FINAL REPORT MN061

SITE ASSESSMENT REPORT
PAST WERNECKE = Lucky Queen
KENO HILL, YUKON

PUBLIC WORKS & GOVERNMENT SERVICES

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NORECOL, DAMES & MOORE

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1.0 INTRODUCTION AND BACKGROUND

In 1993, an assessment of abandoned mine exploration and development sites in the Yukon was performed by DIAND Technical Services under the Arctic Environmental Strategy Action on Waste. The assessments provided a general overview of the level of environmental impacts associated with the sites. Conditions identified ranged from no environmental or safety concerns from mine workings, to significant occurrence of off-site transport of contaminants (by water and, in some cases, fugitive air emissions). The key area of concerns identified included:

- accessible adits and portals;
- deteriorating buildings and other structures;
- abandoned fuel in drums and tanks;
- potentially acid generating tailings and waste rock; and
- metals leaching in mine water.

No samples were collected or analyzed during the performance of these assessment studies.

Subsequent to the completion of the 1993 study, Indian and Northern Affairs Canada determined that additional investigation would be warranted. Norecol, Dames & Moore, Inc. (NDM) was requested to perform a site assessment on four selected mine sites to identify specific environmental and human safety risks associated with the specific abandoned mine sites and to provide recommendations and Class "D" cost estimates for mitigation or remediation of the identified risks. The site inspection and data collection phase of the work program was performed during the period of August 26, 1996 through September 1, 1996. The four mine sites assessed by NDM on behalf of PWGSC included:

- Kalzas Twins
- Paddy Camp
- Wernecke
- Past Wernecke

A brief discussion of the program's scope of work, approach and methodology have been presented in Section 2.0 of this report.

1.1 LOCATION & SITE ACCESS

The Past Wernecke site, also known as Lucky Queen mine, is located approximately 5 km north of the town of Keno City along the Faro Gulch trail, which branches off the Gambler Gulch trail to Wernecke. The site is accessible by four-wheel drive vehicle. All-terrain-vehicle, or by hiking. A description of the site location is presented in Figure 1. Photographs detailing current site conditions have been presented in Appendix C.

1.2 OVERVIEW OF SITE DEVELOPMENT

Mining was undertaken on the "Past Wernecke" site during the latter years of the "Wernecke" operation from 1928 to 1932, and the ore was transported by aerial tramway to the Wernecke mill. The Wernecke mill was located at the Wernecke site located downhill of Past Wernecke and is described in the Wernecke report (NDM, 20749-310, January 1996). There were three shafts on the property, but only one is presently visible.

During the mid 1980s, United Keno Hill Mines Ltd. (UKHM) drove a long cross-cut (5,700') from an adit located near the Black Cap open pit to explore the "Lucky Queen" structure at depth, and from there reportedly drove a raise up to the 400' level. The inclined shaft was de-iced and rehabilitated from surface down to the bottom at the 300' level. This inclined shaft is located immediately to the north of the "Past Wernecke" mine workings, and is on the same structure as the old mine workings on surface. A building, which is in good condition, covers the inclined shaft. It is the understanding of the study team that the site is still owned and is considered active by UKHM.

The site has been bulldozed, with most of the surface portion of the mine workings filled with waste rock.

During the site visit, water was flowing from two areas along the vein structure. This is probably surface water from ground thaw.

2.0 PURPOSE AND SCOPE OF WORK

The NDM assessment of the four mine properties included the following primary elements as requested by PWGSC in their standing offer of August 9, 1996. Work program components were streamlined and tailored as appropriate to the specific mine sites:

- Inspect mine openings and workings, buildings and infrastructure, and waste disposal areas (tailings, waste rock dumps).
- Photo document, survey (as appropriate) and map relevant site features.
- Sample stained soils, surface water (including any flows from adits, diamond drill holes, etc.), and petroleum storage containers.
- Identify and map mineralization which may be prone to acid rock drainage (ARD) (where available, existing deposit/mine geology reports will be used to supplement information collected on site for this project).
- Sample tailings and waste rock dumps as required to identify potential or existing ARD conditions. Samples will be collected for acid base accounting (ABA). As well, pH of leachate (if available) and representative paste pH determinations will be made on site.
- Sample landfills and other solid waste disposal facilities for leachate quality and to identify other environmental problems such as proximity to water bodies, stability hazards, etc.
- Identify available, site-specific, mitigation measures, where required.
- Identify and inventory (quantify) hazardous (such as petroleum products) and non hazardous materials (such as materials stockpiles) (explosives will be identified but not disturbed).
- Identify potential and actual environmental pathways and receptors for site contaminants (and quantified where possible through sampling previously discussed).
- Assess human safety hazards and potential for accidental or deliberate access to hazardous areas.
- Develop preliminary cost estimates (class D [+/-25%]) for the following:
    - physical and chemical stabilization of waste rock and tailings disposal areas;
    - sealing all mine openings;
    - consolidation and land filling of non hazardous, non combustible solid wastes;

- closure of existing landfills and dumps containing non hazardous wastes;
- remediation of contaminated soils to CCME industrial standards (or removal if remediation is not feasible);
- removal and disposal of hazardous solid wastes;
- on site flaring of uncontaminated petroleum products or removal and off site disposal of petroleum and other hazardous liquids;
- demolition of buildings and other structures to foundation level and burning of combustible nonhazardous materials in approved locations.

Optionally, at the discretion of DIAND, revegetation cost estimates could also be provided.

Access roads were not included as a general work program requirement; however, areas affected directly by mine development were reviewed where applicable. As directed by PWGSC, only areas identified as associated with the former exploration activities, or adjacent areas reportedly affected by these activities, were evaluated by the NDM project team during the review program.

3.0 SITE ASSESSMENT METHODOLOGY

3.1 ASSUMPTIONS

At each mine site, the assessment was limited to the area specifically developed or occupied for mine exploration or mining purposes and immediately-adjacent areas within applicable claim boundaries, as well as off-site environmental resources believed to be affected by mine exploration or development activities. Access roadways to mine sites were not included in the assessments.

3.2 ASSESSMENT CRITERIA

In 1991, the Canadian Council of Ministers of the Environment (CCME) initiated the National Contaminated Sites Remediation Program (NCSRP) for remediation of high priority sites in Canada. In order to provide consistent standards against which the remediation of these sites could be completed, the CCME requested the development of the Canadian Environmental Quality Criteria for Contaminated Sites.

The interim environmental quality criteria produced in September, 1991, were adopted from existing guidelines and criteria used throughout Canada on federal lands. The CCME noted at the time of their creation that the CCME criteria did not constitute values for uniform environmental quality at all contaminated sites and their use would require consideration of local conditions (CCME, 1991).

For the purposes of evaluating environmental conditions consistently throughout the four specified mine sites, the CCME interim criteria was applied. Soil and groundwater analytical results were assessed according to CCME criteria, where available. Due to the lack of appropriate CCME criteria for mine sites, the commercial/industrial criteria have been applied as an interim measure for evaluating soil conditions. As no CCME criteria currently exist for VPH and LEPH/HEPH parameters, these analyses were performed for characterization purposes only of suspected petroleum hydrocarbons noted at certain sites in surface soils. To provide a reference for comparison, appropriate BC Criteria for Managing Contaminated Sites (CMCS, July, 1995) and the New Petroleum Hydrocarbon Criteria (August, 1995) have been provided. The characterization information resulting from the application of these analyses has provided information concerning the identification of the suspected petroleum hydrocarbon(s) observed.

Surface water samples have been evaluated against the CCME aquatic life criteria.

3.3.1 Program Methodology

During the performance of the site inspection, site specific information was reviewed to identify the potential contaminants of concern (PCOC's). Information was collected from the Yukon Chamber of Mines, Department of Indian and Northern Affairs, Whitehorse Mining

District Mining Recorder, United Keno Hill Mines Ltd., Department of Energy, Mines and Resources, Environment Canada Atmospheric Environment Service, Yukon Tourism, Keno City Hotel, the Keno City Mining Museum, and Mr. Mike Mancini (Keno City Snack Bar). A full list of references is presented at the end of this report.

Waste rock disposal areas were inspected, measured, characterized and sampled by a professional geologist. Non-hazardous debris was characterized and documented. Mine openings, associated mine workings, and building structures were inspected and assessed by a professional mining engineer for stability and the presence of hazardous materials. Areas of visible contamination were characterized, measured and sampled. Hazardous materials were identified, characterized where possible, and sampled where possible for laboratory analysis. Samples were collected and preserved in anticipation of the finalization of the analytical program to maximize the characterization of the site. Upon completion of the sampling program and data collection phase, NDM consulted DIAND to finalize the analytical program and discuss the identified concerns.

The methodology for assessment of mine openings was based on findings from the field inspection, as well as a review of available reports and other available information. Some records were available on the sites in the DIAND files. Information was also available, in particular of the underground workings, for the "Wernecke" and "Past Wernecke" sites from United Keno Hill Mines Ltd (UKHM).

3.3.2 Sampling Methods and Quality Assurance

Samples of waste rock, surface water, barrel contents, and/or visibly stained soils were collected by a trained environmental scientist for further characterization and laboratory analysis. A sample parameter summary chart has been presented in Table 1.

