INTERIM REPORT ON SOURCE AREA INVESTIGATION 6-MILE RICHARDSON HIGHWAY GROUNDWATER ASSESSMENT

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Alaska Department of Environmental Conservation
610 University Avenue
Fairbanks, Alaska 99709

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

2055 Hill Road
P.O. Box 70843
Fairbanks, Alaska 99707 • 0843
907 • 479 • 0600

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EXECUTIVE SUMMARY

Shannon & Wilson, Inc. has completed an investigation of potential sources of groundwater contamination in the 6-Mile Richardson Highway area, approximately 6 miles southeast of Fairbanks, Alaska. This work was conducted under contract to the Alaska Department of Environmental Conservation (ADEC) for the purpose of investigating two inferred potential sources of contaminated groundwater south of the Richardson Highway, identified during previous environmental studies at properties located in the area. These studies dealt with the contamination of groundwater in the area by trichloroethylene (TCE) and other compounds.

Contamination of groundwater in the area by TCE was first discovered in 1987, when ADEC sampled water supply wells located west and north of the McCall property located at about 6.5-Mile Richardson Highway. Subsequent studies in 1989, 1994, and 1995 revealed a plume of TCE-contaminated groundwater, which extended about 1 mile in a northwesterly direction into the Six-Mile Village Subdivision. The early environmental investigations focused on the McCall property as the source of the groundwater contamination. However, data collected in 1994 suggested the presence of several potential source areas not located on the McCall property. These potential source areas may have caused contamination of groundwater by TCE and other compounds, none of which have been found to date on the McCall property in concentrations high enough to have contaminated the groundwater at the levels found downgradient of the site.

The properties immediately west of the McCall property consist of the Holder, Walsky, and 6-Mile Truck Shop parcels, in that order. The 1994 study found elevated concentrations of TCE in the groundwater in the vicinity of the water supply well on the Holder property, and the data were interpreted to suggest the presence of a primary and a smaller secondary TCE source on that property. Data from the sampling of a limited number of monitoring wells and water supply wells downgradient of that property were interpreted to suggest the possible presence of one or more additional source areas in the vicinity of the Walsky and 6-Mile Truck Shop properties. The 6-Mile Truck Shop property was investigated in February 1996. The Walsky property was investigated in August and September 1996. This current report incorporates these 1996 data

with the results of previous investigations, to provide conclusions regarding the sources of groundwater contamination in the 6-Mile area.

This report concludes that there are multiple sources of groundwater contamination by TCE, trichloroethane (TCA, another chlorinated solvent), and petroleum compounds within the study area. The primary TCE source area still appears to be on the Holder property. The primary source of TCA contamination appears to be near or upgradient of a temporary monitoring well on the eastern portion of the Walsky property, where elevated concentrations of this compound were found. Apparent increases in the concentration of both TCE and TCA in the groundwater in the vicinity of LuAnne Road, which separates the Walsky property from the 6-Mile Truck Shop, continue to suggest a secondary source for one or both of these compounds in this area. Additional exploration will be required to confirm this.

Several source areas of petroleum-contaminated soil have been found within the study area, probably the cause of isolated occurrences of benzene and other fuel-related compounds in the groundwater. None of this contamination on the south side of the highway exceeds the drinking water maximum contaminant levels for these compounds. The source of groundwater contamination by benzene in the Six-Mile Village Subdivision is thought to be on the north side of the highway, based on a separate investigation which was also performed this summer.

Recommendations are provided for additional sampling to confirm which parcels are contributing TCE and TCA to the groundwater.

INTERIM REPORT ON SOURCE AREA INVESTIGATION 6-MILE RICHARDSON HIGHWAY GROUNDWATER ASSESSMENT

1.0 INTRODUCTION

This interim report presents the results of investigation of potential sources of groundwater contamination in the 6-Mile Richardson Highway area, approximately 6 miles southeast of Fairbanks, Alaska (Figure 1). This work was performed for the Alaska Department of Environmental Conservation (ADEC) as Task 6 of Notice to Proceed (NTP) 1880175301A, under Term Contract 18801753 for site assessments.

The presence of groundwater contamination by trichloroethylene (TCE) and other chlorinated solvents in the 6-Mile area was detected by ADEC in 1987, based on investigations related to the McCall property at about 6.5-Mile Richardson Highway. The ADEC sampling was conducted as part of an investigation of alleged open burning and the disposal of solid wastes at the property, including possible hazardous substances. Work conducted by Shannon & Wilson, Inc. for ADEC during 1994 under a separate NTP concluded that there was a primary source area of TCE in the vicinity of the water supply well on the Holder property (located west of the McCall property). The April 1995 report on that work also indicated that there may be separate sources of TCE and other compounds: (1) in the vicinity of the water supply well on the 6-Mile Truck Shop property, and (2) near a monitoring well cluster which had been installed on the Walsky property. These properties are both located west of the McCall and Holder properties, as shown in Figure 2.

The objective of this current work was to evaluate these two properties identified as potential additional sources of trichloroethylene (TCE)-contaminated groundwater, previously found in residential and commercial water supply wells downgradient of these properties. This work was conducted in general accordance with: our proposal dated May 16, 1995, as modified in various discussions with the ADEC project manager, Mr. Doug Bauer, based on the results of prior work on the project; our Project Work Plan dated July 28, 1994 (developed for Shannon &

Wilson's 1994 site assessment work at the McCall property); and our ADEC-approved Quality Assurance Program Plan (QAPP) for underground storage tank work.

This report does not discuss in detail the results of residential and commercial drinking water supply well sampling and analyses in the 6-Mile area, which were presented in Shannon & Wilson's: Interim Report dated October 31, 1995; addendum to that report dated December 1, 1995; and quarterly reports on long-term monitoring dated April 2, 1996, and October 17, 1996. Investigation of the 6-Mile Truck Shop as a potential source area was conducted in February 1996, and the results were presented in a report dated February 26, 1996; the information collected during that investigation is incorporated in this current report. Not directly related to the current investigation of possible source areas of TCE on the south side of the Richardson Highway is an investigation on the north side of the highway searching for the source of elevated concentrations of benzene in the groundwater in the nearby 6-Mile Village Subdivision, under a separate NTP; the results were presented in a report dated November 1996. Similarly, work has been completed under a separate NTP characterizing the contents of drums and releases at the 6-Mile Truck Shop; again, results were presented in a report dated November 1996.

2.0 BACKGROUND

This work was conducted for the purpose of investigating two inferred potential sources of contaminated groundwater, identified during previous environmental studies at properties located at approximately 6.5-Mile Richardson Highway. The study area for the overall current investigation of groundwater contamination involves an area about 1 mile in length, which encompasses approximately 0.45 square miles at about 6- to 6.5-Mile Richardson Highway in Fairbanks, Alaska (Figure 2). Earlier environmental investigations conducted in this area focused on the McCall property located at about 6.5 Mile. Although that site has often been suggested as the sole source of the groundwater contamination in the area, this may not be accurate based on current information. As described in Shannon & Wilson's April 28, 1995, Environmental Site Assessment report for the McCall property, data collected during that site assessment suggested the presence of several potential source areas not located on the McCall property. These potential source areas may have caused contamination of groundwater by TCE and other compounds, none of which have been found to date on the McCall property in concentrations high enough to have contaminated the groundwater at the levels found downgradient of the site. A brief summary of previous environmental investigations in the area is presented below.

2.1 Previous Investigations

Contamination of groundwater in the area by TCE was first discovered in 1987, when ADEC sampled five water supply wells located within a 1,000-foot radius west and north of the northern pond located on the McCall property (a sixth well, about ¾-mile upgradient of the site, was also sampled). The sampling was conducted as part of an investigation in October 1986 of alleged open burning and the disposal of solid wastes at the property, including possible hazardous substances. Both ADEC and another consultant (Polytechnic) collected samples of water from a gravel pit on the McCall property in October 1986; no wells were sampled until 1987. Waste disposal was documented to have occurred in the northern gravel pit at the site. In the 1987 sampling, TCE was detected in wells at two businesses and not detected in four residential wells. Of the two wells in which TCE was reported, the one located farthest downgradient showed only a low level of the compound (0.9 parts per billion [ppb]), which at

the time would have suggested a limited extent of groundwater contamination. Well owners were informed of the results of this sampling by ADEC at the time.

In 1989, Shannon & Wilson conducted an investigation of the McCall property for the law firm of Staley, DeLisio, Cook, and Sherry. One topic of that investigation was drums which were observed in the northern gravel pit on the property. The report of the results of that investigation was provided to ADEC by the law firm on February 2, 1990. The results of that investigation did not show any contamination of the groundwater on the McCall property by TCE. In particular, there was no evidence that the drums which were observed to have been disposed in the northern gravel pit, or possible drums which were inferred to have been buried on the north side of that pit during the early 1980s, were the source of TCE contamination, or that they were the source of any significant levels of contamination by any other compounds for which laboratory tests were performed. Three residential water supply wells to the west of the McCall property were sampled as part of the 1989 investigation. TCE was detected at concentrations of 9.9 to 29 ppb, and the well owners were notified of the test results by the law firm for whom the investigation was performed.

Shannon & Wilson was hired by ADEC in July 1994 to conduct an investigation, the primary objective of which was to attempt to locate the source of the TCE in groundwater in the vicinity of the McCall property. The final report for this study was issued on April 28, 1995. Nine water supply wells to the west and north of the McCall property were sampled as part of the 1994 work. Three wells contained no detected TCE, and the remaining wells contained TCE at concentrations ranging from 0.34 to 19 ppb. Test results were provided to the well owners.

During the 1994 study two potential TCE source areas were tentatively identified, based on soil gas and groundwater probes installed at the McCall and Holder properties (the Holder property is located immediately west of the McCall Property, see Figure 3) and groundwater monitoring well and water supply well samples collected from these and nearby downgradient properties. Groundwater was sampled from 21 shallow groundwater probes on the McCall and Holder properties to attempt to find the upgradient and crossgradient limits of TCE contamination in the groundwater. The starting point for these probes was the water supply well on the Holder

property, which contained the highest concentration of TCE found during the 1987 sampling by ADEC and 1989 sampling by Shannon & Wilson.

Based on the results of the sampling of these groundwater probes, one source area of TCE was suspected to be to the east or southeast of the water supply well on the Holder property, and the other in the vicinity of a former generator building on the Holder/McCall property line. Both of these suspected source areas were believed to be shallow (possibly 2 to 10 feet). A soil gas survey was conducted in these two areas to attempt to find locations with TCE-contaminated soil as targets for drilling and sampling of soil borings, but the results were inconclusive. The only soil found to be contaminated by TCE was 0.33 parts per million (ppm) at groundwater probe P-14, near the former generator building from the antiaircraft facility which was present on the site in the 1950s. Although no other contaminated soil was found, the locations of the source areas were inferred within a several 100-foot-diameter area, based on the results of the groundwater sampling.

Groundwater monitoring wells which had been installed on the McCall property in 1989 (wells MW-1 through MW-3) were again found in 1994 to not contain TCE at concentrations above the detection limit. No evidence was found of significant groundwater contamination originating from a now-filled gravel pit on the southern portion of the McCall property, or from the northern gravel pit where drums were known to have been disposed and additional drums were alleged to have been buried.

Groundwater samples collected from a monitoring well installed on the Walsky property (immediately west of the Holder property), and from the water supply well at the 6-Mile Truck Shop (located immediately west of the Walsky property), in 1994 contained TCE at significantly higher concentrations than the wells on and immediately downgradient of the Holder property. In addition, 1,1,1-trichloroethane (TCA) and several other compounds which were not present in wells on the Holder property were found in the Walsky and 6-Mile Truck Shop wells. These results were interpreted at the time to infer the potential presence of one or more additional source areas for those compounds, possibly located in the vicinity of one or both of those

properties. This inference was based only on the limited data available at the time and has subsequently been revised, as explained later in this current report.

For a more complete description of the history of the McCall site, and results of investigations conducted on that and adjacent sites, the reader is referred to Shannon & Wilson's Environmental Site Assessment report for that site, dated April 28, 1995.

2.2 Groundwater Flow Direction

Water level data collected from the groundwater monitoring wells located on the McCall, Holder, and Walsky properties during the summer and winter months of 1994 indicated that groundwater flows in a direction ranging from N38°W to N50°W (i.e., groundwater flows to the northwest). Data collected from the Arctic Surplus Superfund Site remedial investigation work, which is unrelated to this study, also indicated a groundwater flow direction ranging from N40°W to N50°W. The Arctic Surplus site is located at the northeast corner of Badger Road and the Old Richardson Highway, about 1 mile northwest of the McCall property. The orientation of the plume of TCE-contaminated groundwater extending into the 6-Mile Village Subdivision which was presented in our October 1995 Interim Report is about N30°W. Groundwater flow direction measured in September 1996 at the eastern boundary of the Walsky property was estimated to range from N43°W to N52°W. Flow direction measured in August 1996 at the western boundary of the Walsky property was estimated to range from N18°W to N28°W.

