations at the site:

- The JP-8 release in the vicinity of the manhole affected the soil and groundwater at the intersection of Gull Avenue and Tidewater Road. While much of the affected soil appears to have been removed from the site during repair and replacement of the pipeline, hydrocarbon contamination remains in the soils at concentrations exceeding ADEC matrix score cleanup levels.

- The JP-8 release has entered the groundwater, and is probably flowing southwest toward Cook Inlet. The contaminated groundwater plume probably merges with one centered around a previous release near Boring B-10. The concentration of hydrocarbons in the groundwater exceeds ADEC cleanup levels at Well MW-1, and probably also in the vicinity of Borings B-3, B-4, and B-10. It should be noted that the fill at the site may cause preferential pathways of groundwater flow.

- A lube oil spill appears to have occurred west of the railroad tracks in the vicinity of Well MW-1. The extent of this release is unknown.

- A second release of middle distillate hydrocarbons appears to be present in the vicinity of Borings B-4, B-5, and B-10. The full extent of this release is unknown, but it appears to extend along the pipeline corridor from Boring B-2 to Boring B-5. This release may consist of JP-8 or JP-4, but it appears to be relatively enriched in lighter hydrocarbons than the fuel that was released at the manhole. In addition, the release appears to have originated from the surface. It is possible that this release originated at

the valve yard ("Spaghetti Works") to the west. This release may have been present prior to the release at the manhole, and appears to have been present since at least 1990.

- A release of diesel fuel and/oil appears to have occurred near Boring B-11. The source(s) and age of this release is unknown; however, it appears to be significantly degraded. This release appears to have affected groundwater.

Based on the results of this investigation, there appears to be several sources of hydrocarbon contamination in the site vicinity. Additional investigations may be required to delineate these areas of contamination, and remediation may be required by ADEC. It is our opinion that the remaining hydrocarbon contamination originating from the leak in the pipeline should be addressed as part of a comprehensive effort which would include all the hydrocarbon contamination present in the release vicinity. This effort should take place after ADEC has established alternate cleanup levels for the Port of Anchorage. It should be noted that the current threat to human or wildlife health from the hydrocarbon contamination detected would appear to be minimal, and much of the contaminated soil that occurred as a results of the pipeline release may have already been removed or remediated.

8.0 LIMITATIONS

The conclusions presented in this report are professional opinions based solely on our interpretation of the available analytical data and observations at the site. The conclusions are intended exclusively for the purpose outlined herein and at the site location and project indicated. This report is for the sole use of the Air Force. The scope of services performed in the execution of this investigation may not be appropriate to satisfy the needs of other users, and any re-use of this document or the findings, conclusions, or recommendations presented herein is at the sole risk of said user(s).

It should be recognized that this study is not intended to be a definitive investigation of contamination at the subject property. Given that the scope of services for this project was limited, that exploratory excavations were limited in number and depth, and that sampling of deeper soils and groundwater was not undertaken, it is possible that currently unrecognized contamination may exist at the site.

Opinions and recommendations presented in this report apply to the site conditions existing at

the time of the site visit. They cannot necessarily apply to site changes of which Dames & Moore is unaware and has not had the opportunity to evaluate. This report is intended to be used in its entirety; no excerpts may be taken to be representative of the findings of this investigation.

9.0 REFERENCES

Alaska Department of Environmental Conservation (ADEC). 1990. Interim Guidance for Cleanup of Surface Water and Groundwater Contamination.

ADEC, 1991. Interim Guidance for Non-UST Contaminated Soil Cleanup Levels.

Dames & Moore, 1995. Phase I Final Report - Environmental and Geotechnical Monitoring in Support of Emergency Pipeline Repair, Port of Anchorage Fuel Spill. 22 February 1995.

Dames & Moore, 1995. Phase II Final Report - Environmental and Geotechnical Monitoring in Support of Smart Pigging Operation, Port of Anchorage Fuel Spill. 22 February 1995.

Dames & Moore, 1995. Phase IV Final Report - Environmental and Geotechnical Monitoring in Support of Pipeline Replacement, Port of Anchorage Fuel Spill.

Shannon & Wilson, 1990. Geotechnical Report - Transportation Improvement Project, Port of Anchorage, Anchorage, Alaska.