Surface Water Sampling

Water samples were collected from surface streams upstream and downstream of identified mine workings/exploration activities as well as from representative seeps originating from waste rock stockpiles, pits, tailings or adit areas.

Surface water samples were collected into pre-cleaned plastic bottles supplied by the project laboratory according to the analysis selected. The location of the sample with respect to mine workings, other surface water features, etc. was noted in the field. pH readings were collected in the field for each surface water sample and recorded. Visual observations, including coloration, clarity, odour, etc., was noted and recorded for each sample. Each sample container was clearly labelled with the site name, sample location and sample interval number, and the project scientist's initials. Filled sample containers were stored in ice-packed coolers at the site and during transport to the laboratory. Samples were maintained in a refrigerated state until analysis. Surface water samples were analyzed by CanTest Laboratories, Vancouver, B.C.

Soil Sampling

Soil samples were collected from any areas associated with historical barrel/hazardous materials storage, areas of visible surface staining, garbage dump areas, and boiler houses.

Soil samples were collected by the field scientist using a shovel and/or trowel and were placed into pre-cleaned 250 ml glass jars with Teflon-lined lids, supplied by the project laboratory. The sampling instrument was cleaned between the collection of different samples. Coolers were repacked for shipment with fresh ice packs at the end of the field inspection program, and were immediately delivered to the project laboratory with chain of custody records. All samples were stored under refrigeration at the project laboratory until analysis. Samples were analyzed by CanTest Laboratories, Vancouver, B.C. Soil and Laboratory Quality Assurance/Quality Control information has been presented in Appendix D.

Each sample container was clearly labelled with the site name, sample location and sample interval number, and the project scientist's initials. Visual observations, including size of stained area, presence/absence of odour, particle size, location, etc., were recorded on the field sample sheets. Filled sample containers were stored in ice-packed coolers at the site to minimize dissipation of volatile compounds. Samples were maintained in a refrigerated state prior to analysis.

Waste Rock

Waste rock samples were representatively sampled by the field scientist from as many waste rock piles as could be identified in the field. Field observations such as waste rock pile rock-type composition, colour, presence/absence of visible carbonate/sulphide mineralization, primary and secondary mineralization, etc. were recorded during the site visit. Each waste rock pile was mapped and its dimensions measured.

Each sample was collected by hand and placed into heavy gage plastic bags, sealed tightly, and placed in coolers for shipping. Waste rock samples were analyzed for ABA (Acid Base Accounting) by CESL Laboratories, Vancouver, B.C.

Analytical Parameters

Samples of soil and water were analyzed for compounds of environmental concern that could potentially be present based on existing information and the results of the site inspection. Samples were analyzed to detect potential contaminants of concern (PCOC's) identified during the performance of the work program. The following parameters were analyzed in soils collected from the Past Wernecke camp: Benzene/Toluene/Ethylbenzene/Xylene (BTEX), Volatile Petroleum Hydrocarbons (VPH), Light Extractable Petroleum Hydrocarbons and Heavy Extractable Petroleum Hydrocarbons (LEPH/HEPH), and Total Metals. Surface water samples collected at the Past Wernecke camp were analyzed for conventional parameters (pH, Total Suspended Solids, and sulphate) and Total Metals. Modified Sobek Method Acid-Base Accounting (ABA) analyses were performed on waste rock samples collected by the project

team. ABA analysis included total sulphur, sulphurous sulphate, modified sobek neutralization potential and paste pH. Sulphur content used for calculation of acid potential (AP) was total sulphur content minus sulphate content yielding AP in terms of sulphide content.

4.0 ENVIRONMENTAL SETTING

4.1 MINERALIZATION

The Past Wernecke camp is located within the Keno Hill Camp, and is also known as the "Lucky Queen". According to the GSC, the deposit is characterized by the presence of silver/lead/zinc (Ag-Pb-Zn) mineralization (Roots & Murphy, 1992). The local geological setting of the Past Wernecke camp includes the presence of Mississippian Keno Hill quartzite, Upper Devonian and Mississippian sedimentary and felsic meta-volcanic rocks. Principle ore minerals include argentiferous (silver-containing) galena, freibergite ("grey copper"), and pyrargyrite ("ruby silver") (UKHM, Report No. UKH/96/01, Site Characterization). Minor ore minerals include polybasite, stephanite, argentite, greenochite and native silver. The primary gangue mineral is siderite, often associated with quartz. Sulphosalts, sphalerite, pyrite, calcite, pyrrhotite, siderite, and arsenopyrite have also been reported.

According to a review of site conditions prepared by Access Mining Consultants (6/1/96), the following major rock types are commonly encountered in the study area:

- schists and phyllite with variable carbon content;
- chloritic phyllite and schists;
- quartzite and phyllitic quartzite;
- sericite-quartz phyllite; and,
- greenstones.

According to the Access report, the mineralogy of the phyllite and argillite is essentially the same. Principal constituents include carbonaceous matter (graphite), quartz, sericite, carbonate minerals, feldspar, chlorite, and metacrysts of pyrite. Accessory minerals include tourmaline, rutile, and zircon.

The quartzite is visible throughout the sedimentary sequence and is often interbedded with assemblages of phyllite, schist, and argillite. Principal constituents include quartz, mica (sericite), and carbonate minerals. Accessory minerals include leucoxene, tourmaline, zircon, apatite, and pyrite. Pyrite mineralization in the quartzite often occurs as discrete cubes and/or crystal groupings.

The term " greenstone" has been applied historically to describe an altered basic intrusive rock commonly found in the study area. Principal constituents include hornblende, saussurite, plagioclase, chlorite, stilpnomelane, biotite, sericite, leucoxene, and carbonate minerals. Accessory minerals include quartz, potash feldspar, illuminate, magnetite, limonite, and apatite. Pyrite is often associated with greenstone rocks as a minor constituent.

The presence of sulphide mineralization and/or carbonate minerals at the site is significant in interpreting Acid Base Accounting data as discussed in Section 5.5.

4.2 SURFACE HYDROLOGY

The site is located on the northwest flank of Keno Hill, several kilometres upgradient of Gambler and Hansen Lakes and over 1 km away from Gambler Gulch Creek. Regional drainage appears to flow towards these two lakes and associated connecting stream systems, including the Keno Ladue River. A small tributary of Gambler Lake is located greater than 1 km from the site. According to the Department of Fisheries and Oceans (DFO, Yukon, Habitat Enhancement Branch, 02/05/97), Hansen Lake was the site of a government Toxithene treatment program in the 1960's. Toxithene is an organochloride which was added to the lake in the belief that it would exterminate native fish species prior to the introduction of a non-native rainbow trout.

Subsequent to this program, it was determined that the rainbow trout were unable to survive in the lake. The only species which has since been identified in the lake by DFO includes a successful population of Northern Pike.

During the site visit, water was observed flowing from two areas along the vein structure. It is believed that this surface water has been produced by ground thaw within the study area. Snow was visible at the top of the mountain immediately upgradient of the site. The trickling water flow from the study area was followed by the field scientist into the field of labrador tea and moss downgradient of the site. Approximately 100 m from the trench area, the water flow dispersed and disappeared.

No adverse impacts to nearby surface water features and/or fisheries habitat were noted by DFO due to the historical activities at the Past Wernecke camp.

4.3 CLIMATE

A total of four climate stations exist within the study area and include:

- Atmospheric Environment Services (AES) station at the Elsa Townsite;
- Atmospheric Environment Services (AES) station on the southern flank of Keno Hill;
- Seasonal station operated by DIAND at the Flat Creek Catchment; and,
- Principal climatological station at the Mayo Airport, operated by the AES.

Climate records for Keno Hill from July 1974 to February 1982 show average temperatures ranging from -16.7°C in January, the coldest month, to 10.4°C in June, the warmest month of the year. The record low temperature during this period was -44.4°C on January 5, 1975, and the record high was on August 1, 1976 and was 27.2°C. Average monthly precipitation ranges from 25.3 mm in February to 79.6 mm in July. The mean annual precipitation for Keno Hill is 597.4 mm.

A review of the available climatological information for the Elsa area has identified a direct correlation between an increase in rain precipitation with increasing elevation in the study

area. It is therefore assumed that the Past Wernecke camp receives a higher level of precipitation on an annual basis than does Wernecke.

4.4 VEGETATION

The study area is located within the Mayo Lake - Ross River Ecoregion (Oswald and Senyk, 1977). The study area is located above the treeline and is characterized by the presence of alpine vegetation supporting a variety of plant communities. Typical low ground cover is characterized by the presence of moss campion, heather, Labrador tea, and lichen.

4.5 FISH AND WILDLIFE RESOURCES

4.5.1 Fisheries

During the site visit, water was observed flowing from two areas along the vein structure. It is believed that this surface water has been produced by ground thaw within the study area. Snow was visible at the top of the mountain immediately upgradient of the site. The trickling water flow from the study area was followed by the field scientist into the field of labrador tea and moss downgradient of the site. Approximately 100 m from the trench area, the water flow dispersed and disappeared. At the time of the field visit, the water flow dispersed and disappeared at a distance greater than 2 km from the small tributary of Gambler Gulch Creek.