The range of groundwater flow directions discussed above generally agrees with information presented by the U.S. Geological Survey (USGS) in a 1982 report on the hydrology of the Badger Road area. Shannon & Wilson is unaware of any factual conflicting data on groundwater flow direction in the vicinity of 6-Mile Richardson Highway and, therefore, concludes that the groundwater flow in the study area is in a northwesterly direction.

Groundwater flow gradients measured for this project in 1994 averaged about 4¾ feet per mile, which generally agrees with the 1982 USGS report which cites "approximately 4 feet per mile" for the water table slope in the Badger Road area. It is our understanding that the USGS

currently uses an estimate of 600 ± 200 feet per day as their estimate of the hydraulic conductivity of the sand and gravel aquifer in the Fairbanks area. Using this average conductivity, an assumed porosity of 0.3, and a gradient of 0.0009, the groundwater flow velocity is calculated to be about 1.8 feet per day.

2.3 Rationale for Investigation of Potential Source Areas

Data which was available at the conclusion of the 1994 field work, which led Shannon & Wilson to hypothesize the possible existence of other source areas for the groundwater contamination in the 6-Mile area, was limited to results from: (1) monitoring wells and groundwater probes in the vicinity of the Holder water supply well; (2) a cluster of monitoring wells on the northern Holder parcel and two water supply wells, all about 650 feet downgradient of the Holder water supply well; (3) a cluster of monitoring wells on the Walsky property; (4) the water supply well at 6-Mile Truck Shop; and (5) the water supply well at Environmental Systems, Inc. (ESI), downgradient from 6-Mile Truck Shop.

In 1994, concentrations of TCE up to 139 parts per billion (ppb) were found in the groundwater on the Holder property in groundwater probes at very shallow depths (generally 9 to 12 feet total depth). However, since the concentrations in the adjacent monitoring well and water supply well (20 to 30 feet and 40 feet deep, respectively) on the Holder property were so much lower (7.4 and 7.2 ppb), it was suspected by Shannon & Wilson that the higher concentrations were limited to the very shallow groundwater, and the TCE rapidly dispersed to a lower concentration. This hypothesis appeared to be supported by the fact that only 2.2 to 8.8 ppb TCE were found in the monitoring well cluster on the northern Holder parcel and the two residential wells on Eskimo Museum Lane.

Based on these data, our April 28, 1995 report stated (bracketed comments added for clarity):

> "The data at monitoring well cluster MW-4/MW-5 on the Walsky property, 1,250 feet downgradient of the Holder well, require some interpretation. In our opinion, the presence of four other compounds in addition to 34 ppb of TCE suggests that there may be another nearby source of contamination [since these compounds, including 1,1,1 trichloroethane (TCA), had not been detected in any of the wells farther upgradient]. In

> our opinion, this contamination has not originated from the primary TCE source area [since concentrations of TCE at the same 20- to 30-foot depth in upgradient wells were several times lower than this 34 ppb, and concentrations of dissolved contaminants would be expected to decrease with distance from the source rather than increase]. The 3.7 ppb of TCE in the deeper well could either be due to downgradient migration from the primary source area or vertical dispersion from a nearby source.
>
> The 19 ppb of TCE at the 6-Mile Truck Shop well, 550 feet farther downgradient from the Walsky monitoring well cluster, is also in our opinion not related to the primary TCE source. It might reflect downgradient attenuation of the source of the 34 ppb of TCE at the Walsky well cluster. However, the 46 ppb of TCA reported at 6-Mile (compared to only 3.6 ppb TCA at the Walsky cluster) suggests that there is a separate source of TCA and other compounds in the vicinity of the 6-Mile well, and, therefore, the 19 ppb of TCE may be from this same source.
>
> All of the compounds detected in the well at ESI [Environmental Systems, Inc., on the north side of the Richardson Highway downgradient of 6-Mile Truck Shop] are present at higher concentrations in the 6-Mile Truck Shop well. In our opinion, this suggests that the same source responsible for the groundwater contamination at the 6-Mile Truck Shop is the source for the contamination observed at ESI."

It was for these reasons that it was concluded that there might be additional potential source areas in the vicinity of the Walsky and 6-Mile Truck Shop properties.

3.0 FIELD METHODS

In order to discuss the topic of potential source areas of the groundwater contamination in an area-wide context, this report makes use of the results of groundwater sampling from a number of sources. These include:

- The installation and sampling of three shallow (20- to 30-foot screened interval) and one deep (69- to 79-foot screened interval) monitoring wells on the 6-Mile Truck Shop property on February 9 through February 17, 1996; and the resampling of these wells on August 13, 1996

- The installation and sampling of six shallow (20- to 30-foot screened interval) temporary monitoring wells on the Walsky property between August 12 and September 13, 1996

- The installation and sampling of two shallow (20- to 30-foot screened interval) temporary monitoring wells in LuAnne Road between the Walsky and 6-Mile Truck Shop properties on September 18, 1996

- The sampling of six shallow (generally 20- to 30-foot screened interval) and three deep (70- to 80-foot screened interval) previously installed monitoring wells on the McCall, Holder, and Walsky properties between August 12 and 17, 1996

- The most recent sampling results for one other shallow monitoring well and two former water supply wells (one 15 feet deep, and the other 62 feet deep) on the McCall property: samples collected on October 12 and 17, 1995

- The most recent sampling results from six water supply wells within the study area (all but two of these wells are between 18 and 40 feet deep; the other two are 65 and 100 feet deep); sampling dates range from June 23, 1995 to August 15, 1996

- The results from 13 shallow (generally 9 to 12 feet total depth), temporary, groundwater probes installed and sampled on the Holder and McCall properties between August 3 and 23, 1994; eight additional groundwater probes were installed on these properties, but since no compounds were detected in the groundwater samples from them, and they are farther upgradient of the probes discussed herein, they are omitted for clarity; they were previously described in our April 1995 report.

- The results of the installation and sampling of one new shallow (about 20 to 30-foot screened interval) monitoring well on the McCall property on October 16 and 17, 1996

The work performed at the 6-Mile Truck Shop, on the Walsky property, in LuAnne Road, and at the new monitoring well on the McCall property was performed specifically for this task of the NTP, and the field methodology is described in the following subsections. The sampling of the monitoring wells and water supply wells is described in our October 17, 1996, quarterly monitoring report, the Interim Report dated October 31, 1995, and its December 1, 1995, Addendum. The installation and sampling of the temporary groundwater probes on the McCall property are described in our April 28, 1995, report on our 1994 Environmental Site Assessment of the McCall property.

The locations of all of the wells referenced in this report are presented in Figure 3. Results of laboratory testing, both for the most recent and any previous samples, are presented in Table 1. Laboratory analytical reports for any sampling which has not previously been reported are provided in Appendix A.

Shannon & Wilson acknowledges that the concentrations of chemicals dissolved in groundwater can change with time, and it would be preferable to be able to study a problem such as this with samples which were all collected at the same time. However, in our opinion, if this possible source of uncertainty is kept in mind during the analysis of the data, it is still possible to use the entire body of data which has been collected within the study area. While Shannon & Wilson's

April 1995 report documented that concentrations of TCE had decreased in two residential water supply wells by a factor of four between 1989 and 1995, subsequent reports on long-term monitoring have indicated that the results of repeat sampling of various wells in the period of 1994 through 1996 have generally been within a range of ±30 percent. The majority of the samples used to support the conclusions in this report were collected between August 12 and September 18, 1996, and in our opinion are recent enough for the purpose of this study.

There are two other variables besides the time of sample collection which have the potential to impact the data presented in this report: the depth from which the sample was collected, and whether the sample was collected from a groundwater probe, a monitoring well, or a water supply well. The water samples discussed in this report came from several depth ranges: (1) groundwater probes with a screen about 2 feet long which were installed to a total depth of generally about 9 to 12 feet, (2) monitoring wells screened generally from about 20 to 30 feet, (3) monitoring wells screened generally from about 70 to 80 feet, and (4) water supply wells completed at depths of 15, 18, 30, 40, 62, 65, and 100 feet. In discussions within this report, trends of contaminant concentrations in groundwater have been considered in three zones: (1) very shallow, the 9- to 12-foot-deep probes; (2) shallow, generally the 20- to 30-foot-deep monitoring wells, but also including the water supply wells from 15 to 40 feet deep; and (3) deep, the 70- to 80-foot-deep monitoring wells and the 62-, 65-, and 100-foot-deep water supply wells. In our opinion, contaminant behavior and distribution within each of these depth ranges should be similar enough to allow conclusions to be drawn for the purposes of this study.

Water samples for this project were collected using four different techniques: (1) a peristaltic pump was used for the groundwater probe samples in 1994; (2) a bailer was used for the 1994 monitoring well samples; (3) a low-flow, submersible sampling pump was used for all subsequent monitoring well samples; and (4) water supply wells were sampled from a non-aerated tap, where possible, with the exception of the two inactive supply wells on the McCall property, which were sampled with a bailer. Tests performed on other projects have shown that the results obtained by sampling the same well with a bailer and with a low-flow submersible sampling pump are comparable.

As discussed in our April 1995 report, "the use of a peristaltic pump might result in some loss of volatiles." Research by others (EPA, 1992) has indicated that this loss may range from 4 to 30 percent, although this is contradicted by a different researcher (Tai, et al, 1991) who concluded that the impact would be at the low end of this range. With respect to samples collected from water supply wells, our April 1995 report stated that "collection of samples through the [submersible or surface-mounted] pumps may have resulted in a significant loss of volatile compounds, but the samples are representative of the water being consumed by the people utilizing the wells." However, the data in that report show that at the only location where a direct comparison can be made, the Holder well and its adjacent shallow monitoring well, the result from the water supply well is only 3 percent lower than the result from the monitoring well, which constitutes excellent agreement. No other locations are available within the study area where a monitoring well is immediately adjacent to a water supply well and other comparisons can be made. In our opinion, the data obtained using the various sampling methods described above are comparable enough for the purposes of this study to allow the conclusions contained in this report to be made.

3.1 6-Mile Truck Shop

On February 9, 14, and 15, 1996, Shannon & Wilson drilled four soil borings, completed as monitoring wells, within the property boundaries of the 6-Mile Truck Shop. Two wells were installed upgradient of the building on the property to a depth of 30 feet, and a cluster of two wells was installed downgradient from the building to a depth of 30 feet and 80 feet. The locations of the wells were selected to help quantify the amount of contamination entering the property from any upgradient sources, and any amounts exiting the property downgradient that may suggest the possible presence of an additional contaminant source, if the downgradient concentrations were higher than the upgradient concentrations.

The borings were drilled using a truck-mounted Mobile B-61 drill rig equipped with continuous-flight, hollow-stem auger. Split-spoon samples were collected ahead of the auger following modified Standard Penetration Test procedures. The sampling interval was 2.5 feet for the first 20 feet, then 5-foot intervals to 30 feet, and 10-foot intervals after 30 feet. Eight soil samples and a field duplicate collected from the soil borings were submitted for analysis of

polychlorinated biphenyls (PCBs) and volatile organic compounds using Environmental Protection Agency (EPA) Methods 8080 and 8240, respectively.

Monitoring wells constructed from 2-inch I.D. PVC pipe were installed in each of the four borings after they were drilled. The two upgradient wells, MW-17 and MW-18, were screened from about 20 to 30 feet below ground surface. The downgradient shallow well (MW-20) was screened from about 21 to 31 feet, and the adjacent deep well (MW-19) was screened from about 69 to 79 feet. Groundwater samples were collected from the four monitoring wells on February 16, 1996. Prior to sampling, the wells were purged of a minimum of three well volumes of water. In addition to the monitoring wells, the water supply well located on the property was also sampled. The groundwater samples were analyzed for PCBs and volatile organic compounds by EPA Methods 608 and 502.2, respectively. The water supply well was only analyzed for volatile organic compounds.

The results of the laboratory analyses indicated that the groundwater samples contained concentrations of various volatile organic analytes (Table 1). The highest concentrations were reported in MW-17, an upgradient well. PCBs were not detected above the laboratory detection limit of 1 ppb in any of the analyzed groundwater samples.

The analytical results for the soil samples which were submitted did not indicate the presence of volatile organics above the laboratory detection limits in the tested samples from wells MW-17 and MW-18. Samples from well MW-19 contained total xylenes at concentrations slightly higher than the detection limit. In addition, the analytical testing indicated that none of the soil samples submitted contained PCBs above the laboratory detection limit of 0.04 parts per million (ppm).