TABLES

TABLE 1
ANALYTICAL RESULTS OF SOIL SAMPLES
PORT OF ANCHORAGE

Sample Location	Depth (ft. bgs)	PID (ppm)	DRO (mg/kg)	GRO (mg/kg)	BTEX Compounds (mg/kg)					Fuel I.D.[1]
					TotalB TEX	Benzene	Toluene	Ethyl-benzene	Xylenes	
MW-1	2-3	3.7	**374**	61.0	0.4696	0.254	<0.0552	<0.0552	0.2156	Oil
	5-6	7.9	81.8	19.1	0.0707	0.0707	<0.0493	<0.0493	<0.0493	Oil
	5-6 Dup.	7.9	**243**	10.8	ND	<0.0450	<0.0450	<0.0450	<0.0450	Oil
	8-9[W]	854	**3,940**	**7,260**	**57.1**	35.0	197	58.8	280.2	JP-8
B-8	3-4	4.5	143	4.57	ND	<0.0470	<0.0470	<0.0470	<0.0470	Oil
	3-4 Dup.	4.5	157	4.54	ND	<0.0486	<0.0486	<0.0486	<0.0486	Oil
	6-7	3.0	162	6.95	0.0423	0.0423[J]	<0.0486	<0.0486	<0.0486	Oil
	8-9[W]	2.5	23.4	27.6	0.8627	0.0922	0.0830	0.0815	0.606	Oil/Diesel
B-9	2-3	5.0	62.0	1.52	ND	<0.0591	<0.0591	<0.0591	<0.0591	None
	6-7	5.2	92.1	4.87	ND	<0.0666	<0.0666	<0.0666	<0.0666	None
	6-7 Dup.	5.2	76.1	4.11	ND	<0.0635	<0.0635	<0.0635	<0.0635	None
	8-9[W]	2.6	**292**	**444**	**18.84**	0.692	1.66	5.27	11.22	Jet Fuel
B-10	2-3	4.5	**4,660**	**15,400**	**1,476**	43.4	536	180	717	Jet Fuel
	2-3 Dup.	386	**2,550**	**11,500**	**1,053**	40.2	396	129	488.4	Jet Fuel
	5-6[W]	320	**1,110**	**3,710**	**320.2**	19.7	112	37.1	151.4	Jet Fuel
	8-9[W]	320	44.6	**287**	**15.5**	1.88	1.06	3.89	8.63	Jet Fuel

TABLE 1 (CONT.)
ANALYTICAL RESULTS: SOIL SAMPLES FROM BORINGS
PORT OF ANCHORAGE

Sample Location	Depth (ft. bgs)	PID (ppm)	DRO (mg/kg)	GRO (mg/kg)	BTEX Compounds (mg/kg)					Fuel I.D.[1]
					TotalB TEX	Benzene	Toluene	Ethyl-benzene	Xylenes	
B-11	2-4	36	90.6	19.6	0.692	0.201	0.142	0.193	0.156	Diesel/Oil
	2-4 Dup.	36	113	12.7	0.120	0.120	<0.0560	<0.0560	<0.0560	Diesel/Oil
	5-6[W]	20	17.4	6.88	0.4281	<0.0427	<0.0427	0.130	0.2981	Diesel/Oil
	8-9[W]	9	74.3	3.98	ND	<0.0627	<0.0627	<0.0627	<0.0627	Diesel/Oil
ADEC Category B Cleanup Levels			200	100	15	0.5	N/A	N/A	N/A	N/A

Notes:
< = Not reported above analytical detection limit.
BTEX = Benzene, toluene, ethylbenzene, xylenes by EPA Method 8020.
ft. bgs = Feet below ground surface.
mg/kg = Milligrams per kilogram.
ppm = Parts per million.
PID = Photoionization detector.
DRO = Diesel range organics by EPA Method 8100m.
GRO = Gasoline range organics by EPA Method 8015m.
Dup. = Duplicate.
ND = Not detected.
N/A = Not applicable.
W = Collected below groundwater.
1 = Tentative identification based on comparison of sample chromatogram with chromatograms for various fuels (Appendix D).

Concentrations exceeding ADEC Category B Cleanup Levels are in bold.