No adverse impacts to nearby surface water features and/or fisheries habitat were noted by DFO due to the historical activities at the Past Wernecke camp.

4.5.2 Wildlife

The Elsa-Keno Hill area supports a wide variety of wildlife, including waterfowl, upland game birds, fur-bearers, small mammals, and ungulates. Caribou have been occasionally harvested in the area; however, no recent occurrences have been recorded. Moose, marten, wolverine and lynx are also known to inhabit the study area. Historically, thin-horn sheep inhabited the area but disappeared in the 1920's because of over-hunting. Small mammals common to the study area include muskrat, ground squirrel, beaver, red squirrel, varying hare, fox, mink, weasel, vole, shrew, porcupine, river otter, and chipmunks. Large carnivorous mammals include grizzly bear, black bear, and timber wolf.

4.6 SITE TOPOGRAPHY AND SOILS

The site is located on the western slope of Keno Hill at an approximate elevation of 1525 m above sea level. The study area is gently sloping and exhibits extensive trenching across the site. A site layout plan has been presented in Figure 2.

Site soils are sparse and consist primarily of residual soils formed by the weathering of the underlying bedrock and from the decomposition of granular till. The effects of frost action, soil creep and slope wash are typical of this type of terrain; however, no evidence of these

features were observed at the study area during the site inspection. Glacial till material, observed in the lower vegetated areas downgradient of the site, are grey to greenish in color and generally consist of a mixture of sand, clay, cobble and boulder-sized particles of schist, quartzite, and greenstone rocks.

4.7 PERMAFROST

The region is characterized by the presence of discontinuous permafrost. According to previous studies (Access Mining Consultants Ltd. 6/1/96), permafrost is irregularly distributed and its character is influenced by several factors including elevation, hillside exposure, depth of overburden, amount of vegetative cover, and the presence of surface and/or ground water. According to this study, mine workings on the north slope of Keno Hill intersected permafrost at 400 feet below ground surface. Mine workings located on the south slope of Keno Hill showed little evidence of permafrost due to its southern hillside exposure and lower elevation.

No surface signs of underlying permafrost were noted during the site visit; however, it is highly likely due to its location that permafrost conditions would be encountered in the study area at depth.

5.0 SITE DESCRIPTION AND FINDINGS

5.1 BUILDINGS, INFRASTRUCTURE, EQUIPMENT

At the time of the site visit, one building was present. This wood frame asphalt siding-clad structure measured 5 x 13 m and housed the opening to an inclined shaft. The top of the shaft is secured with a wooden cover. The structure was secured and access to the interior of the structure was difficult. The building is in good condition. The building is shown in Photograph #3.

5.2 NON-HAZARDOUS MATERIALS

No significant waste dumps were observed at the study area during the site inspection. Various materials as described in Section 5.1 were left at the site adjacent to the shaft building and may represent remnant materials from the building construction.

Other material found at the site include scrap metal (pipe, culvert pieces, metal cladding) and approximately 10 wooden ladders. This material was observed adjacent to the shaft building.

Other site features include wooden tramline towers extending from the site to Wernecke camp, and power poles extending up the hill above the "Past Wernecke" site. The tramline towers were constructed with untreated timber. The power line belongs to UKHM, and services other mine sites further up the hill. The tramway is shown in Photograph #1. A view of the tramway and the power poles is shown in Photograph #2.

5.3 HAZARDOUS MATERIALS

No hazardous materials were observed by the NDM team during the field inspection. A small area of surface staining was observed near the shaft building and one sample (PWS1) was collected for BTEX, VPH, LEPH/HEPH, and metals analyses. According to the results of the analytical program, the sample was within CCME criteria for BTEX. As no CCME criteria is available VPH and LEPH/HEPH, these analyses were performed as a screening process and have been referenced to BC CMCS and New Petroleum Hydrocarbon criteria (July and August, 1995) for commercial/industrial sites. According to the results for these analyses, VPH and LEPH were within the selected criteria for commercial/industrial landuse. HEPH levels exceeded the selected criteria for commercial/industrial landuse and characterized as a heavy-end oil, i.e. hydraulic oil. The area of surface staining was quite small and measured approximately 1 x 2 m. The vertical depth of the staining appeared to be less than 0.15 m. Due to the limited lateral and vertical extent of the staining and total estimated volume, this area is not considered to represent a manageable unit.

The results of the metals analysis of the sample PWS1 elevated levels of lead and zinc, consistent with the presence of an Au-Ag-Pb-Zn deposit. A sample parameter summary chart is presented in Table 1. Soil sample results have been presented in Tables 3 through 5.

5.4 SURFACE WATER QUALITY

Five surface water samples (PWW1 through PWW5) were collected from the trench areas on the Past Wernecke site (Figure 2) and analyzed for pH, total suspended solids (TSS), sulphate, and total metal concentrations (Tables 5 and 6). Photograph #4 shows the surface water conditions at trench PWW1. Photograph #6 shows surface water conditions at trench PWW4. Other than water in the trenches, no other surface water bodies such as creeks were encountered on the site.

The surface water pH was within the CCME criteria for Freshwater Aquatic Life (CCME) with the exception of one sample which was slightly lower than the criteria (PWW1).

Total metal concentrations in the sample were above CCME for lead and zinc in all samples and in silver for all but one sample (PWW5). Sulphate and TSS concentrations were low (<10 mg/L) and within an acceptable range. There are no CCME for sulphate and TSS. Photograph #5 shows the location of sample PWW5.

The elevated total lead, zinc, and in one case silver concentrations are most likely primarily related to particulates within the sample and not leaching from exposed mineralized surfaces.

5.5 WASTE ROCK DISPOSAL AREAS

Numerous waste rock piles were observed adjacent to the bull-dozed trenches present at the site. Waste rock has evidently been graded in areas of the site to permit vehicle access and to level out the site topography. Waste rock piles are shown in Photographs #1, 3, 4, and 6.

At the time of the site visit, visual observations were made as to the condition of the waste rock piles, characterization of rock type, visible presence of carbonate/sulphides, visible evidence of acid generation, etc. No visible evidence of acid generation was noted at the time of the site visit. Six waste rock samples (PWWR1 through PWWR2; sampling locations shown on Figure 2) were collected and submitted for ABA tests.

The waste rock samples consisted of Argillite (PWWR1, PWWR2 and WWR3) and Quartzite (PWWR4, PWWR5 and PWWR6). The samples were submitted for ABA tests (Modified Sobek Method) which provide: paste pH, total sulphur, total sulphate, calculated acid potential (SAP) and neutralization potential (NP) and NP/AP ratio (Table 2).

The samples were all non-acidic (paste pH varying from 6.8 to 7.4) with low total sulphur concentrations (0.02 to 0.18%). Sulphate-sulphur concentrations ranged from <0.01 to 0.08%. The corresponding acid potential (SAP) ranged from 0 to 4 kg $CaCO_3$/t. The neutralization potential (NP) was generally low with one sample containing a higher NP (1.9 to 7.6, and 31 kg $CaCO_3$/t). Due to the low sulphur content and NP/SAP of 1 to 33, the material was classified as potentially acid consuming.

5.6 TAILINGS

No tailings were observed at the study area.

5.7 MINE OPENINGS

There were three shafts on the Past Wernecke (Lucky Queen) property, but only one is presently visible. This inclined shaft is located to the north of the "Past Wernecke" mine workings, and is on the same mineralized structure as the old mine workings on surface. The other shafts have presumably been filled and are buried under the waste cover.

The inclined shaft was re-opened during the late seventies by United Keno Hill Mines Ltd. The work included de-icing and rehabilitating the shaft from surface down to the bottom at the 300' level. A wooden building, which is in good condition, covers the inclined shaft.

A 1,740 m (5,700') long cross-cut was also driven from an adit located near the Black Cap open pit to explore the "Lucky Queen" structure at depth, and from there, a raise was driven up to the existing workings.

The site has been bulldozed, with most of the surface portion of the mine workings filled with waste rock.

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 HEALTH AND SAFETY

The inclined shaft at this site is a moderate public health and safety risk. It is enclosed within a building which is reasonably well secured.

On decommissioning, the building should be removed and the inclined shaft should be filled with waste rock. Use of waste to fill the shaft should provide a permanent seal for the opening. It is also the cheapest method of sealing the shaft.

6.2 ENVIRONMENTAL RISKS

A trickle of water from the study area was followed into a field of labrador tea and moss downgradient of the site (Photograph #5). Approximately 100 m from the trench area, the water flow dispersed and disappeared. At the time of the field visit, the flow disappeared at a distance greater than 2 km from the small tributary of Gambler Gulch Creek.

No adverse impacts to nearby surface water features and/or fisheries habitat were noted by DFO due to the historical activities at the Past Wernecke camp.

According to the results of analyses performed on sample PWS1, HEPH levels exceeded B.C. criteria for commercial/industrial landuse and characterized as a heavy-end oil, i.e. hydraulic oil. The presence of HEPH at levels exceeding the criteria is not considered to be an environmental risk as the lateral and vertical extent (approximately 1 m x 2 m) of the stained area does not represent a manageable unit.