3.2 Walsky Property

Prior exploration on the Walsky property had been limited to the installation of monitoring well cluster MW-4/MW-5 in November 1994. Well MW-4 is screened from about 70 to 80 feet, and MW-5 is screened from about 20 to 30 feet. Work performed in 1996 associated with the Walsky property consisted of the installation and sampling of groundwater from temporary

monitoring wells constructed of 2-inch I.D. PVC pipe. The wells were installed in borings drilled using a truck-mounted Mobile B-61 drill rig equipped with continuous-flight, hollow-stem auger. The scope of work in our proposal dated May 16, 1995, involved the installation of three permanent monitoring wells to a depth of 30 feet on this property. However, based on discussions with the ADEC project manager, this was changed to the installation and sampling of temporary monitoring wells, which were more cost-effective and would allow the collection of samples from a greater number of locations within the same budget. The following temporary wells were installed and sampled:

- Three wells, designated TMW-1 through TMW-3 and installed on August 12, in a generally north-south transect through the location of well cluster MW-4/MW-5, to provide further information on the lateral extent of the elevated concentrations of TCE and other compounds previously detected in the well cluster

- Three wells, designated TMW-4 through TMW-6, as close to the eastern (upgradient) side of the property that they could be installed without requiring the clearing of trees or brush; these wells were intended to provide information on the concentrations of dissolved compounds in groundwater entering the property from farther upgradient. These wells were installed on September 12, and sampled on September 13, 1996.

- Two wells, designated TMW-7 and TMW-8, were installed within the right-of-way of LuAnne Road, immediately west of the Walsky property, on September 18, 1996. The purpose of these wells was to provide information on concentrations of compounds in groundwater leaving the Walsky property and entering the downgradient 6-Mile Truck Shop property. Heavy brush on the western edge of the Walsky property prevented installing these wells within the limits of the Walsky property, so they were installed in the road instead.

Each of these temporary wells was screened from a depth of about 20 to 30 feet. Since the primary purpose of the borings was to collect groundwater samples, no split-spoon soil samples

were collected during drilling. However, during the drilling of well TMW-5 hydrocarbon odors were noted when the auger was advanced through the soils near the water table (which was present at a depth of about 6 feet), and the cuttings were noted to have an oily coating. Difficult drilling through what was interpreted as buried debris had been encountered from about 4 to 5 feet. Small pieces of sheet metal, and what appeared to be a piece of an oil filter, were brought to the surface with the drill cuttings. When headspace screening with a photoionization detector confirmed the presence of volatile compounds in the drill cuttings, a soil sample was collected from the cuttings for laboratory analysis. The results of testing of this soil sample are summarized below (laboratory reports are attached in Appendix A):

Gasoline Range Organics	< 5 ppm
Diesel Range Organics	959 ppm
Residual Range Organics	3800 ppm
Volatile Organic Compounds:	
Tetrachloroethene	1.9 ppm

Prior to sampling, the wells were purged of a minimum of three well volumes of water. Purge water was collected in drums and transported to Petroleum Sales for disposal. The groundwater samples were analyzed for volatile organic compounds by EPA Method 502.2/524.2. The results of this testing are presented in Table 1, and laboratory results are presented in Appendix A.

The locations of wells TMW-1 through TMW-6, and the elevations of TMW-4 through TMW-6, were measured by a survey crew from Design Alaska following installation. This data was used to provide the location of these wells as depicted in Figure 3. Additionally, the elevation data, combined with elevations determined at the same time for monitoring wells MW-4/MW-5, MW-17, and MW-18, were used in conjunction with measurements of depth to groundwater to estimate groundwater flow direction. Flow direction on September 13, 1996, based on measurements in TMW-4 through TMW-6 (i.e., at the eastern boundary of the Walsky property) was estimated to range from N43°W to N52°W. Flow direction on August 12 and 13, 1996, based on measurements in monitoring wells MW-4, MW-17, and MW-18 (i.e., at the western

boundary of the Walsky property) was estimated to range from N18°W to N28°W. This more northerly trend at this location agrees more closely with the N30°W flow direction cited earlier for the overall extent of the TCE plume, and is also supported by the hypothesis presented in Sections 4.1 and 4.2 that monitoring well cluster MW-19/MW-20 downgradient of 6-Mile Truck Shop may be located on the southwestern edge of the plume.

During our work on the Walsky property, an array of at least 31, 4-inch I.D., ABS plastic pipes was observed protruding about 3 feet from the ground, in an area about 60 by 100 feet located in the brush between temporary wells TMW-2 and TMW-3 and LuAnne Road. Sounding of the pipes revealed that they were filled with soil at a depth of 2½ to 3½ feet below ground surface (except for one pipe which was open to 6 feet below ground surface). Shannon & Wilson could not determine what the former purpose of these pipes had been.

3.3 McCall Property

In the Fall of 1995, the volume of the contents of the three known underground storage tanks (USTs) on the McCall property was measured in preparation for emptying these tanks. Two of these tanks are 500-gallon heating oil USTs, serving the double Quonset building southwest of the cluster of remaining buildings. The contents of these two tanks were tested for comparison with the EPA specification for used oil for energy recovery, and the product was found to be consistent with heating oil.

The third tank is a larger (probably 2,000 to 5,000-gallon) UST located at the northeast corner of the original military shop building (the northernmost building on the property), also presumably a heating oil tank. This latter tank was found to be about half full of water, with no significant amount of oil floating on the water; the elevation of the water in the tank was found to vary when the groundwater elevation varied. The bottom of the tank is buried at about 10½ feet below ground surface, while the water table in the vicinity tends to be on the order of 5 to 8 feet. It was concluded by Shannon & Wilson that there was probably a hole in this tank which presumably caused it to lose the remainder of its contents and fill with water.

On October 16, 1996, monitoring well MW-21 was installed about 150 feet downgradient of this tank, screened from about 18 to 28 feet, and sampled to determine if groundwater in the area was being impacted by a release of fuel from this tank. The 2-inch I.D. PVC well was installed in a boring drilled with continuous-flight, hollow-stem auger. A split-spoon soil sample was collected at the water table (7.5 to 9 feet depth). Since this sample had a headspace gas concentration (measured with a PID) of about 100 ppm, it was submitted to the laboratory for analysis of volatile compounds by EPA Method 8260. The results of testing of this sample are summarized below (laboratory reports are attached in Appendix A):

Benzene	0.11 ppm
Toluene	0.31 ppm
Xylenes	0.19 ppm
Tetrachloroethene	0.62 ppm

The day following installation, the well was purged and a sample of groundwater collected for analysis by EPA Method 524.2. Groundwater sample results are presented in Table 1, and the laboratory report is presented in Appendix A.

4.0 DISCUSSION OF DATA

4.1 Trichloroethylene

Figure 4 is a site plan of the study area for this current study of potential source areas for groundwater contamination, with the most recent laboratory result for TCE plotted at every location where groundwater has been sampled. These data span the period from August 1994 through October 1996, although a substantial portion of the data were collected in August and September 1996. Based on a groundwater flow direction to the northwest, the occurrence of TCE on these properties is discussed below, beginning with the farthest upgradient property and progressing in a downgradient direction.

The data in Figure 4 depict TCE being present in only two locations on the McCall property: 0.29 ppb in MW-2 northwest of the north gravel pit, and 2.3 ppb measured in probe P-14 near the former generator building from the antiaircraft facility, which was present on the site in the 1950s. For reference, the drinking water maximum contaminant level (MCL) for TCE is 5 ppb. The August 1996 sample was the first time that TCE was detected in well MW-2, and it should be noted that the current result is very close to the 0.20 ppb detection limit. TCE was reported in the water in the north pit at concentrations of 12 to 19 ppb in samples collected in October 1986, but was not detected in three subsequent sampling events.

During the summer of 1996, the U.S. Environmental Protection Agency (EPA) conducted a removal action at the McCall property, and focused on buried drums in the north pit and former north pit. Although no report is yet available summarizing that work, it is our understanding that the contents of the excavated drums did not suggest that they were a possible source of any significant TCE contamination. In our opinion, none of the available groundwater sampling results suggest that the north pit or the buried drums are a source of the area-wide groundwater contamination by TCE. Other than the recent occurrence of 0.29 ppb in MW-2, TCE has never been detected in any of the sampling points which lie in the general range of groundwater flow downgradient of the pit and the former buried drums: monitoring well MW-3, the deep on-site water supply well OSW-1, the shallow on-site water supply well OSW-2, or newly installed monitoring well MW-21.

Further evidence supporting the fact that the north pit and former buried drums are not a significant source of TCE is found in the absence of detectable TCE in the closest water supply wells downgradient of the pit on the north side of the Richardson Highway: residences on Davison Street and businesses at 1488 Richardson Highway and 1463 Wescott Lane. TCE is not detected on the north side of the highway until Environmental Systems, Inc. (ESI, at 1438 Richardson Highway), which is approximately ½-mile northwest of the McCall property.

The southern of the two Holder parcels contains the highest concentrations of TCE which have been reported in the area to date. Groundwater probes installed about 5 feet below the water table surface contained from 62 to 139 ppb TCE in a zone at least 50 feet wide, perpendicular to the direction of groundwater flow near the water supply well. However, since both the 40-foot-deep supply well and the adjacent 30- and 80-foot-deep monitoring wells contained much lower concentrations, it was originally assumed that the higher concentrations were limited to the very shallow groundwater, and the TCE rapidly dispersed to a lower concentration. The April 28, 1995, report concluded:

> "In our opinion, the most logical explanation for the trend in the data is the presence of a primary source area of TCE-contaminated soil at a shallow depth (possibly about 2 to 10 feet) and probably within a 50-foot radius or less to the east or southeast of the Holder well. The shallow source depth would explain the significantly higher TCE concentration in groundwater probe P-2 at a depth of 10 feet, and the nearly equal TCE concentrations in the monitoring well screened at 20 to 30 feet and the Holder well at 40 feet. If the source was very close to monitoring well cluster MW-8/MW-9 and in the shallow soil, it would explain why TCE was not detected in the 80-foot deep monitoring well at that location."

Although not stated in this conclusion, it was Shannon & Wilson's opinion at the time that the 62 and 92 ppb in probes P-1 and P-6, respectively, represented a TCE concentration just below the water table, but not necessarily a concentration which would, for instance, be leaving the Holder property in the groundwater at a depth of say 20 to 30 feet (i.e., the depth at which the majority of the "shallow" monitoring wells for this project are screened).

In our opinion, based on the additional data now available, that original hypothesis may not have been entirely correct. While it may still be true that the source is very shallow, the concentrations of TCE reported in temporary wells TMW-5 and TMW-6 on the east side of the Walsky property (20.5 and 33.3 ppb, respectively) suggest that concentrations on the order of 50 ppb may be present in the "shallow" groundwater leaving the Holder property.

However, the available data do not change our original conclusion that there may be a second source of TCE on the Holder property or in the vicinity of the Holder/McCall property line:

> "In our opinion, the data from groundwater probes P-19 (36 ppb TCE) and P-21 (17 ppb TCE) suggest the presence of a smaller, secondary shallow source in the vicinity of the former generator building on the Holder/McCall property line. The presence of only 1.2 ppb TCE in monitoring well MW-10 at this location again supports the hypothesis of a shallow, nearby source."

Shannon & Wilson's April 1995 report did not address the implications of the apparent width of the plume of TCE-contaminated groundwater at the inferred primary source area on the Holder property (i.e., near the Holder well). Probes P-1 and P-6 (62 and 92 ppb) are separated by more than 50 feet in a direction perpendicular to groundwater flow, and yet are only about 25 feet downgradient from probe P-2 with the highest TCE concentration (139 ppb). If the source were a point source, such a wide lateral spread of the plume of groundwater contamination would not be expected so close to the source. In Shannon & Wilson's opinion, this may suggest the presence of a broader area in which TCE was spilled or disposed. It has also been documented by others (Pankow and Cherry, 1996) that vapor transport through the vadose zone (the unsaturated soils above the water table) can result in the creation or spread of a plume of contaminated groundwater, and it is possible that this mechanism has resulted in a wider plume of contaminated groundwater than would be expected so close to the source area. Testing of this hypothesis would require the comparison of TCE concentrations in the groundwater immediately below the water table surface with concentrations at greater depths in the same location.

TCE concentrations measured in the six temporary wells and the shallow permanent well (MW-5) on the Walsky property during August and September 1996 ranged from 20.5 to 33.3 ppb. These findings did not exhibit any clear pattern of concentrations decreasing in a downgradient direction, as would be generally expected if all of these occurrences were the result of a source upgradient of the Walsky property, and: (1) the plume is the result of a release that is old enough that the plume is no longer expanding, and (2) the concentration of TCE in the plume is not subject to seasonal variation.

It is probably a correct assumption that the plume is no longer expanding, since the presence of TCE in the groundwater in the area has been known at least since 1987. The plume extends about 1 mile into the 6-Mile Village Subdivision. With a groundwater flow velocity on the order of 1 to 2 feet per day, this would imply the age of release (if a single release is responsible) of about 7 to 14 years (i.e., probably long enough ago that the plume is no longer expanding).