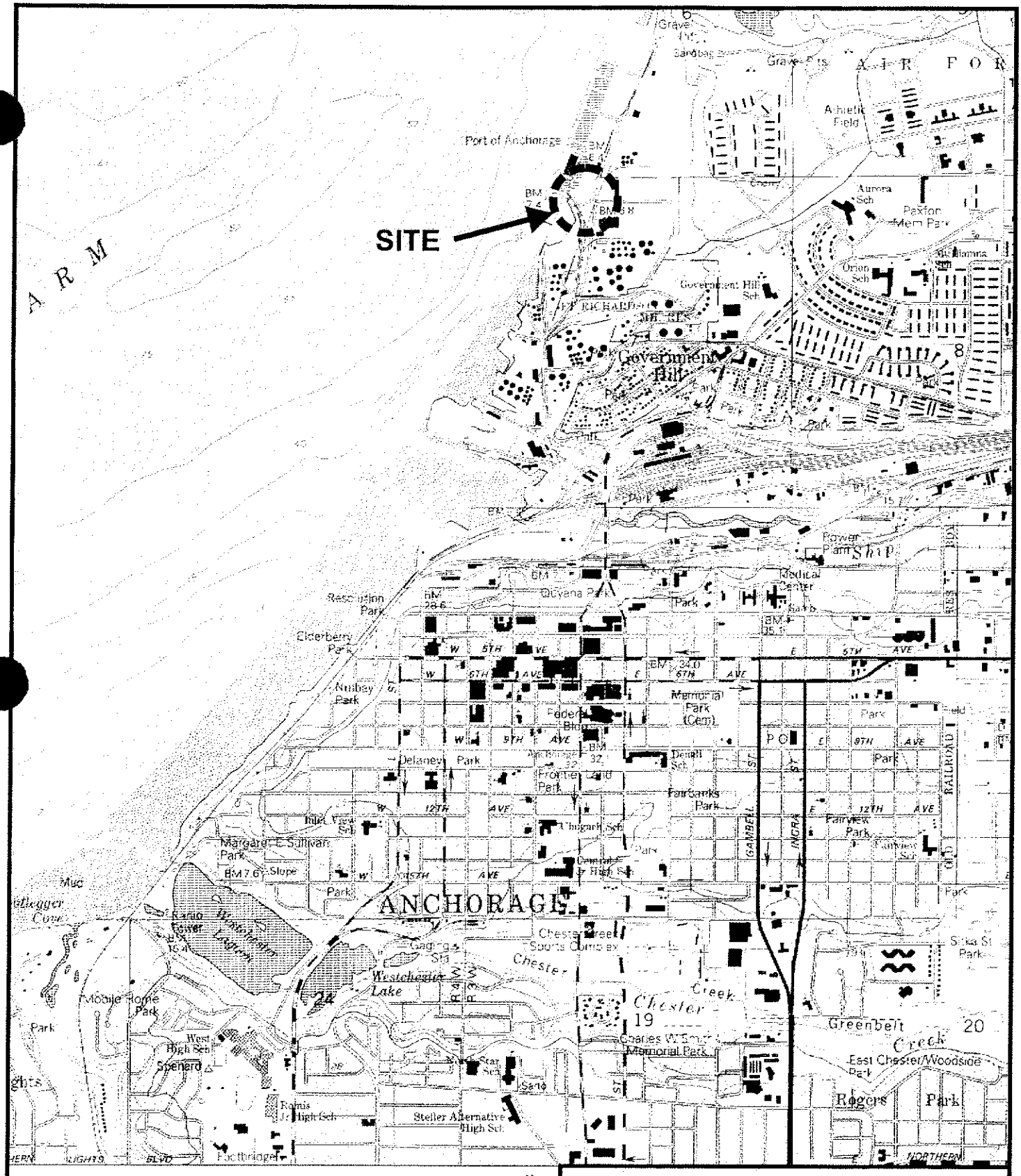
TABLE 2
ANALYTICAL RESULTS: GROUNDWATER, RINSATE, AND TRIP BLANK SAMPLES
PORT OF ANCHORAGE

Sample Location	DRO (mg/L)	GRO (mg/L)	BTEX Compounds (mg/L)					Fuel I.D.
			Total BTEX	Benzene	Toluene	Ethylbenzene	Xylenes	
MW-1	**20.3**	**52.7**	16.5	**3.55**	**6.19**	**1.08**	5.68	JP-8
Rinse Blank	<0.200	<0.200	ND	<0.050	<0.050	<0.050	<0.050	N/A
Trip Blank	--	--	ND	<0.050	<0.050	<0.050	<0.050	N/A
ADEC Cleanup Levels[1]	1.0	1.0	--	0.005	2.0	0.7	10.0	N/A

Notes:
1 = Source: ADEC (1990)
< = Not reported above analytical detection limit.
BTEX = Benzene, toluene, ethylbenzene, xylenes by EPA Method 8020.
mg/L = Milligrams per liter.
DRO = Diesel range organics by EPA Method 8100m.
GRO = Gasoline range organics by EPA Method 8015m.
- = Not analyzed.
N/A = Not applicable.

Concentrations exceeding ADEC cleanup levels are in bold.

FIGURES



Reference: Anchorage (A-8) NW Map, USGS 1:25,000 Topographic Series, 1994

DEPARTMENT OF THE AIR FORCE

REPAIR NORTH JET PIPELINE
SITE VICINITY MAP

PORT OF ANCHORAGE
ANCHORAGE, ALASKA

JOB NO:		DRAWN:	ELK
DATE:	20 JANUARY 1997	FILE:	01016\474\FIG01.CDR

FIGURE 1