6.3 AESTHETIC CONCERNS

Due to the isolated nature of the site and the nature of ongoing exploration activities, no immediate aesthetic concerns were noted by the study team. Upon completion of exploration/mining activities at the site, decommissioning activities should be undertaken to restore the local area to its original condition as much as possible, including the filling in of trenches and the removal of site structures and debris.

7.0 LIMITATIONS

The findings and conclusions documented in this report have been prepared for specific application to this project and have been developed in a manner consistent with that level of care and skill normally exercised by members of the environmental science profession currently practising under similar conditions in the area, and in accordance with the terms and conditions set forth in our proposal. No other warranty, expressed or implied, is made. This report is for the exclusive use of Public Works & Government Services Canada and their representatives. The scope of services performed in execution of this investigation may not be appropriate to satisfy the needs of other users, and any use or re-use of this document or the findings, conclusions, or recommendations presented herein is at the sole risk of said user.

Testing conducted on the site was in locations and for parameters consistent with former site uses. However, as conditions between sampling locations may vary, a potential always remains for the presence of unknown, unidentified, or unforeseen surface and subsurface contamination. Given that the scope of service for this assessment included limited soil and groundwater sampling and analytical testing, it is possible that currently unrecognized contamination may exist at the site and, if present, that the levels of contamination may vary across the site. Further evidence against such potential site contamination would require additional surface and subsurface exploration and chemical analytical testing.

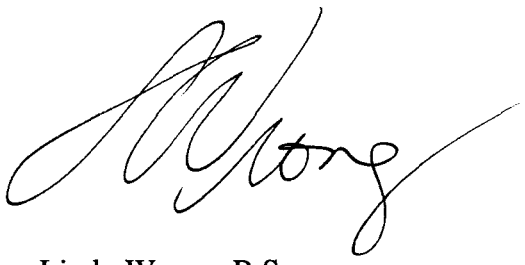
Opinions, conclusions and recommendations in this report apply to site conditions existing at the time of our assessment and are based on comparison of chemical analytical results to the Canadian Council of Ministers of the Environment (1991), B.C. Environment, Lands and Parks "Criteria For Managing Contaminated Sites In B.C.", (July 1995) and the New Petroleum Hydrocarbon Criteria (August, 1995). In the event these criteria are changed, new criteria are introduced, or new information is developed in future site work, Norecol, Dames & Moore, Inc. should be provided the opportunity to reevaluate the conclusions of this report, and to amend our opinions, as appropriate.

Norecol, Dames & Moore, Inc.'s objective is to perform our work in a professional manner and with the best interests of our clients in mind. It is important to recognize that even the most comprehensive scope of services may fail to detect environmental liability on a particular site. Therefore, Norecol, Dames & Moore, Inc. cannot act as insurers and cannot "certify" or "underwrite" that a site is free of environmental contamination, and no expressed or implied representation or warranty is included or intended in our reports except that our

work was performed, within the limits prescribed by our client, with the customary thoroughness and competence of our profession.

NORECOL, DAMES & MOORE, INC.

per:



Linda Wrong, B.Sc.
Environmental Geologist

David P. Harpley, P.Geo.
Senior Consultant
Senior Review

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TABLES

TABLE 1
PAST WERNECKE SITE
SAMPLE PARAMETERS SUMMARY CHART
PUBLIC WORKS AND GOVERNMENT SERVICES
YUKON ABANDONED MINE SITES - PAST WERNECKE
20749-013-310

Sample Identification	Sample Type	Parameters Analysed					
		PCB	Total Metals	ABA	BTEX/ VPH	LEPH/ HEPH	Conventional Parameters
PWWR1	waste rock			X			
PWWR2	waste rock			X			
PWWR3	waste rock			X			
PWWR4	waste rock			X			
PWWR5	waste rock			X			
PWWR6	waste rock			X			
PWS1	soil		X		X	X	
PWW1	surface water		X				X
PWW2	surface water		X				X
PWW3	surface water		X				X
PWW4	surface water		X				X
PWW5	surface water		X				X

PCB - polychlorinated biphenyls

ABA - acid-base accounting

BTEX/VPH - benzene, toluene, ethylbenzene, xylenes, volatile petroluem hydrocarbons

LEPH/HEPH - light extractable petroleum hydrocarbons / heavy extractable petroleum hydrocarbons

Conventional Parameters - pH, sulphate, total suspended solids

PAH - polycyclic aromatic hydrocarbons

TABLE 2
MODIFIED SOBEK METHOD ACID-BASE ACCOUNTING
PUBLIC WORKS AND GOVERNMENT SERVICES
YUKON ABANDONED MINE SITES - PAST WERNECKE
20749-013-310

Sample No.	Rock Type	Paste pH	S(T) %	S(SO4) %	AP	NP	NET NP	NP/AP
PWWR1	Argillite with abundant quartz veining, iron staining, 1% carbonate, <1% finely disseminated pyrite, blocky cleavage	7.37	0.02	0.02	0.0	2.5	2.5	NA
PWWR2	Argillite with abundant quartz veining, iron staining, 1% carbonate, <1% finely disseminated pyrite, blocky cleavage	6.82	0.11	0.08	0.9	31.1	30.2	33.2
PWWR3	Argillite with abundant quartz veining, iron staining, 1% carbonate, <1% finely disseminated pyrite, blocky cleavage	6.77	0.18	0.04	4.4	4.9	0.5	1.1
PWWR4	Quartzite, with abundant quartz veining, buff to grey, gneissoid appearance, <1% finely disseminated pyrite	7.15	0.02	<0.01	0.5*	1.9	1.5	4.1
PWWR5	Quartzite, with abundant quartz veining, buff to grey, gneissoid appearance, <1% finely disseminated pyrite	6.91	0.11	0.05	1.9	7.6	5.7	4.0
PWWR6	Quartzite, with abundant quartz veining, buff to grey, gneissoid appearance, <1% finely disseminated pyrite	7.24	0.02	<0.01	0.5*	2.1	1.7	4.5

* - A S(SO4) value of 0.005% was used for the AP calculation.
AP = Acid Potential in Tonnes CaCO3 Equivalent per 1000 Tonnes of material.
NP = Neutralization Potential in Tonnes CaCO3 Equivalent per 1000 Tonnes of Material.
NET NP = Net Neutralization Potential = Tonnes CaCO3 Equivalent per 1000 Tonnes of Material.

TABLE 3
CONCENTRATION OF BTEX AND VOLATILE PETROLEUM HYDROCARBONS IN SOIL SAMPLES
PUBLIC WORKS AND GOVERNMENT SERVICES
YUKON ABANDONED MINE SITES - PAST WERNECKE
20749-013-310
ug/g (ppm)

			Benzene	Ethylbenzene	Toluene	Xylenes	Volatile Petroleum Hydrocarbons
CCME	Commercial/Industrial		5.	50.	30.	50 (a)	200 (b)
Sample No.	Location	Depth (m)					
PWS1	Near shaft area	0 - 0.15	<0.5	<0.5	<0.5	<0.5	10.
Method Detection Limit			0.5	0.5	0.5	0.5	10.

CCME - Canadian Council of Ministers of the Environment Interim Canadian Environmental Quality Criteria for Contaminated Sites
< - less than the detection limit indicated
NC - no criteria established
(a) - Criteria for total of m, p and o xylenes.
(b) - British Columbia Criteria for Managing Contaminated Sites, July 1995, New Petroleum Hydrocarbon Criteria, August, 1995
☐ - Greater than CCME commercial/industrial criteria

TABLE 4
CONCENTRATIONS OF LEPH & HEPH IN SOIL SAMPLES
PUBLIC WORKS AND GOVERNMENT SERVICES
YUKON ABANDONED MINE SITES - PAST WERNECKE
20749-013-310
ug/g (ppm)

			LEPH	HEPH
CMCS PHC	Commercial/Industrial		2000.	5000.
Sample No.	Location	Depth (m)		
PWS1	Near shaft building	0 - 0.15	<250.	**19000.**
Method Detection Limit			250.	250.

CMCS PHC - British Columbia Criteria for Managing Contaminated Sites, July 1995,
New Petroleum Hydrocarbon Criteria, August 1995
< - less than the detection limit indicated
NC - no criterion established
☐ - Greater than CMCS PHC criteria for commercial/industrial land use

TABLE 5
CONCENTRATION OF METALS IN SOIL SAMPLES
PUBLIC WORKS AND GOVERNMENT SERVICES
YUKON ABANDONED MINE SITES - PAST WERNECKE
20749-013-310
ug/g (ppm)

			Silver	Arsenic	Boron	Barium	Beryllium	Cadmium	Cobalt	Chromium*	Copper	Mercury	Manganese	Molybdenum	Nickel	Lead	Antimony	Selenium	Tin	Vanadium	Zinc
CCME	Commercial/Industrial		40.	50.	NC	2000.	8.	20.	300.	800.	500.	10.	NC	40.	500.	1000.	40.	10.	300.	NC	1500.
Sample No.	Location	Depth (m)																			
PWS1	Near shaft building	0 - 0.15	<2.	0.47	12.	46.	<1.	18.2	4.	8.	110.	0.19	2290.	<4.	14.	1720.	<10.	<0.5	<5.	11.	1480.
Method Detection Limit			2.	0.05	0.5	0.1	1.	0.25	1.	2.	1.	0.001	0.2	4.	2.	1.	10.	0.5	5.	0.5	1.