However, with respect to the second assumption, insufficient long-term monitoring data have been collected to date to know whether seasonal fluctuations in concentration may be occurring. In considering the potential impact of seasonal fluctuation, one should bear in mind that if seasonal fluctuation of the water table results in changes of the concentration of TCE in the groundwater at the source area, and if the wells being compared are at different distances downgradient from the source area, then (given a more or less constant flow velocity) the result of a seasonal high or low concentration at the source area would not manifest itself at the same time in wells which are different distances downgradient of the source. For example, if the highest concentrations at the source area occurred each summer, then during the summer a well which was 1 year's travel time downgradient from the source might also exhibit its highest seasonal concentration, while a well which was ½ or 1½ year's travel time downgradient might simultaneously exhibit its lowest seasonal concentration.

Another possible explanation for the concentrations of TCE observed on the Walsky property may be variations in the precision of the sample collection and analytical process. The average TCE concentration in TMW-1 through TMW-6 and MW-5 is 27.2 ppb. The concentrations in

the individual wells span a range of ±25 percent from this average value. The comparison of the laboratory results from a duplicate pair of samples provides a measure of the precision of the sample collection, handling, and analysis procedures. Although no duplicate samples were collected from the temporary monitoring wells, they were collected for quality control purposes from four of the monitoring wells (including MW-5) during the August 1996 sampling episode.

Precision is assessed by calculating the relative percent difference (RPD) between a sample and its duplicate. RPD is calculated as the difference between the sample and its duplicate, divided by the average of the two results, expressed as a percentage. Shannon & Wilson's data quality objective (DQO) for precision, stated in our July 28, 1994, Project Work Plans for this project, is ±50 percent for the analysis of volatile organic compounds in water by the test method which was used. RPDs for TCE for the August 1996 duplicate samples ranged from 0 (i.e., both the sample and duplicate were reported to contain the same concentration, which was the case in well MW-5) to 19 percent. Thus, the precision achieved during the August 1996 sampling episode met the DQO for this project.

The fact that the ±25 percent spread in TCE concentrations on the Walsky property also falls within the DQO for precision, and is not much greater than the worst RPD for the 1996 duplicate samples, could be used as a possible explanation for the range of TCE values seen on the Walsky property. However the fact remains that, in the 600-foot distance between the farthest upgradient and downgradient wells on the property, it would have been expected to see a more orderly decrease in TCE concentration in a downgradient direction (particularly since a decreasing progression of TCE concentrations is seen farther downgradient in the plume).

When the TCE concentrations measured in the wells in LuAnne Road and on the upgradient side of the 6-Mile Truck Shop property are compared with the concentrations on the Walsky property, it becomes more difficult to support a hypothesis of a single source upgradient of the Walsky property. The 29.6 ppb found in well MW-18 at 6-Mile Truck Shop is very close to the average 27.2 ppb found on the Walsky property. However, the 45.2 to 55.6 ppb found in TMW-7 and TMW-8 (LuAnne Road) and MW-17 (6-Mile Truck Shop), which are 66 to 104 percent higher than the average concentration on the Walsky property, in Shannon & Wilson's

opinion suggests that there is another source in or upgradient of LuAnne Road contributing TCE to the groundwater (unless some extremely complicated groundwater flow path is responsible for the distribution of the observed TCE concentrations, or upgradient vapor transport of TCE is occurring into LuAnne Road from the area between the road and monitoring wells MW-17 and MW-18).

The decreasing TCE concentrations farther downgradient on the 6-Mile Truck Shop property do not seem to suggest any additional source areas on that property. When the result from the shallow well of the downgradient cluster (4.17 ppb in well MW-20) is compared with results farther downgradient in the plume on the north side of the Richardson Highway, it appears that the well cluster may be situated on the southwestern edge of the plume, resulting in a lower concentration of TCE than might be expected to be present to the northeast of that location.

A similar situation may be present at the monitoring well cluster on the northern Holder parcel (MW-6/MW-7) and the two residential water supply wells on Eskimo Museum Lane. While the relatively low concentrations in these wells were previously concluded to represent a decreasing concentration in the plume, our interpretation of the data which is currently available is that these wells may be situated along the northeastern edge of the plume.

The discussions above have summarized only the TCE concentrations observed in the shallow wells within the study area. There are currently only seven deep wells within the area; no TCE was detected in four of them. No TCE was detected in the deep monitoring well near the water supply well on the Holder property (i.e., near the source area). Sampling revealed 4.58 ppb TCE in deep monitoring well MW-4 on the Walsky property, and 12.7 ppb TCE in deep monitoring well MW-19 on the 6-Mile Truck Shop property. In Shannon & Wilson's opinion, the concentration in well MW-4 could represent the TCE from a primary source area on the Holder property dispersing to the deeper groundwater as it flows downgradient. However, the increase in concentration from 4.58 to 12.7 ppb between well MW-4 and well MW-19 suggests the possible presence of an additional source contributing to the groundwater contamination between those two locations.

4.2 1,1,1-Trichloroethane

1,1,1-trichloroethane (TCA) is another chlorinated solvent like TCE, but it is a distinctly different product and not related to TCE as a breakdown product. The MCL for TCA, 200 ppb, is higher than the 5 ppb MCL for TCE. In Shannon & Wilson's April 1995 report it was the occurrence of TCA in wells on the Walsky and 6-Mile Truck Shop properties that led to our conclusion that there may be other potential sources of groundwater contamination in the area. Similar to the discussion of TCE in the previous section of this report, the occurrence of TCA in the study area is discussed below, beginning with the farthest upgradient property and progressing in a downgradient direction.

The data in Figure 5 depict TCA being present in only two locations on the McCall property: 0.86 ppb in MW-2 northwest of the north gravel pit, and 12 ppb in newly installed well MW-21 near the northwest corner of the property. TCA was historically present in well MW-2 at higher concentrations (up to 5.5 ppb in December 1994). TCA was reported in the water in the north pit at concentrations as high as 94 ppb in October 1986. Concentrations of TCA in the north pit were much lower after 1986:

October 2, 1986	37 to 67 ppb
October 9, 1986	94 ppb
September 22, 1989	0.8 to 3.6 ppb
September 16, 1994	5.2 ppb

TCA has never been reported at any of the other groundwater sampling locations on the McCall property, most specifically the two on-site water supplies wells (OSW-1 and OSW-2) which lie between MW-2 and MW-21. Therefore, in Shannon & Wilson's opinion, the north pit (which was backfilled by the EPA following the completion of their drum removal project in the summer of 1996) does not appear to be the source of the TCA reported in MW-21, nor does it appear to represent a major source of groundwater contamination by this compound. The location of well MW-21 downgradient of the original military shop building suggests that activities in or around this building may be responsible for the TCA in well MW-21. The absence of detectable TCA in the closest water supply wells downgradient of well MW-21 on

the north side of the Richardson Highway (residences on Davison Street and businesses at 1488 Richardson Highway and 1463 Wescott Lane) suggests that the occurrence of 12 ppb TCA in well MW-21 does not represent a major plume of TCA-contaminated groundwater leaving the McCall property. TCA is not detected on the north side of the highway until ESI (at 1438 Richardson Highway, approximately ½-mile northwest of the McCall property).

On the southern Holder parcel, the only samples in which TCA has been reported are the 1995 sample from the water supply well and its duplicate. The reported concentration, 0.86 ppb (0.95 ppb in the duplicate), is less than twice the 0.5 ppb detection limit for this compound.

TCA concentrations measured in the six temporary wells and the shallow permanent well (MW-5) on the Walsky property during August and September 1996 ranged from nondetect to 177 ppb. The highest concentration was found in the farthest upgradient sampling point, temporary well TMW-6. Projecting the N38°W to N52°W range of groundwater flow measured in this portion of the study area in an upgradient direction from temporary well TMW-6 to the Holder/Walsky property line, illustrates that most of the groundwater leaving the Holder property and flowing toward well TMW-6 would be sampled by groundwater probes P-1 through P-5. No TCA was detected in these probes or in any other samples in the vicinity, with the exception of 0.86 ppb in the most recent sample from the Holder water supply well.

In Shannon & Wilson's opinion, since TCA concentrations on the Walsky property downgradient of well TMW-6 are at lower concentrations, and no significant concentration of TCA has been reported upgradient of this point on the Holder property, there is likely a source area for TCA near or upgradient of temporary well TMW-6. Additional sampling along the Holder/Walsky property line to the north of probe P-1 and to the south of probe P-5 would be required to conclusively rule out the TCA source being on the Holder property; no historical sampling points are located in the northwestern corner of the Holder property or the northeastern corner of the Walsky property.

The two temporary wells in LuAnne Road and the two upgradient wells and the water supply well on the 6-Mile Truck Shop property all contain higher concentrations of TCA (11.4 to 58.2

ppb, averaging 30.8 ppb) than do the wells on the western portion of the Walsky property (non-detect to 11.4 ppb, averaging 3.7 ppb). This is similar to the situation discussed above for TCE and again, in Shannon & Wilson's opinion, suggests that there is another source in or upgradient of LuAnne Road contributing TCA to the groundwater (unless some extremely complicated groundwater flow path is responsible for the distribution of observed TCE concentrations).

The decreasing TCE concentrations farther downgradient on the 6-Mile Truck Shop property do not seem to suggest any additional source areas on that property. When the TCA result from the shallow well of the downgradient cluster (2.47 ppb in well MW-20) is compared with results farther downgradient in the plume on the north side of the Richardson Highway, it again appears that the well cluster may be situated on the southwestern edge of the plume, resulting in a lower concentration of TCA than might be expected to be present to the northeast of that location.

No TCA was detected in the monitoring well cluster on the northern Holder parcel (MW-6/MW-7), or the two residential water supply wells on Eskimo Museum Lane. Subject to the same previous discussion regarding the limited number of wells in this area, in Shannon & Wilson's opinion, these data are consistent with a TCA source area located in the general vicinity of temporary well TMW-6, rather than farther upgradient (such as on the Holder property). If the TCA source was on the Holder property, one would expect to find TCA in MW-6/MW-7 and the Eskimo Museum Lane wells, just as TCE is found in these wells.

The discussions above have summarized only the TCA concentrations observed in the shallow wells within the study area. Only one of the seven deep wells within the area contained TCA, MW-19 on the 6-Mile Truck Shop property (with 4.62 ppb).

4.3 Breakdown Products

Chlorinated solvents such as TCE and TCA are known to break down to other chlorinated compounds. TCE breaks down to both 1,2-dichloroethylene (which has both cis- and trans-isomers) and 1,1-dichloroethylene. These two compounds both, in turn, transform to vinyl chloride.

TCA can break down to 1,1-dichloroethane, which in turn breaks down to chloroethane. However, TCA can also break down to 1,1-dichloroethylene and then to vinyl chloride.

While the intermediate breakdown products of TCE and TCA were found in many of the samples where the parent compounds were present, neither of the ultimate breakdown products (vinyl chloride or chloroethane) were present in the most recent groundwater samples at any of the sampling points within the study area. Vinyl chloride has never been found historically in these wells. Chloroethane has been found only once, at a concentration of 14 ppb in the September 1989 sample from well MW-2, northwest of the north pit on the McCall property. No MCL has been established for chloroethane; the measured 14 ppb is well below the 8,600 ppb 10^{-6} risk-based concentration (RBC) developed by the EPA for a drinking water exposure scenario.

4.4 Fuel-Related Compounds

A number of the chemical compounds detected in groundwater samples collected throughout the study area are constituents of fuel (including both gasoline and diesel/heating oil) or fuel additives, in addition to their potential uses as solvents or degreasers. Included in this category are benzene, toluene, ethylbenzene, and xylene (BTEX) compounds; 1,2-dichloroethane (1,2-DCA); chloromethane; naphthalene; 1,2,4- and 1,3,5-trimethylbenzene; n-propylbenzene and isopropylbenzene; 4-isopropyltoluene; and n- and sec-butylbenzene. Of these compounds, benzene had the greatest number of occurrences in groundwater; the 15 occurrences ranged in concentration from 0.25 to 3.3 ppb. Benzene concentrations in groundwater are plotted in Figure 1, along with a designation for sampling points in which other fuel-related compounds were detected in the water or soil. The distribution of benzene in groundwater throughout the study area does not suggest the presence of a single source and resulting plume. Rather, the presence of benzene and that of the other fuel-related compounds appears to be in several isolated, unrelated locations. None of these occurrences exceeded the MCL for compounds for which one has been established, or the 10^{-6} RBC for compounds lacking an MCL. For reference, MCLs and RBCs are listed in the heading of Table 1 for each compound where they are available.

Low levels of fuel-related compounds have been detected at several locations on the McCall property, including probe P-14, located near the former generator building, where contaminated soil was found at the water table containing the following compounds:

Xylenes	1.09 ppm
TCE	0.331 ppm

The groundwater sample which was collected from about 5 feet below the contaminated soil contained TCE, diesel range organics, xylene, and three other fuel-related compounds listed in Table 1. No BTEX or other fuel-related compounds have been detected in monitoring wells MW-8, MW-9, or MW-10 downgradient of this site, or in the water supply well on the Holder property.

BTEX and other fuel-related compounds were also found in the water sample from well MW-21 near the northwest corner of the McCall property, and were also present in the soil sample collected at the water table. The location of this well was selected because it was downgradient of the inferred leaking UST at the northeast corner of the original military shop building. None of the BTEX concentrations in well MW-21 exceed the drinking water MCLs, and no BTEX compounds have been detected in the nearest adjacent water supply wells on the north side of the Richardson Highway.

The concentration of benzene in the soil at the water table at well MW-21 slightly exceeds the most stringent matrix cleanup level for the compound. The presence of other fuel-related compounds such as naphthalene in this soil suggests that the source is diesel fuel rather than gasoline. This well is about 150 feet away from the UST at the shop. In Shannon & Wilson's experience, fuel products do not spread on top of the water table that far from the source area (at a gradient as flat as what is present in the Fairbanks area) unless a very large quantity is spilled. However, if that large a quantity had been spilled, we would expect the concentration of BTEX compounds in the water sample from well MW-21 to have been much higher. Therefore it is possible that there may be a separate source area of spilled fuel closer to the location of well MW-21. The 0.62 ppm of tetrachloroethene (PCE) also reported in the soil

sample from this well (but not present in the water sample) appears to indicate spillage or disposal of this solvent as well.

Temporary monitoring well TMW-4 on the Walsky property contained the widest range of fuel-related compounds found within the study area. The soil at the water table in well TMW-5 contained 959 ppm DRO and 3800 ppm RRO, but no detected BTEX compounds. The water from this well contained no detected fuel-related compounds, but this is not unexpected since the sample was collected from about 13 to 23 feet below the depth of this contaminated soil. Temporary well TMW-6 contained the highest concentration of benzene within the study area, 3.3 ppb. The wells farther downgradient on the Walsky property, in LuAnne Road, and on the 6-Mile Truck Shop property all contained lesser concentrations of benzene.

The deep water supply well at 1540 Eskimo Museum Lane (Pailing residence) had not historically contained BTEX compounds, but the November 1995 sample contained 0.68 ppb benzene and 1.5 ppb toluene. Neither the deep or shallow monitoring wells upgradient of this well (MW-6/MW-7) have ever contained any BTEX compounds. A low level (0.1 ppm) of xylenes was reported in a soil sample from near the water table in well MW-7.

Similar low levels of xylenes were reported in soil samples from well MW-10 on the southern Holder parcel and well MW-19 at 6-Mile Truck Shop (0.18 and 0.07 ppm, respectively).

The possible existence of multiple sources of hydrocarbon contamination within the study area makes it difficult to conclusively interpret the available data with respect to the location of potential source areas. Our interpretation of the currently available data is presented below:

- The multiple occurrences of low levels of fuel constituents at various locations on the McCall property may be related to one source or more than one source. Significant concentrations do not appear to be leaving the property downgradient.

- The apparently fuel-contaminated soil at the location of probe P-14 (the former generator building on the Holder/McCall property line) does not seem to be measurably impacting the groundwater downgradient and off site.

- Hydrocarbon-contaminated soil is known to be present at the location of temporary well TMW-5 on the Walsky property.

- Since temporary well TMW-4 appears to be downgradient from TMW-5, the fuel constituents in the groundwater at TMW-4 may be originating from contaminated soil in the area of TMW-5, or from some other source at an as-yet unknown location.

- The 3.3 ppb benzene in temporary well TMW-6 (and ethylbenzene and xylenes) appear to be originating from another, as-yet unidentified, location.

- In Shannon & Wilson's opinion, there is insufficient data at the current time to conclude whether the occurrences of benzene (and occasionally other BTEX compounds) on the west side of the Walsky property and farther downgradient represent the impact of sources or potential sources discussed above, or whether there may be other sources involved. However, the concentrations of these compounds do not exceed the drinking water MCLs in any of the wells.

5.0 CONCLUSIONS

Shannon & Wilson's conclusions regarding possible source areas of groundwater contamination by chlorinated solvents and other compounds within the study area on the south side of the Richardson Highway are summarized below. Since these are based on the collection of additional data, they supersede the conclusions presented in our previous reports.

- There appear to be multiple sources of TCE, TCA, and petroleum compounds in the study area.

- The former north pit and buried drums on the McCall property are not considered to be a significant source of groundwater contamination.

- There appears to be a shallow primary source area of TCE-contaminated soil to the east or southeast of the Holder well. Additional sampling will be required along the western Holder property line, to determine if TCE-contaminated groundwater from this source is leaving the Holder property at a high enough concentration to be responsible for the TCE contamination observed in the groundwater on the eastern part of the Walsky property.

- There appears to be a secondary TCE source area to the southeast of the Holder well, in the vicinity of the former generator building near the Holder/McCall property line.

- The increase in TCE concentrations in the wells in LuAnne Road when compared to the nearest wells to the east on the Walsky property suggests that there may be a separate, contributing source of TCE under or immediately upgradient of LuAnne Road. This conclusion could be contradicted if some extremely complicated groundwater flow path is responsible for the distribution of observed TCE concentrations, or if TCE is being transported upgradient in a vapor phase

or other means from a source between LuAnne Road and monitoring wells MW-17 and MW-18.

- The data which have been collected to date provide no direct evidence of the presence of a separate source of TCE or TCA on the 6-Mile Truck Shop property. However, the area between LuAnne Road and monitoring wells MW-17 and MW-18 has not been explored, and wells MW-19 and MW-20 may not be in a truly downgradient direction from the northern part of the property, depending on local variations in groundwater flow direction.

- There appears to be a source area for TCA near or upgradient of temporary well TMW-6, which is located on the Walsky property.

- The data suggest that there may be a secondary source of TCA under or immediately upgradient of LuAnne Road (again, depending on the groundwater flow path, or possibly the result of upgradient vapor phase transport).

- There appears to be a source of apparent diesel-contaminated soil near the former generator building at the Holder/McCall property line, which does not appear to be having a significant effect on downgradient groundwater.

- There appears to be a source of apparent diesel-contaminated soil northwest of the original military shop building on the McCall property (possibly related to the UST at that building), which does not appear to be having a significant effect on downgradient groundwater. The source of TCA in the groundwater and PCE in the soil at the northwest corner of the McCall property is not known.

- Hydrocarbon-contaminated soil is known to be present at the location of temporary well TMW-5 on the Walsky property.

- Since temporary well TMW-4 appears to be downgradient from temporary well TMW-5, the fuel constituents in the groundwater at temporary well TMW-4 may be originating from contaminated soil near temporary well TMW-5, or from some other source at an as-yet unknown location.

- The 3.3 ppb benzene in temporary well TMW-6 (and ethylbenzene and xylenes) appears to be originating from another upgradient as-yet unidentified location.

- There are insufficient data at the current time to conclude whether the occurrences of benzene (and occasionally other BTEX compounds) on the west side of the Walsky property and farther downgradient represent the impact of sources or potential sources discussed above, or whether there may be other sources involved. However, the concentrations of these compounds do not exceed the drinking water MCLs in any of the wells.

6.0 RECOMMENDATIONS

Shannon & Wilson's recommendations regarding possible source areas of groundwater contamination by chlorinated solvents and other compounds within the study area on the south side of the Richardson Highway are summarized below. Since these are based on the collection of additional data, they supersede the recommendations presented in our previous reports. These recommendations are based on the assumption that ADEC will continue to perform long-term monitoring of the groundwater in the 6-Mile area. Therefore they address only the locating and characterizing of the source areas which have been identified or hypothesized in this report.

- In order to determine whether the hypothesized source area east or southeast of the water supply well on the Holder property is the source for the TCE-contaminated groundwater observed on the eastern portion of the Walsky property, it will be necessary to install a series of three or four monitoring wells (or otherwise obtain groundwater samples) to a depth of 20 to 30 feet along the Holder/Walsky property line. One or more additional wells screened just below the water table surface in this same area would help determine whether vapor phase transport in the vadose zone is a contributing factor to contaminant migration.

- If the results of the work recommended above, when considered in combination with the recommendations regarding potential source areas on the Walsky property, indicate that a significant source of the plume of TCE-contaminated groundwater is on the Holder property, it may be worthwhile to make further attempts to locate the soils which are the source of the TCE contamination. This is a reversal of the opinion stated in Shannon & Wilson's April 1995 report that no further effort be expended to locate these source soils.

- Additional exploration should be performed along LuAnne Road, the western edge of the Walsky property, and the area between the road and monitoring wells MW-17 and MW-18 on the 6-Mile Truck Shop property, to attempt to determine

the reason for increases in the concentration of TCE and TCA groundwater contamination in that area.

- Installation of one or two monitoring wells at additional locations along the north side of the 6-Mile Truck Shop property would help assess conditions on the downgradient boundary of that property through a wider range of possible groundwater flow directions.

- An attempt should be made to locate the source area for the elevated levels of TCA in groundwater found in temporary well TMW-6 on the Walsky property. This work should also attempt to locate the source of BTEX groundwater contamination found in that well.

- The extent of the hydrocarbon-contaminated soil found in well TMW-5 should be investigated, as well as its impact on the groundwater in the near vicinity.

- If the contaminated soil found in temporary well TMW-5 is concluded not to be the source of the groundwater contamination by fuel constituents in temporary well TMW-4, then a search should be made for the source of the contaminated groundwater in temporary well TMW-4.

- A regulatory decision should be made whether the levels of soil and groundwater contamination reported in well MW-21 at the northwest corner of the McCall property justify further exploration to attempt to locate the source area.

7.0 LIMITATIONS

This report was prepared for the exclusive use of the Alaska Department of Environmental Conservation (ADEC) and their representatives for the study of potential sources of groundwater contamination in the vicinity of 6-Mile Richardson Highway in Fairbanks, Alaska. This work presents Shannon & Wilson's professional opinion based on a scope of field explorations agreed to with the ADEC project manager.

The information included in this report is representative of the time and locations at which the sampling occurred. It was not the intent of our investigation to detect the presence of soil or water affected by contaminants other than those for which laboratory analyses were performed. No conclusions can be drawn on the presence or absence of other contaminants.

The conclusions and recommendations we have presented are based on the sampling and analyses that we performed. They should not be construed as definite conclusions about the soil and groundwater quality at the site. It is possible that our tests may not represent the highest levels of contamination on the site. As a result, the analysis and sampling performed can only provide the reader with our judgment as to the environmental characteristics of the site, and in no way guarantees that an agency or its staff will reach the same conclusions.

The observed levels of contamination may be dependent upon seasonal fluctuations of the groundwater table and/or the general passage of time. Changes in the condition of the property can also occur due to activities on these or adjacent properties. The data presented in this report should be considered representative only of the time the data was collected. In addition, changes in government codes, regulations, or laws may occur. Because of such changes beyond our control, our observations and interpretations may need to be revised. If substantial time has elapsed between submission of this report and the start of activities or action based upon it, we recommend that this report be reviewed to determine the applicability of the conclusions and recommendations considering the time lapsed or changed conditions.

This report was prepared for the exclusive use of the State of Alaska Department of Environmental Conservation and their representatives in the study of potential contamination in accordance with the scope of work. If it is made available to others, it should be for information on factual data only and not as a warranty of described conditions, such as those interpreted from the field explorations and presented in discussions of subsurface conditions included in this report.

Sincerely,

SHANNON & WILSON, INC.