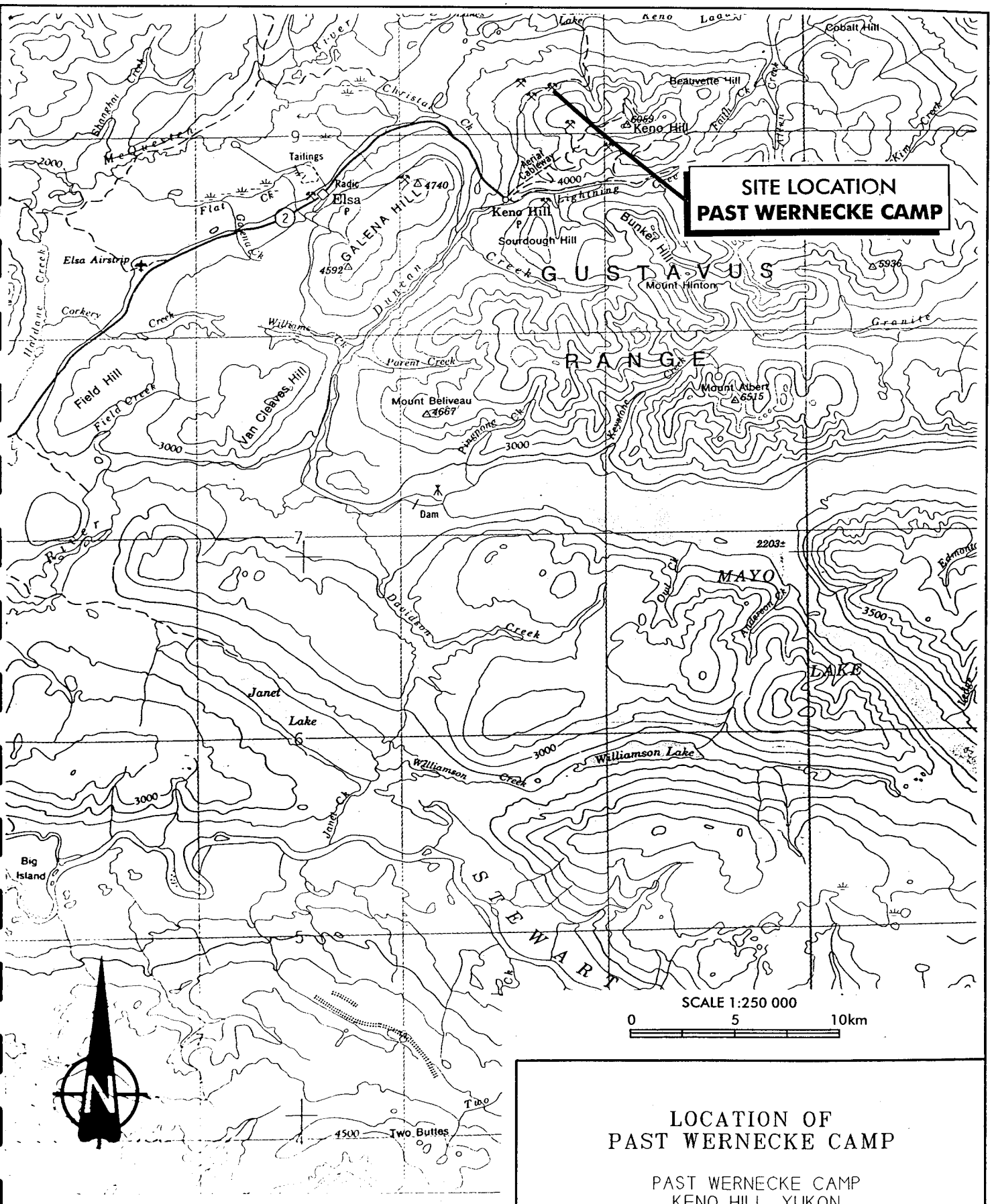
CCME - Canadian Council of Ministers of the Environment Interim Canadian Environmental Quality Criteria for Contaminated Sites
< - less than the detection limit indicated
NC - no criteria established
☐ - Greater than CCME criteria for commercial/industrial land use
* - Total Chromium

TABLE 6
CONCENTRATION OF CONVENTIONAL PARAMETERS AND TOTAL METALS IN SURFACE WATER
PUBLIC WORKS AND GOVERNMENT SERVICES
YUKON ABANDONED MINE SITES - PAST WERNECKE
20749-013-310
ug/L (ppb)

		pH	Total Suspended Solids (mg/L)	Sulphate SO4 (mg/L)	Silver	Aluminum*	Arsenic	Boron	Barium	Beryllium	Cadmium	Cobalt	Chromium	Copper	Iron	Mercury	Manganese	Molybdenum	Nickel	Lead	Selenium	Tin	Vanadium	Zinc
CCME	Freshwater Aquatic Life	6.5-9.0	NC	NC	0.1	5 - 100	50	NC	NC	NC	0.2 - 1.8	NC	2 - 20	2 - 4	300	0.1	100	NC	25 - 150	1 - 7	1	NC	NC	30
Sample	Location																							
PWW1	Midsection of flow through northernmost trench	6.08	<1.	4.6	**2.9**	<200.	<1.	10.	17.	<3.	1.2	<1.	<1.	2.	<30.	<0.05	55.	<1.	2.	**320.**	<1.	<1.	<10.	**65.**
PWW2	Downgradient of PWW1	7.18	10.	4.8	**1.8**	<200.	<1.	<10.	19.	<3.	1.4	<1.	<1.	<1.	<30.	<0.05	42.	<1.	2.	**190.**	1.	<1.	<10.	**75.**
PWW3	Upgradient of PWW1 at source	7.83	<5.	3.5	**3.7**	<200.	<1.	<10.	18.	<3.	0.8	<1.	<1.	<1.	<30.	<0.05	10.	<1.	<1.	**110.**	<1.	<1.	<10.	**35.**
PWW4	At source of water flow at southernmost trench	7.11	<1.	5.	**0.2**	<200.	<1.	<10.	11.	<3.	0.4	<1.	<1.	<1.	<30.	<0.05	85.	<1.	2.	**27.**	<1.	<1.	<10.	18.
PWW5	Downgradient of PWW4	7.81	<5.	5.3	<0.1	<200.	<1.	<10.	9.	<3.	0.2	<1.	<1.	<1.	<30.	<0.05	75.	<1.	1.	**16.**	<1.	<1.	<10.	12.
Method Detection Limit					0.1	200.	1.	10.	1.	3.	0.2	1.	1.	1.	30.	50.	3.	1.	1.	1.	1.	1.	10.	5.

CCME - Canadian Council of Ministers of the Environment Interim Canadian Environmental Quality Criteria for Contaminated Sites
< - less than the detection limit indicated
NC - no criteria established
☐ - Greater than CCME criteria for freshwater aquatic life
* - Criteria depend on pH or hardness of sample