John E. Cronin
Vice President
Environmental Services/Hydrogeology

8.0 REFERENCES

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TABLE 1
SUMMARY OF VOLATILE ORGANIC COMPOUNDS* IN GROUNDWATER
(all concentrations in ug/L or ppb)

Well Number	Well Screen Depth	Sample Date	Sample Number	Trichloroethylene	cis-1,2-Dichloroethylene	trans-1,2-Dichloroethylene	1,1,1-Trichloroethane	Chloroethane	1,1-Dichloroethane	Tetrachloroethylene	1,2-Dichloroethane	1,1-Dichloroethylene	Bromomethane	Chloromethane	Naphthalene	1,2,4-Trimethylbenzene	1,3,5-Trimethylbenzene	n-Propylbenzene	Isopropylbenzene	4-Isopropyltoluene	Methylene Chloride (Dichloromethane)	Benzene	Toluene	Ethylbenzene	Xylenes	n-Butylbenzene	sec-Butylbenzene	Fluorotrichloromethane
			MCL	5	70	100	200	8,600**	810**	5	5	7	8.7**	1.4**	1,500**	300**	300**	-	-	-	5	5	1,000	700	10,000	-	61	1,300**
MONITORING WELLS																												
MW-1	17'-27'	9/7/89	220-907-B101	<0.2	-	<1.0	<0.4	<2.0	<0.2	<0.2	<0.2	<1.0	<2.0	<2.0	-	-	-	-	-	-	<2.0	<0.2	<0.2	<0.2	<0.6	-	-	<2.0
		12/19/94	667-1219-101	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50	<0.50	<0.50	<1.0	<0.50	<0.50	<0.50
		10/12/95	72912-1012-114	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	**0.47 J**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0	**0.30 J**	<0.50	<0.50
		8/14/96	72981496-MW1	<0.20	<0.20	<0.20	<0.20	<1.00	<0.20	<0.50	<0.50	<0.50	<0.50	<0.50	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.50	<0.20	<0.30	<0.20	<0.40	<0.20	<0.20	<0.20
MW-2	18'-28'	9/8/89	220-908-B21	<0.2	-	<1.0	**1.0**	**14**	**0.5**	<0.2	**0.5**	<1.0	<2.0	<2.0	-	-	-	-	-	-	<2.0	**0.6**	**12**	**1.1**	**4.9**	-	-	<2.0
		12/19/94	667-1219-201	<0.50	<0.50	<0.50	**5.5**	<0.50	**0.63**	<0.50	<0.50	<0.50	<1.0	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50	<0.50	<0.50	<1.0	<0.50	<0.50	<0.50
		10/12/95	72912-1012-113	<0.50	<0.50	<0.50	**2.2**	<0.50	**0.36 J**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50	<0.50	<0.50
		8/14/96	72981496-MW2	**0.29**	**0.52**	<0.20	**0.86**	<1.00	**0.89**	**0.65**	<0.20	<0.20	<1.0	<0.50	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.50	**0.46**	<0.30	<0.20	<0.40	<0.20	<0.20	<0.20
MW-3	18'-28'	9/8/89	220-908-B31	<0.2	-	<1.0	<0.4	<2.0	<0.2	<0.2	<0.2	<1.0	<2.0	<2.0	-	-	-	-	-	-	<2.0	**0.9**	**1.8**	**0.2**	**1.2**	-	-	<2.0
		12/19/94	667-1219-301	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50	<0.50	<0.50	<1.0	<0.50	<0.50	<0.50
		10/12/95	72912-1012-115	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	**0.42 J**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50	<0.50	<0.50
		Well casing blocked in 8/96																										
MW-4	70'-80'	12/20/94	667-1220-401	**3.7**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50	<0.50	<0.50
		Did not receive access for 1995 sampling																										
		8/12/96	729-81296-MW4	**4.58**	**0.33**	<0.20	<0.20	<1.00	<0.20	<0.20	<0.20	<0.20	<1.00	<0.50	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.50	<0.20	<0.30	<0.20	<0.40	<0.20	<0.20	<0.20
MW-5	20'-30'	12/20/94	667-1220-501	**34 D**	**1.8**	<0.50	**3.60**	<0.50	**0.83**	<0.50	<0.50	<0.50	<1.0	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0	**0.71**	<0.50	<0.50	<1.0	<0.50	<0.50	<0.50
		Did not receive access for 1995 sampling																										
		8/12/96	729-81296-MW5	**27.2**	**2.31**	**0.57**	**2.25**	<1.00	**0.73**	<0.20	<0.20	**0.22**	<1.00	<0.50	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.50	**0.66**	<0.30	<0.20	<0.40	<0.20	<0.20	<0.20
		8/12/96 duplicate	729-81296-MWA	**27.2**	**2.43**	**0.58**	**2.39**	<1.00	**0.78**	<0.20	<0.20	**0.22**	<1.00	<0.50	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.50	**0.69**	<0.30	<0.20	<0.40	<0.20	<0.20	<0.20
MW-6	20'-30'	11/22/94	667-1122-601	**2.2**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	**0.52**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50	<0.50	<0.50
		10/13/95	72903-1013-MW6	**2.8**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	**0.47 J**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50	<0.50	<0.50
		8/17/96	729-81796-MW6	**2.83**	<0.20	<0.20	<0.20	<1.00	<0.20	<0.20	<0.20	<0.20	<1.00	<0.50	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.50	<0.20	<0.30	<0.20	<0.40	<0.20	<0.20	<0.20
MW-7	70'-80'	11/22/94	667-1122-701	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50	<0.50	<0.50
		10/13/95	72903-1013-MW7	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50	<0.50	<0.50
		8/17/96	729-81796-MW7	<0.20	<0.20	<0.20	<0.20	<1.00	<0.20	<0.20	<0.20	<0.20	<1.00	<0.50	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.50	**0.30 J**	<0.50	<0.50	<1.0	<0.50	<0.50	<0.50
MW-8	70'-80'	12/20/94	667-1220-801	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50	<0.50	<0.50	<1.0	<0.50	<0.50	<0.50
		10/13/95	72903-1013-MW8	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50	<0.50	<0.50
		8/17/96	729-81796-MW8	<0.20	<0.20	<0.20	<0.20	<1.00	<0.20	<0.20	<0.20	<0.20	<1.00	<0.50	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.50	<0.20	<0.30	<0.20	<0.40	<0.20	<0.20	<0.20
MW-9	20'-30'	12/20/94	667-1220-901	**7.4**	**0.58**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50	<0.50	<0.50	<1.0	<0.50	<0.50	<0.50
		12/20/94 duplicate	667-1220-902	**7.2**	**0.59**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0	**1.8**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50	<0.50	<0.50	<1.0	<0.50	<0.50	<0.50
		10/13/95	72903-1013-MW9	**7.7**	**0.80**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50	<0.50	<0.50
		10/13/95 duplicate	72903-1013-MW11	**7.3**	**0.76**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50	<0.50	<0.50
		8/17/96	729-81796-MW9	**5.62**	**0.65**	<0.20	<0.20	<1.00	<0.20	<0.20	<0.20	<0.20	<1.00	<0.50	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.50	<0.20	<0.30	<0.20	<0.40	<0.20	<0.20	<0.20
MW-10	20'-30'	11/28/94	667-1128-1001	**1.2**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50	<0.50	<0.50
		10/13/95	72903-1013-MW10	**1.6**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50	<0.50	<0.50
		8/17/96	729-81796-MW10	**1.18**	**0.29**	<0.20	<0.20	<1.00	<0.20	<0.20	<0.20	<0.20	<1.00	<0.50	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.50	<0.20	<0.30	<0.20	<0.40	<0.20	<0.20	<0.20
		8/17/96 duplicate	729-81796-MWC	**1.26**	**0.32**	<0.20	<0.20	<1.00	<0.20	<0.20	<0.20	<0.20	<1.00	<0.50	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.50	<0.20	<0.30	<0.20	<0.40	<0.20	<0.20	<0.20

TABLE 1
SUMMARY OF VOLATILE ORGANIC COMPOUNDS* IN GROUNDWATER
(all concentrations in ug/L or ppb)

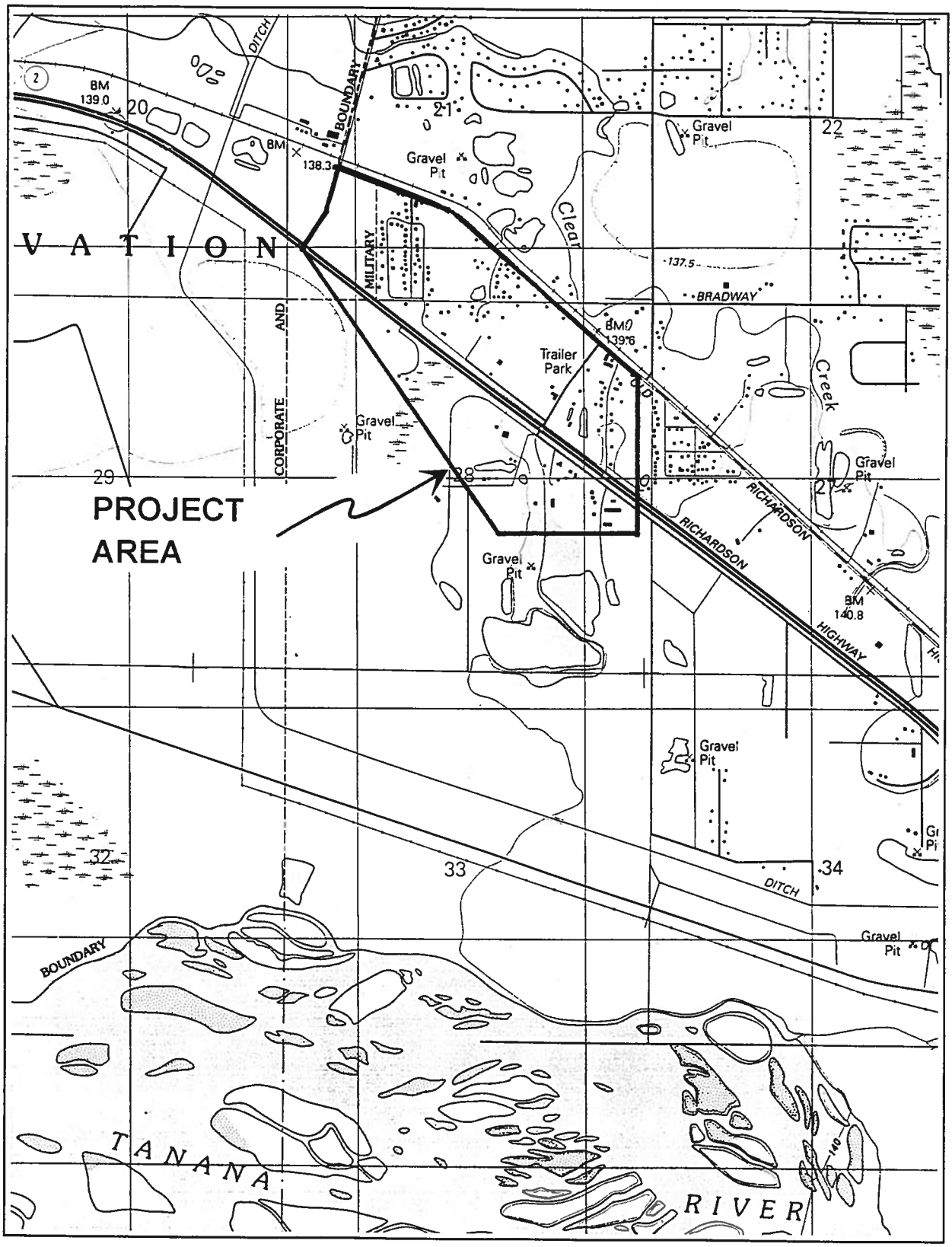
Well Number	Well Screen Depth	Sample Date	Sample Number	Trichloroethylene	cis-1,2-Dichloroethylene	trans-1,2-Dichloroethylene	1,1,1-Trichloroethane	Chloroethane	1,1-Dichloroethane	Tetrachloroethylene	1,2-Dichloroethane	1,1-Dichloroethylene	Bromomethane	Chloromethane	Naphthalene	1,2,4-Trimethylbenzene	1,3,5-Trimethylbenzene	n-Propylbenzene	Isopropylbenzene	4-Isopropyltoluene	Methylene Chloride (Dichloromethane)	Benzene	Toluene	Ethylbenzene	Xylenes	n-Butylbenzene	sec-Butylbenzene	Fluorotrichloromethane
			MCL	5	70	100	200	8,600**	810**	5	5	7	8.7**	1.4**	1,500**	300**	300**	-	-	-	5	5	1,000	700	10,000	-	61	1,300**
MW-17	20'-30'	2/16/96	7296-0216-MW17	**66 D**	**4.2**	**0.88**	**48 D**	<0.50	**12**	<0.50	<0.50	**5.9**	<0.50	**0.85**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	**1.1**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
		8/13/96	729-81396-MW17	**55.6**	**3.79**	**0.82**	**35.3**	<1.00	**11.9**	<0.20	<0.20	**1.17**	<1.00	<0.50	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	**1.10**	<0.30	<0.50	<0.40	<0.20	<0.20	<0.20
MW-18	20'-30'	2/16/96	7296-0216-MW18	**31 D**	**1.9**	**0.46 J**	**30 D**	<0.50	**6.6**	<0.50	<0.50	**3.2**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	**0.87**	**0.60**	<0.50	**0.39 J**	<0.50	<0.50	<0.50
		8/13/96	729-81396-MW18	**29.6**	**2.20**	**0.46**	**28.9**	<1.00	**6.37**	<0.20	<0.20	**0.71**	<1.00	<0.50	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	**0.65**	<0.30	<0.20	<0.40	<0.20	<0.20	<0.20
MW-19	70-80'	2/16/96	7296-0216-MW19	**9.1**	**0.51**	<0.50	**3.9**	<0.50	**1.1**	<0.50	<0.50	**0.41 J**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50	<0.50	<0.50
		8/13/96	729-81396-MW19	**12.7**	**0.69**	<0.20	**4.62**	<1.00	**1.27**	<0.20	<0.20	<0.20	<1.00	<0.50	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	**0.25**	<0.30	<0.20	<0.40	<0.20	<0.20	<0.20
MW-20	20-30'	2/16/96	7296-0216-MW20	**3.5**	**1.1**	**0.97**	**2.7**	<0.50	**2.0**	<0.50	<0.50	**0.33 J**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50	<0.50	<0.50
		2/16/96 duplicate	7296-0216-MW21	**3.5**	**1.1**	**1.0**	**2.7**	<0.50	**2.0**	<0.50	<0.50	**0.34 J**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50	<0.50	<0.50
		8/13/96	729-81396-MW20	**4.17**	**1.47**	**1.10**	**2.47**	<1.00	**2.18**	<0.20	<0.20	<0.20	<1.00	<0.50	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.30	<0.20	<0.40	<0.20	<0.20	<0.20
		8/13/96 duplicate	729-81396-MWB	**3.43**	**1.25**	**0.97**	**2.05**	<1.00	**2.01**	<0.20	<0.20	<0.20	<1.00	<0.50	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.30	<0.20	<0.40	<0.20	<0.20	<0.20
MW-21		10/17/96	729-1017-102	<0.20	<0.20	<0.20	**12.0**	<1.00	**1.34**	<0.20	<0.20	<0.20	<1.00	<0.50	**0.26**	**0.91**	**0.37**	**0.37**	<0.20	<0.20	<0.50	<0.20	**1.23**	**0.5**	1.97	<0.20	<0.20	<0.20
WATER SUPPLY WELLS																												
OSW-1	62'	9/22/89	220-922-04	<0.2	-	<1.0	<0.4	<2.0	<0.2	<0.2	<0.2	<1.0	<2.0	<2.0	-	-	-	-	-	-	<2.0	<0.2	<0.2	<0.2	<0.6	-	-	<2.0
		10/17/95	72912-1017-OSW1	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	**0.55 B**	<0.50	<0.50	<0.50	<0.50	<0.50	**0.35 J**	<0.50	<0.50	<0.50	<1.0	<0.50	<0.50	<0.50
OSW-2	15'	10/17/95	72903-1017-OSW2	<0.50	<0.50	<0.50	<0.50	<0.50	**0.43**	<0.50	<0.50	<0.50	<0.50	<0.50	**0.68 B**	<0.50	<0.50	<0.50	<0.50	<0.50	**0.34 J**	<0.50	<0.50	<0.50	<1.0	**0.33 J**	<0.50	<0.50
Ensley Rd.																												
922 Meeker	65'	6/23/95	7294-623-001	<0.20	<0.20	<0.20	<0.20	<0.50	<0.20	<0.20	<0.20	<0.20	<0.50	<0.50	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.50	<0.20	<0.30	<0.20	<0.20	<0.20	<0.20	<0.20
930 Palmer	18'	9/13/94	667-913-004	**0.34 J**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50	<0.50	<0.50
Palmer		8/1/95	7294-801-038	**0.33 J**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	**0.49 J**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50	<0.50	<0.50
Palmer		2/22/96	729-222-154	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50	<0.50	<0.50
Palmer		8/15/96	729-81596-164	**0.27**	<0.20	<0.20	<0.20	<1.00	<0.20	<0.20	<0.20	<0.20	<1.00	<0.50	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.50	<0.20	<0.30	<0.20	<0.40	<0.20	<0.20	<0.20
Eskimo Museum Lane																												
1530 Bonilla	40'	10/2/89	220-102-01	**21/20**	-	<1.0	<0.4	<2.0	<0.2	<0.2	<0.2	<1.0	<2.0	<2.0	-	-	-	-	-	-	<2.0	<0.2	<0.2	<0.2	<0.6	-	-	<2.0
Rocheleau		9/13/94	667-913-005	**4.7**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Rocheleau		9/13/94 duplicate	667-913-006	**4.8**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Mason		8/1/95	7294-801-037	**4.57**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	**0.57**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Mason		11/7/95	72911-1107-147	**4.6**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
1540 Bonilla	100'	10/2/89	220-102-02	**9.9/9.4**	-	<1.0	<0.4	<2.0	<0.2	<0.2	<0.2	<1.0	<2.0	<2.0	-	-	-	-	-	-	<2.0	<0.2	<0.2	<0.2	<0.6	-	-	<2.0
Pailing		9/13/94	667-913-07	**8.8**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	**0.41 J**
Pailing		8/2/95	7294-802-045	**8.4**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	**0.50**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Pailing		11/8/95	72911-1108-148	**6.7**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	**0.68**	**1.5**	<0.50	<0.50	<0.50	<0.50	**0.48 J**
Davison Street																												
1569 Holder	40'	10/4/89	220-104-01	**29/26**	-	<1.0	<0.4	<2.0	<0.2	**0.2**	<0.2	<1.0	<2.0	<2.0	-	-	-	-	-	-	<2.0	<0.2	<0.2	<0.2	<0.6	-	-	<2.0
Holder		9/13/94	667-913-002	**7.2**	**0.43 J**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50	<0.50	<0.50
Holder		8/1/95	7294-801-018	**5.41**	**0.41 J**	<0.50	**0.86**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	**0.44 J**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Holder		8/1/95 duplicate	7294-801-036	**5.42**	**0.40 J**	<0.50	**0.95**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	**0.42 J**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50