FIGURES



LOCATION OF PAST WERNECKE CAMP

PAST WERNECKE CAMP
KENO HILL, YUKON

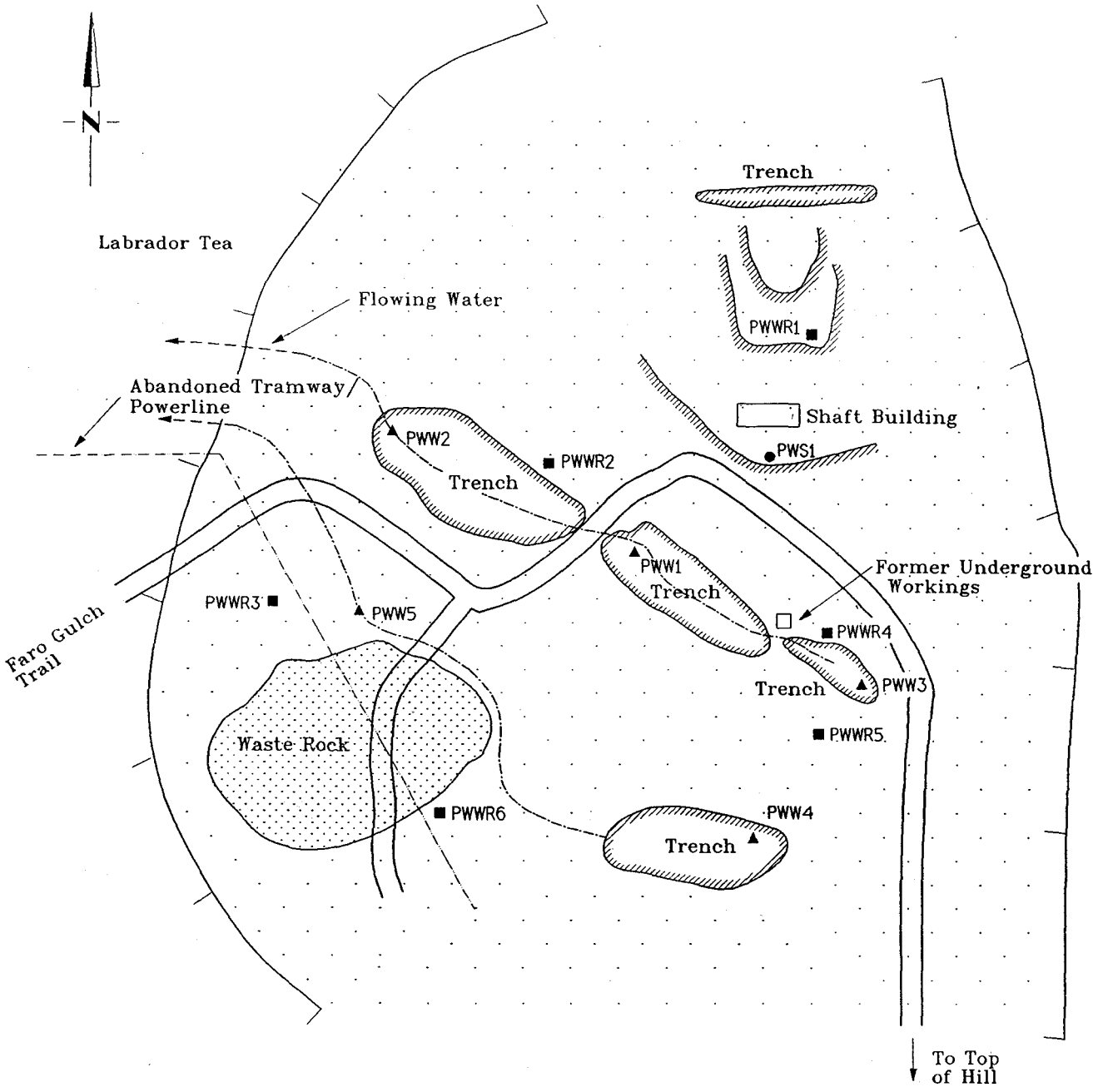
PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

OCTOBER 1996	FIGURE 1

NORECOL DAMES & MOORE

NDM 20749-013-gcd-border

A DAMES & MOORE SUBSIDIARY



LEGEND

- Waste Rock
- Waste Rock Accumulation
- PWS1 ● Soil Sample
- PWW1 ▲ Water Sample
- PWWR3 ■ Waste Rock Sample
- Slope Direction

SCALE APPROXIMATE

0 50 100m

SITE PLAN – LOCATION OF SOIL, WATER AND WASTE ROCK SAMPLES

PAST WERNECKE CAMP
KENO, YUKON

PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

NORECOL DAMES & MOORE
A DAMES & MOORE SUBSIDIARY

NDM-20749-013-gcd-pwer

FEBRUARY 1997 | FIGURE 2

APPENDIX A

FIELD DATA COLLECTION SHEETS

BARREL SAMPLING

PROJECT NAME: Yukon Mine Site Review **SAMPLE #:** _____

Location: East Wernecke *Date:* _____

Name of sampler: _____ _____

Physical Observation

Condition of barrel: poor fair good

Size (L): 205L other Labels _____

Soil staining: Y / N

Barrel Contents

Quantity of liquid: 1/4 ½ 3/4 full

Colour of liquid: light dark multiphase other

Suspected type of liquid: gasoline jet fuel waste oil glycol oil

other _____

Sludge observed: Y / N Quantity _____

Analysis (if required)

Type of sample taken: composite grab

Analysis required: metals PCBs chlorine other _____

Comments: No full barrels were identified at the site.

Sample # Format site name - BL number
eg. Tintina - BL1

BL = barrel
W = water
S = soil
WR = waste rock

SOIL SAMPLING

Location: Past Wernecke

Date: 08/29/96
Name of Sampler: L AW/JD

Sample #	Time	Depth (m)	Type of Soil (%) Clay	Silt	Sand	Confining Layer	Distance to surface H2O	oil staining (Y/N)	grab/ composite	Analysis required	Comments
RJ01	2:00p.m	0-0.5	Crushed waste rock			–	100m to track drainage	Y	Grab	BTEX/VPH/ EPH/Metals	Crushed waste rock with minor staining near shaft building

Comments:
Sample # format site name - Snumber
eg. Tintina-S1

WATER SAMPLING

PROJECT NAME: YMSR **NAME OF SAMPLER:** LAW / JD

Location: Post Wernecke *Date:* 08/29/96

SAMPLE #: PWW1 pH: 5.0

Location description: Mid-section of flow through Northern-most trench

Analysis: (metals) (water chem) Eh (TSS) total sulphur

SAMPLE #: PWW2 pH: 5.0

Location description: Downgradient of PWW1

Analysis: (metals) (water chem) Eh (TSS) total sulphur

SAMPLE #: PWW3 pH: 5.0

Location description: Upgradient of PWW1 at source

Analysis: (metals) (water chem) Eh (TSS) total sulphur

SAMPLE #: PWW4 pH: 5.0

Location description: At source of water flow at southern-most trench

Analysis: (metals) (water chem) Eh (TSS) total sulphur

SAMPLE #: PWW5 pH: 5.0

Location description: Downgradient of PWW4

Analysis: (metals) (water chem) Eh (TSS) total sulphur

Comments: Source of flowing water through trenches undetermined - may be snow melt or bedrock fracture systems

Sample # Format — site name - W number, eg. Tintina - W1

BL = barrel
W = water
S = soil
WR = waste rock

APPENDIX B

LABORATORY ANALYTICAL REPORTS

Analysis Report

CANTEST

CanTest Ltd

Professional
Analytical
Services

1523 West 3rd Ave
Vancouver, BC
V6J 1J8

Fax: 604 731 2386

Tel: 604 734 7276

1 800 665 8566

REPORT ON: Analysis of Soil and Water Samples

REPORTED TO: Norecol, Dames & Moore, Inc.
Suite 1900
650 West Georgia Street
Vancouver, B.C.
V6B 4N7

Att'n: Ms. Linda Wrong

CHAIN OF CUSTODY: 19028, 19024, 19025, 19027
PROJECT NAME: PWASC
PROJECT NUMBER: 20749-013

NUMBER OF SAMPLES: 25

REPORT DATE: September 24, 1996

DATE SUBMITTED: September 3, 1996

GROUP NUMBER: 6090406

SAMPLE TYPE: Water and Soil

TEST METHODS:

Volatile Petroleum Hydrocarbons in Soil (VPH-GNS) - analysis was performed using a draft methanol extraction-purge and trap-GC/FID procedure specified by the B.C. MOELP. The VPH compounds elute between n-pentane (n-C5) and n-undecane (n-C11). BTEX compounds are not included in the VPH result. VPH results produced by this method can be compared to Generic Numerical Standard (GNS) criteria.

Volatile Organic Compounds in Soil - analysis was performed using procedures based on U.S. EPA Methods 624/8240, involving methanol extraction, sparging/collection with a Purge and Trap apparatus and analysis using GC/MS.

Conventional Parameters - analyses were performed using procedures based on those described in "British Columbia Environmental Laboratory Manual For the Analysis of Water, Wastewater, Sediment and Biological Materials" (1994 Edition), Province of British Columbia and "Standard Methods for the Examination of Water and Wastewater" 17th Edition, (1989) and 16th Edition (1985), published by the American Public Health Association.

Extractable Petroleum Hydrocarbons in Water/Soil (LEPH/HEPH-GNS) - analysis was performed using a draft DCM extraction-GC/FID procedure specified by the B.C. MOELP. Compounds eluting between n-decane (n-C10) and n-nonadecane (n-C19) are defined as Light Extractable Petroleum Hydrocarbons (LEPH). Compounds eluting between n-nonadecane and n-dotriacontane (n-C32) are defined as Heavy Extractable Petroleum Hydrocarbons (HEPH). These results can be compared to Generic Numerical Standard (GNS) criteria. The results may or may not be corrected for specified PAH's, as noted on the report.

Mercury in Water - analysis was performed using procedures based on Standard Methods for the Examination of Water and Wastewater section 3112 B, acid permanganate digestion , analysis using Cold Vapour Atomic Absorption.

(Continued)

CANTEST LTD.

Richard S. Jornitz
Supervisor, Inorganic Testing

REPORTED TO: Norecol, Dames & Moore, Inc.

REPORT DATE: September 24, 1996

GROUP NUMBER: 6090406

CANTEST

Metals in Water - analysis was performed using Inductively Coupled Plasma Spectroscopy (ICP) or Graphite Furnace Atomic Absorption.

Metals in Water - analysis was performed using procedures based on U.S. EPA Method 200.8, Determination of Trace Elements in Waters and Wastes by Inductively Coupled Plasma-Mass Spectroscopy (ICP/MS).

Polynuclear Aromatic Hydrocarbons - analysis was performed using procedures based on U.S. EPA Methods 625/8270, involving extraction, clean-up steps, and analysis using GC/MS.

Arsenic in Soil - analysis was performed using Zeeman background-corrected Graphite Furnace Atomic Absorption Spectrophotometry.

Cadmium in Soil - analysis was performed using background-corrected Flame Atomic Absorption Spectrophotometry.

Mercury in Soil - analysis was performed using Cold Vapour Atomic Absorption Spectrophotometry.

Lead in Soil - analysis was performed using background-corrected Flame Atomic Absorption Spectrophotometry.

Metals in Soil - Undried representative samples were digested with a mixture of nitric acid and hydrochloric acid-"Aqua Regia". Analysis was performed using Inductively Coupled Argon Plasma Spectroscopy (ICAP) or by specific techniques as described. Moisture was determined gravimetrically at 105 on a separate sample portion.

Selenium in Soil - analysis was performed using Zeeman background-corrected Graphite Furnace Atomic Absorption Spectrophotometry.

TEST RESULTS:

(See following pages)

REPORTED TO: Norecol, Dames & Moore, Inc.

REPORT DATE: September 24, 1996

GROUP NUMBER: 6090406

CANTEST

Conventional Parameters in Water

CLIENT SAMPLE IDENTIFICATION:	SAMPLE DATE	CAN TEST ID	pH	Total Suspended Solids	Sulphate SO4
WW1	Aug 29/96	609040027	7.93	3	433
PWW1	Aug 29/96	609040028	6.08	<	4.6
PWW2	Aug 29/96	609040029	7.18	10	4.8
PWW3	Aug 29/96	609040030	7.83	< 5	3.5
PWW4	Aug 29/96	609040031	7.11	<	5.0
PWW5	Aug 29/96	609040032	7.81	< 5	5.3
KW1	Aug 28/96	609040033	5.62	7	9.1
KW2	Aug 28/96	609040034	5.51	<	8.8
PW1	Aug 28/96	609040035	8.05	7	178
PW2a	Aug 28/96	609040036	7.72	< 0.2	502
PW2b	Aug 28/96	609040037	8.00	5	179
PW3	Aug 28/96	609040038	8.11	4	181
DETECTION LIMIT			-	1	1
UNITS			pH units	mg/L	mg/L

mg/L = milligrams per liter
< = Less than detection limit

REPORTED TO: Norecol, Dames & Moore, Inc.

REPORT DATE: September 24, 1996

GROUP NUMBER: 6090406

CANTEST

Metals Analysis in Water

CLIENT SAMPLE IDENTIFICATION:		WW1	PWW1	PWW2	PWW3		
SAMPLE PREPARATION:		TOTAL	TOTAL	TOTAL	TOTAL		
DATE SAMPLED:		Aug 29/96	Aug 29/96	Aug 29/96	Aug 29/96		
CAN TEST ID:		609040027	609040028	609040029	609040030	DETECTION LIMIT	UNITS
Aluminum	Al	<	<	<	<	0.2	mg/L
Antimony	Sb	<	<	<	<	0.2	mg/L
Arsenic	As	<	<	<	<	0.001	mg/L
Barium	Ba	0.008	0.017	0.019	0.018	0.001	mg/L
Beryllium	Be	<	<	<	<	0.003	mg/L
Boron	B	<	0.01	<	<	0.01	mg/L
Cadmium	Cd	0.0002	0.0012	0.0014	0.0008	0.0002	mg/L
Calcium	Ca	167	1.78	1.81	1.18	0.01	mg/L
Chromium	Cr	<	<	<	<	0.001	mg/L
Cobalt	Co	<	<	<	<	0.001	mg/L
Copper	Cu	<	0.002	<	<	0.001	mg/L
Iron	Fe	0.05	<	<	<	0.03	mg/L
Lead	Pb	<	0.32	0.19	0.11	0.001	mg/L
Magnesium	Mg	39.7	0.56	0.55	0.30	0.05	mg/L
Manganese	Mn	0.029	0.055	0.042	0.010	0.003	mg/L
Mercury	Hg	<	<	<	<	0.05	µg/L
Molybdenum	Mo	0.003	<	<	<	0.001	mg/L
Nickel	Ni	0.002	0.002	0.002	<	0.001	mg/L
Phosphorus	PO4	<	<	<	<	0.4	mg/L
Potassium	K	1.07	0.14	0.12	0.10	0.01	mg/L
Selenium	Se	<	<	0.001	<	0.001	mg/L
Silicon	SiO2	2.2	3.2	2.8	2.9	0.1	mg/L
Silver	Ag	<	0.0029	0.0018	0.0037	0.0001	mg/L
Sodium	Na	1.2	0.7	0.6	0.6	0.1	mg/L
Strontium	Sr	0.50	0.009	0.008	0.007	0.001	mg/L
Tin	Sn	<	<	<	<	0.001	mg/L
Titanium	Ti	<	<	<	<	0.006	mg/L
Vanadium	V	<	<	<	<	0.01	mg/L
Zinc	Zn	0.047	0.065	0.075	0.035	0.005	mg/L
Zirconium	Zr	<	<	<	<	0.02	mg/L

mg/L = milligrams per liter
< = Less than detection limit

µg/L = micrograms per liter

REPORTED TO: Norecol, Dames & Moore, Inc.

REPORT DATE: September 24, 1996

GROUP NUMBER: 6090406

CANTEST

Metals Analysis in Water

CLIENT SAMPLE IDENTIFICATION:		PWW4	PWW5	KW1	KW2		
SAMPLE PREPARATION:		TOTAL	TOTAL	TOTAL	TOTAL		
DATE SAMPLED:		Aug 29/96	Aug 29/96	Aug 28/96	Aug 28/96		
CAN TEST ID:		609040031	609040032	609040033	609040034	DETECTION LIMIT	UNITS
Aluminum	Al	<	<	<	<	0.2	mg/L
Antimony	Sb	<	<	<	<	0.2	mg/L
Arsenic	As	<	<	<	<	0.001	mg/L
Barium	Ba	0.011	0.009	0.063	0.069	0.001	mg/L
Beryllium	Be	<	<	<	<	0.003	mg/L
Boron	B	<	<	<	0.01	0.01	mg/L
Cadmium	Cd	0.0004	0.0002	<	<	0.0002	mg/L
Calcium	Ca	1.51	1.50	2.42	2.35	0.01	mg/L
Chromium	Cr	<	<	<	<	0.001	mg/L
Cobalt	Co	<	<	<	<	0.001	mg/L
Copper	Cu	<	<	0.003	0.003	0.001	mg/L
Iron	Fe	<	<	<	0.06	0.03	mg/L
Lead	Pb	0.027	0.016	<	<	0.001	mg/L
Magnesium	Mg	0.37	0.37	0.71	0.68	0.05	mg/L
Manganese	Mn	0.085	0.075	0.029	0.013	0.003	mg/L
Mercury	Hg	<	<	<	<	0.05	µg/L
Molybdenum	Mo	<	<	<	<	0.001	mg/L
Nickel	Ni	0.002	0.001	0.001	0.002	0.001	mg/L
Phosphorus	PO4	<	<	<	<	0.4	mg/L
Potassium	K	0.11	0.094	0.59	0.45	0.01	mg/L
Selenium	Se	<	<	<	<	0.001	mg/L
Silicon	SiO2	3.0	3.0	6.0	6.2	0.1	mg/L
Silver	Ag	0.0002	<	<	<	0.0001	mg/L
Sodium	Na	0.6	0.6	0.9	0.9	0.1	mg/L
Strontium	Sr	0.007	0.007	0.017	0.017	0.001	mg/L
Tin	Sn	<	<	<	<	0.001	mg/L
Titanium	Ti	<	<	<	<	0.006	mg/L
Vanadium	V	<	<	<	<	0.01	mg/L
Zinc	Zn	0.018	0.012	0.007	0.009	0.005	mg/L
Zirconium	Zr	<	<	<	<	0.02	mg/L

mg/L = milligrams per liter

µg/L = micrograms per liter

< = Less than detection limit

REPORTED TO: Norecol, Dames & Moore, Inc.