TABLE 1
SUMMARY OF VOLATILE ORGANIC COMPOUNDS* IN GROUNDWATER
(all concentrations in ug/L or ppb)

Well Number		Well Screen Depth	Sample Date	Sample Number	Trichloroethylene	cis-1,2-Dichloroethylene	trans-1,2-Dichloroethylene	1,1,1-Trichloroethane	Chloroethane	1,1-Dichloroethane	Tetrachloroethylene	1,2-Dichloroethane	1,1-Dichloroethylene	Bromomethane	Chloromethane	Naphthalene	1,2,4-Trimethylbenzene	1,3,5-Trimethylbenzene	n-Propylbenzene	Isopropylbenzene	4-Isopropyltoluene	Methylene Chloride (Dichloromethane)	Benzene	Toluene	Ethylbenzene	Xylenes	n-Butylbenzene	sec-Butylbenzene	Fluorotrichloromethane
				MCL	5	70	100	200	8,600**	810**	5	5	7	8.7**	1.4**	1,500**	300**	300**	-	-	-	5	5	1,000	700	10,000	-	61	1,300**
Richardson Highway																												
1455	6-Mile	30'	9/16/94	667-916-010	19	1.5	1.1	46 D	<0.50	6.8	<0.50	<0.50	0.44 J	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	2.0	0.36	0.21 J	<0.50	<1.0	<0.50	<0.50	<0.50
	Truck		9/28/95	72912-928-083	22 D	1.8	1.1	24 D	<0.50	6.4	<0.50	<0.50	4.5	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.65	0.45	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Shop		2/16/96	7296-WH-WA	23D	1.7	0.81	20D	<0.50	5.9	<0.50	<0.50	2.0	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.51	0.33J	<0.50	<1.0	<0.50	<0.50	<0.50
TEMPORARY WELLS																														
TMW-1			8/12/96	729-81296-TMW1	28.4	3.03	0.76	11.4	<1.00	2.15	<0.20	<0.20	0.33	<1.00	<0.50	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.50	0.56	<0.30	<0.20	<0.40	<0.20	<0.20	<0.20
TMW-2			8/12/96	729-81296-TMW2	31.9	2.06	0.83	1.05	<1.00	0.40	<0.20	<0.20	<0.20	<1.00	<0.50	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.50	0.85	<0.30	<0.20	<0.40	<0.20	<0.20	<0.20
TMW-3			8/12/96	729-81296-TMW3	23.0	2.31	1.80	<0.20	<1.00	0.20	<0.20	<0.20	<0.20	<1.00	<0.50	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.50	1.03	<0.30	<0.20	<0.40	<0.20	<0.20	<0.20
TMW-4			9/13/96	729-91296-TMW4	25.8	1.49	0.38	0.37	<1.00	<0.20	<0.20	<0.20	<0.20	<1.00	<0.50	10.2	2.85	5.19	3.33	2.13	3.17	<0.50	0.37	<0.30	1.37	1.41	3.85	3.61	<0.20
TMW-5			9/13/96	729-91296-TMW5	20.5	1.50	0.34	0.48	<1.00	0.28	<0.20	<0.20	<0.20	<1.00	<0.50	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.50	<0.20	<0.30	<0.20	<0.40	<0.20	<0.20	<0.20
TMW-6			9/13/96	729-91296-TMW6	33.3	1.77	<0.20	177	<1.00	65.3	<0.20	<0.20	2.41	<1.00	<0.50	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.50	3.30	<0.30	0.40	1.16	<0.20	<0.20	<0.20
TMW-7			9/18/96	729-918-96-TMW7	54.7	3.67	0.70	58.2	<1.00	13.1	<0.20	<0.20	1.54	<1.00	<0.50	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.50	1.27	<0.30	<0.20	<0.40	<0.20	<0.20	<0.20
TMW-8			9/18/96	729-91896-TMW8	45.2	<0.20	0.93	11.4	<1.00	4.05	<0.20	<0.20	0.57	<1.00	<0.50	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.50	0.85	<0.30	<0.20	<0.40	<0.20	<0.20	<0.20
1994 GROUNDWATER PROBES																														
P-1			8/3/94	667-803-101	62	3 J	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	-	-	-	-	-	<1.0	-	-	-	-	-	-	<1.0
P-2			8/3/94	667-803-201	139 D	22 J	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	-	-	-	-	-	<1.0	-	-	-	-	-	-	<1.0
P-3			8/3/94	667-803-301	<1.0	1.9 J	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	-	-	-	-	-	<1.0	-	-	-	-	-	-	<1.0
			8/3/94 duplicate	667-803-302	<1.0	1.4 J	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	-	-	-	-	-	<1.0	-	-	-	-	-	-	<1.0
P-4			8/3/94	667-803-401	<1.0	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	-	-	-	-	-	<1.0	-	-	-	-	-	-	<1.0
P-5			8/3/94	667-803-501	<1.0	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	-	-	-	-	-	<1.0	-	-	-	-	-	-	<1.0
P-6			8/3/94	667-803-601	92 D	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	-	-	-	-	-	<1.0	-	-	-	-	-	-	<1.0
P-7			8/3/94	667-803-701	7.0	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	-	-	-	-	-	<1.0	-	-	-	-	-	-	<1.0
P 8			8/3/94	667-803-801	<1.0	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	-	-	-	-	-	<1.0	-	-	-	-	-	-	<1.0
P-9			8/3/94	667-803-901	<1.0	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	-	-	-	-	-	<1.0	-	-	-	-	-	-	<1.0
P-10			8/3/94	667-803-1001	<1.0	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	-	-	-	-	-	<1.0	-	-	-	-	-	-	<1.0
P-14***			8/9/94	667-809-1401	2.3	<0.50	<0.50	<0.50	<0.50	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	-	-	-	-	-	<1.0	-	-	-	-	-	-	<1.0
P-19			8/23/94	667-823-1901	36	-	<1.0	<1.0	<1.0	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.94	2.5	<0.50	<0.50	0.97	<0.50	<0.50	<0.50	<0.50	1.7	<0.50	<0.50	<0.50
P-21			8/23/94	667-823-2101	17	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	-	-	-	-	-	<1.0	-	-	-	-	-	-	<1.0
																						<1.0	-	-	-	-	-	-	<1.0

Notes: - = Sample not analyzed for this compound.

Notes:
J = Estimated concentration. Sample result was below method detection limit.
B = Compound also detected in laboratory blank sample.
D = Secondary dilution required for sample result to fall within calibration range.
E = Estimated concentration.
* Samples were analyzed by EPA Method 502.2; only those compounds detected at concentrations above the method detection limit are listed.
** Compound does not have a listed MCL. The value listed here corresponds to a 10 (-6) risk-based concentration developed by the USEPA.
*** Sample from P-14 also contained 30.6 ppm diesel range organics.



Adapted from USGS Fairbanks (D-2) SE, Alaska, 1992. Approximate scale 1:25,000

N

6-Mile Richardson Highway Groundwater Assessment
Fairbanks, Alaska

SITE LOCATION MAP

December 1996 X-0729

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

Figure 1

Notes:

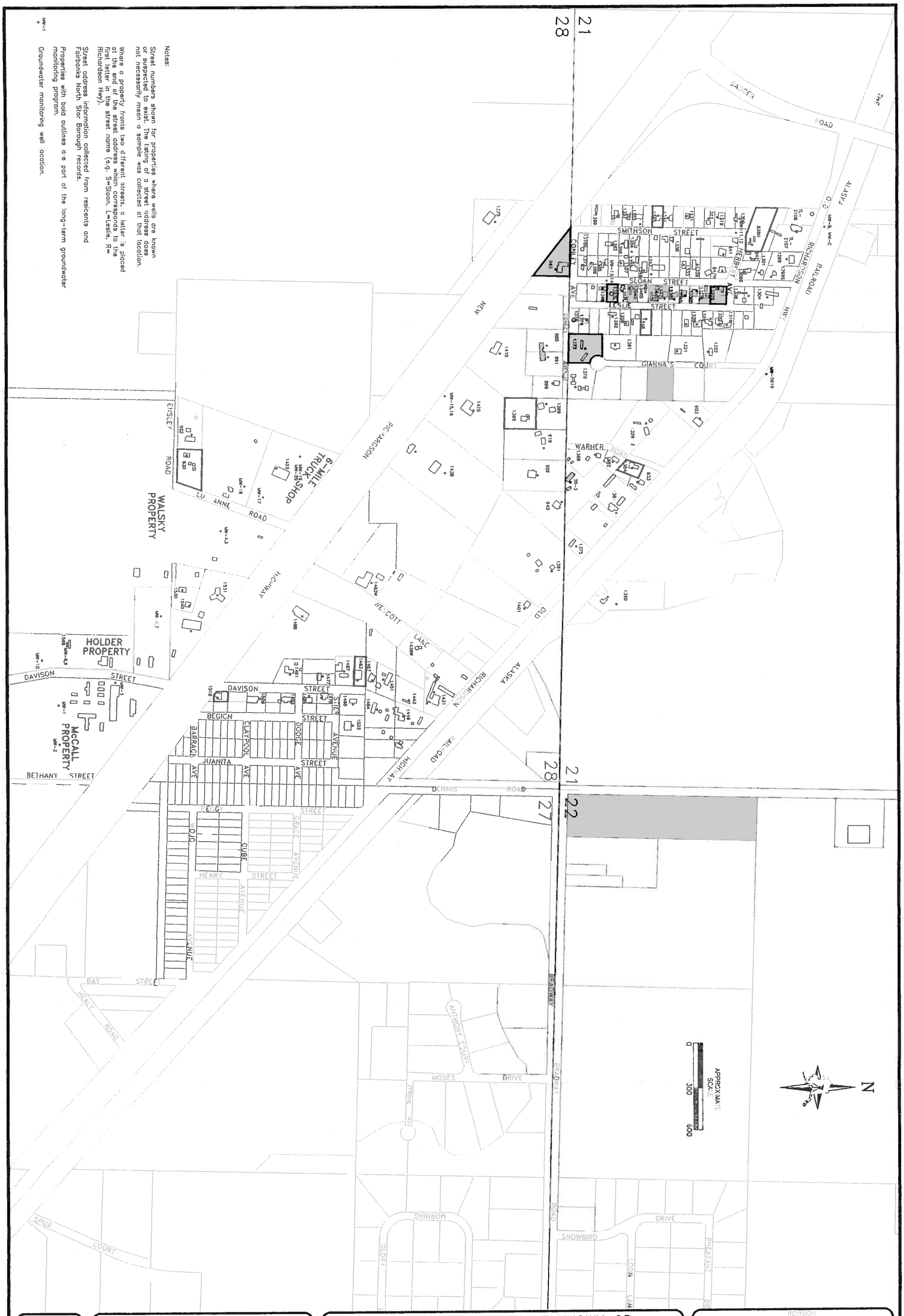
Street numbers shown for properties where wells are known or suspected to exist. The listing of a street address does not necessarily mean a sample was collected at that location.

Where a property fronts two different streets, a letter is placed at the end of the street address which corresponds to the first letter in the street name (e.g. S=Sloan, L=Leslie, R=Richardson Hwy).

Street address information collected from resicents and Fairbanks North Star Borough records.

Properties with bold outlines a e part of the long-term groundwater monitoring program.

MW-1 Groundwater monitoring well location.



SHEET NUMBER	2		
SHANNON & WILSON, INC. GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS			
DATE:	10/11/95	PROJECT:	X-0729-02
DRAWN:	BC	FILE:	LOC_B2 DWG
CHECKED:	JEC	SCALE:	1" = 600'

PROJECT: STREET ADDRESSES AT KNOWN OR SUSPECTED WELL LOCATIONS

LOCATION: SIX MILE RICHARDSON HIGHWAY GROUNDWATER ASSESSMENT FAIRBANKS, ALASKA

REVISION NO.	DATE:		BY
	10/31/95		JEC
	10/14/96		JEC
	11/26/96		JEC

N

MW-20 MW-19 6-Mile Truck Shop

1455

MW-17

MW-18

LuAnne Road

TMW-8

TMW-7

TMW-3

TMW-2

MW-4

MW-5

TMW-1

922 930

Ensley Road

Richardson Highway

Frontage Road

Fairbanks Museum Lane

TMW-4

1531

1540

1530

MW-6 MW-7

TMW-5

Walsky

Holder

Davison Street

MW-21

OSW-2

TMW-6

MW-3

P-10

P-9

Holder

P-8

P-7

P-6

OSW-1

P-1 1569 P-2

MW-8 MW-9

P-21

P-3

MW-10 P-19

P-4

P-5

P-14

MW-1

MW-2

McCall

Bethany Street

Range of groundwater flow direction

N18°W

N52°W

APPROXIMATE SCALE: 1 inch = 200 feet

0 100 200 400 800

(feet)

LEGEND:

◔ — Monitoring well location and number
MW-1

■ — 1996 temporary monitoring well location and number
TMW-1

● — Water supply well location and street address
930

▲ — 1994 probe location and number
P-5

— Approximate property boundary

— Approximate tree line

— Gravel pit

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SITE PLAN

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Figure 3

N

LEGEND:

- ◔ — Monitoring well location
- ■ — 1996 temporary monitoring well location
- ● — Water supply well location
- ▲ — 1994 probe location
- — Approximate property boundary
- — Approximate tree line
- — Gravel pit

0.29 ppb — TCE concentration in parts per billion (ppb)

ND — No detected TCE

(deep) — Indicates result from well which is generally in the 60 to 100-foot depth range

6-Mile Truck Shop

4.17 ppb
12.7 ppb (deep)
23 ppb
55.6 ppb
29.6 ppb
ND (deep)
0.27 ppb
Ensley Road
LuAnne Road
45.2 ppb
64.7 ppb
23.0 ppb
31.9 ppb
4.58 ppb (deep)
27.2 ppb
28.4 ppb
25.8 ppb
Richardson Highway
Frontage Road
Eskimo Museum Lane
6.7 ppb (deep)
4.6 ppb
2.83 ppb
ND (deep)
Walsky
20.5 ppb
Holder
33.3 ppb
Davison Street
ND
ND
ND
ND
ND
Holder
ND
7 ppb
92 ppb
5.41 ppb
62 ppb
139 ppb
ND (deep)
5.62 ppb
17 ppb
ND
ND
1.18 ppb
36 ppb
ND
2.3 ppb
ND
ND (deep)
ND
0.29 ppb
McCall
Bethany Street

Range of groundwater flow direction
N18°W
N52°W

APPROXIMATE SCALE: 1 inch = 200 feet

0 100 200 400 800
(feet)

The analytical results for 930 Ensley Road and monitoring wells MW-1, MW-2, MW-4 through MW-10, and MW-17 through MW-20 are for samples collected between August 12 and 17, 1996. The results for monitoring well MW-21 are for a sample collected on October 17, 1996. The results for the 6-Mile Truck Shop well are for a sample collected on February 16, 1996.

The results for the temporary wells are for samples collected between August 12 and September 18, 1996.

The results for monitoring well MW-3 and water supply wells OSW-1 and OSW-2 are for samples collected between October 12 and October 17, 1995.

The results for 1530 and 1540 Eskimo Museum Lane are for samples collected on November 7 and 8, 1995. The results for 1569 Davison Street are for a sample collected on August 1, 1995, and the results for 922 Ensley Road are for a sample collected on June 23, 1995.

The results for the 1994 groundwater probes are for samples collected between August 3 and 23, 1994.

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TCE CONCENTRATIONS IN GROUNDWATER

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Figure 4

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N

2.47 ppb
4.62 ppb (deep)
6-Mile Truck Shop
20 ppb
35.3 ppb
28.9 ppb
LuAnne Road
11.4 ppb
58.2 ppb
ND
1.05 ppb
ND (deep)
2.25 ppb
11.4 ppb
ND (deep)
ND
Ensley Road
Richardson Highway
Frontage Road
0.37 ppb
Eskimo Museum Lane
ND (deep)
ND
ND ND (deep)
Walsky
0.48 ppb
Holder
177 ppb
Davison Street
12.0
ND
ND
ND
ND
Holder
ND
ND
ND
0.86 ppb
ND
ND (deep)
ND
ND
ND
ND
ND
ND
ND
ND
ND (deep)
Bethany Street
ND
0.86 ppb
McCall

Range of groundwater flow direction
N18°W
N52°W

APPROXIMATE SCALE: 1 inch = 200 feet
0 100 200 400 800
(feet)

LEGEND:

- — Monitoring well location
- — 1996 temporary monitoring well location
- — Water supply well location
- — 1994 probe location
- — Approximate property boundary
- — Approximate tree line
- — Gravel pit

0.86 ppb—TCA concentration in parts per billion (ppb)

ND—No detected TCA

(deep)—Indicates result from well which is generally in the 60 to 100-foot depth range

The analytical results for 930 Ensley Road and monitoring wells MW-1, MW-2, MW-4 through MW-10, and MW-17 through MW-20 are for samples collected between August 12 and 17, 1996. The results for monitoring well MW-21 are for a sample collected on October 17, 1996. The results for the 6-Mile Truck Shop well are for a sample collected on February 16, 1996.

The results for the temporary wells are for samples collected between August 12 and September 18, 1996.

The results for monitoring well MW-3 and water supply wells OSW-1 and OSW-2 are for samples collected between October 12 and October 17, 1995.

The results for 1530 and 1540 Eskimo Museum Lane are for samples collected on November 7 and 8, 1995. The results for 1569 Davison Street are for a sample collected on August 1, 1995, and the results for 922 Ensley Road are for a sample collected on June 23, 1995.

The results for the 1994 groundwater probes are for samples collected between August 3 and 23, 1994.

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TCA CONCENTRATIONS IN GROUNDWATER
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Figure 5

N

6-Mile Truck Shop

ND
0.25 ppb (deep) (+soil)
0.51 ppb*
1.1 ppb
0.65 ppb
ND (deep)
ND

LuAnne Road

0.85 ppb
1.27 ppb
1.03 ppb
0.85 ppb
ND (deep)
0.66 ppb
0.56 ppb

Ensley Road

Richardson Highway

Frontage Road

Eskimo Museum Lane

0.37 ppb*
ND
0.68 ppb* (deep)

Walsky

ND
ND (deep) (+soil)
ND(+soil)

Holder

Davison Street

ND*(+soil)

3.3 ppb*

Holder

ND*
ND* (deep)
ND*
ND (deep)
ND

Bethany Street

ND
0.46 ppb

McCall

ND (+soil)
ND*(+soil)

Range of groundwater flow direction

N18°W

N52°W

APPROXIMATE SCALE: 1 inch = 200 feet

0 100 200 400 800

(feet)

LEGEND:

- — Monitoring well location
- ■ — 1996 temporary monitoring well location
- ● — Water supply well location
- ▲ — 1994 probe location
- — Approximate property boundary
- — Approximate tree line
- — Gravel pit

0.86 ppb — Benzene concentration in parts per billion (ppb) Locations without sample results were not analyzed for fuel-related compounds.

ND — No detected benzene

(deep) — Indicates result from well which is generally in the 60 to 100-foot depth range

* — Indicates the presence of other fuel-related compounds in groundwater

(+soil) — Indicates the presence of soil contamination by fuel-related compounds

The analytical results for 930 Ensley Road and monitoring wells MW-1, MW-2, MW-4 through MW-10, and MW-17 through MW-20 are for samples collected between August 12 and 17, 1996. The results for monitoring well MW-21 are for a sample collected on October 17, 1996. The results for the 6-Mile Truck Shop well are for a sample collected on February 16, 1996.

The results for the temporary wells are for samples collected between August 12 and September 18, 1996.

The results for monitoring well MW-3 and water supply wells OSW-1 and OSW-2 are for samples collected between October 12 and October 17, 1995.

The results for 1530 and 1540 Eskimo Museum Lane are for samples collected on November 7 and 8, 1995. The results for 1569 Davison Street are for a sample collected on August 1, 1995, and the results for 922 Ensley Road are for a sample collected on June 23, 1995.

The 1994 groundwater probes sampled between August 3 and 23, 1994, were not analyzed for fuel-related compounds, except for probe P-14.

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FUEL-RELATED COMPOUNDS

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Figure 6