REPORT DATE: September 24, 1996

GROUP NUMBER: 6090406

CANTEST

Metals Analysis in Water

CLIENT SAMPLE IDENTIFICATION:		PW1	PW2a	PW2b	PW3		
SAMPLE PREPARATION:		TOTAL	TOTAL	TOTAL	TOTAL		
DATE SAMPLED:		Aug 28/96	Aug 28/96	Aug 28/96	Aug 28/96		
CAN TEST ID:		609040035	609040036	609040037	609040038	DETECTION LIMIT	UNITS
Aluminum	Al	<	<	<	<	0.2	mg/L
Antimony	Sb	<	<	<	<	0.2	mg/L
Arsenic	As	0.002	0.008	0.002	0.002	0.001	mg/L
Barium	Ba	0.044	0.027	0.043	0.042	0.001	mg/L
Beryllium	Be	<	<	<	<	0.003	mg/L
Boron	B	0.02	<	0.02	0.03	0.01	mg/L
Cadmium	Cd	0.0023	0.0016	0.0023	0.0022	0.0002	mg/L
Calcium	Ca	90.7	192	90.7	92.3	0.01	mg/L
Chromium	Cr	<	<	<	<	0.001	mg/L
Cobalt	Co	<	<	<	<	0.001	mg/L
Copper	Cu	0.001	0.003	0.001	0.001	0.001	mg/L
Iron	Fe	0.38	<	0.29	0.22	0.03	mg/L
Lead	Pb	0.002	0.002	0.001	0.001	0.001	mg/L
Magnesium	Mg	16.8	58.1	17.2	17.7	0.05	mg/L
Manganese	Mn	0.095	0.004	0.088	0.084	0.003	mg/L
Mercury	Hg	<	<	<	<	0.05	µg/L
Molybdenum	Mo	<	<	<	<	0.001	mg/L
Nickel	Ni	0.002	0.004	0.002	0.001	0.001	mg/L
Phosphorus	PO4	<	<	<	<	0.4	mg/L
Potassium	K	0.43	1.10	0.40	0.36	0.01	mg/L
Selenium	Se	0.002	0.001	0.003	0.002	0.001	mg/L
Silicon	SiO2	5.5	4.6	5.2	5.3	0.1	mg/L
Silver	Ag	<	<	<	<	0.0001	mg/L
Sodium	Na	1.2	3.1	1.2	1.3	0.1	mg/L
Strontium	Sr	0.20	0.38	0.20	0.20	0.001	mg/L
Tin	Sn	<	<	<	<	0.001	mg/L
Titanium	Ti	<	<	<	<	0.006	mg/L
Vanadium	V	<	<	<	<	0.01	mg/L
Zinc	Zn	0.28	0.12	0.27	0.25	0.005	mg/L
Zirconium	Zr	<	<	<	<	0.02	mg/L

mg/L = milligrams per liter
< = Less than detection limit

µg/L = micrograms per liter

REPORTED TO: Norecol, Dames & Moore, Inc.

REPORT DATE: September 24, 1996

GROUP NUMBER: 6090406

CANTEST

Polycyclic Aromatic Hydrocarbons in Soil

CLIENT SAMPLE IDENTIFICATION:	WS3	
DATE SAMPLED:	Aug 29/96	
CAN TEST ID:	609040051	DETECTION LIMIT
ANALYSIS DATE:	Sep 7/96	
Low Molecular Weight PAH's		
Naphthalene	0.07	0.05
Acenaphthylene	0.12	0.05
Acenaphthene	<	0.05
Fluorene	<	0.05
Phenanthrene	1.8	0.05
Anthracene	0.35	0.05
Total LMW-PAH's	2.34	
High Molecular Weight PAH's		
Fluoranthene	5.2	0.05
Pyrene	6.0	0.05
Benzo(a)anthracene	4.2	0.05
Chrysene	8.3	0.05
Benzo(b)fluoranthene	17	0.05
Benzo(k)fluoranthene		0.05
Benzo(a)pyrene	7.2	0.05
Indeno(1,2,3-c,d)pyrene	15	0.05
Dibenz(a,h)anthracene	1.6	0.05
Benzo(g,h,i)perylene	18	0.05
Total HMW-PAH's	82.5	
Total PAH's	84.8	

Results expressed as micrograms per gram, on a dry weight basis. (μg/g)
< = Less than detection limit
NOTE: Benzo(b)fluoranthene and Benzo(k)fluoranthene reported as total.

REPORTED TO: Norecol, Dames & Moore, Inc.

REPORT DATE: September 24, 1996

GROUP NUMBER: 6090406

CANTEST

Monocyclic Aromatic Hydrocarbons in Soil

CLIENT SAMPLE IDENTIFICATION:	KS1	KS2	KS3	KS4	
DATE SAMPLED:	Aug 28/96	Aug 28/96	Aug 28/96	Aug 28/96	
CAN TEST ID:	609040041	609040042	609040043	609040044	DETECTION LIMIT
ANALYSIS DATE:	Sep 8/96	Sep 8/96	Sep 8/96	Sep 8/96	
Volatile Pet. Hydrocarbons	<	<	<	<	10
Benzene	<	<	<	<	0.5
Ethylbenzene	<	<	<	<	0.5
Toluene	<	<	<	<	0.5
Xylenes	<	<	<	<	0.5
Surrogate Recovery					
Toluene-d8	101	103	104	104	-
Bromofluorobenzene	86	93	91	89	-

Results expressed as micrograms per gram, on a dry weight basis. (μg/g)
Surrogate recoveries expressed as percent (%)
< = Less than detection limit

REPORTED TO: Norecol, Dames & Moore, Inc.

REPORT DATE: September 24, 1996

GROUP NUMBER: 6090406

CANTEST

Monocyclic Aromatic Hydrocarbons in Soil

CLIENT SAMPLE IDENTIFICATION:	KS5	PS1	PS2	PS3	
DATE SAMPLED:	Aug 28/96	Aug 28/96	Aug 28/96	Aug 28/96	
CAN TEST ID:	609040045	609040046	609040047	609040048	DETECTION LIMIT
ANALYSIS DATE:	Sep 8/96	Sep 8/96	Sep 8/96	Sep 4/96	
Volatile Pet. Hydrocarbons	<	<	<	<	10
Benzene	<	<	<	<	0.5
Ethylbenzene	<	<	<	<	0.5
Toluene	<	<	<	<	0.5
Xylenes	<	<	<	<	0.5
Surrogate Recovery					
Toluene-d8	86	87	88	91	-
Bromofluorobenzene	83	84	83	83	-

Results expressed as micrograms per gram, on a dry weight basis. (μg/g)
Surrogate recoveries expressed as percent (%)
< = Less than detection limit

REPORTED TO: Norecol, Dames & Moore, Inc.

REPORT DATE: September 24, 1996

GROUP NUMBER: 6090406

CANTEST

Monocyclic Aromatic Hydrocarbons in Soil

CLIENT SAMPLE IDENTIFICATION:	WS1	WS4	PWS1	
DATE SAMPLED:	Aug 29/96	Aug 29/96	Aug 29/96	
CAN TEST ID:	609040049	609040053	609040054	DETECTION LIMIT
ANALYSIS DATE:	Sep 8/96	Sep 8/96	Sep 8/96	
Volatile Pet. Hydrocarbons	<	<	10	10
Benzene	<	<	<	0.5
Ethylbenzene	<	<	<	0.5
Toluene	<	<	<	0.5
Xylenes	<	<	<	0.5
Surrogate Recovery				
Toluene-d8	91	92	94	-
Bromofluorobenzene	84	79	92	-

Results expressed as micrograms per gram, on a dry weight basis. (μg/g)
Surrogate recoveries expressed as percent (%)
< = Less than detection limit

REPORTED TO: Norecol, Dames & Moore, Inc.

REPORT DATE: September 24, 1996

GROUP NUMBER: 6090406

CANTEST

Extractable Petroleum Hydrocarbons in Soil

CLIENT SAMPLE IDENTIFICATION:	SAMPLE DATE	CAN TEST ID	LEPH-uncorrected for PAH's	HEPH-uncorrected for PAH's
KS1	Aug 28/96	609040041	940	49000
KS2	Aug 28/96	609040042	620	1700
KS3	Aug 28/96	609040043	<	<
KS4	Aug 28/96	609040044	<	<
KS5	Aug 28/96	609040045	<	<
PS1	Aug 28/96	609040046	<	1100
PS2	Aug 28/96	609040047	<	<
PS3	Aug 28/96	609040048	<	<
WS1	Aug 29/96	609040049	<	<
WS4	Aug 29/96	609040053	<	<
PWS1	Aug 29/96	609040054	<	19000
DETECTION LIMIT			250	250
UNITS			µg/g	µg/g

µg/g = micrograms per gram, on a dry weight basis.
< = Less than detection limit
Sample# 609040041 , 609040042 , 609040046 , 609040054 - The presence of hydrocarbon components with boiling points greater than that of C30 were detected.

REPORTED TO: Norecol, Dames & Moore, Inc.

REPORT DATE: September 24, 1996

GROUP NUMBER: 6090406

CANTEST

Metals Analysis in Soil

CLIENT SAMPLE IDENTIFICATION:		KS1	KS2	KS3	KS4		
DATE SAMPLED:		Aug 28/96	Aug 28/96	Aug 28/96	Aug 28/96	DETECTION LIMIT	UNITS
CAN TEST ID:		609040041	609040042	609040043	609040044		
Metals Analysis							
Moisture		26.8	55.2	42.8	33.5	0.01	%
Antimony	Sb	<	<	<	<	10	µg/g
Arsenic	As	0.17	0.21	0.34	0.20	0.05	µg/g
Barium	Ba	12.3	139	326	176	0.1	µg/g
Beryllium	Be	<	<	<	<	1	µg/g
Cadmium	Cd	0.36	0.52	<	1.61	0.25	µg/g
Chromium	Cr	12	18	39	29	2	µg/g
Cobalt	Co	2	<	16	8	1	µg/g
Copper	Cu	25	22	99	48	1	µg/g
Lead	Pb	31	71	27	147	1	µg/g
Mercury	Hg	0.03	0.13	0.07	0.10	0.001	µg/g
Molybdenum	Mo	<	<	<	<	4	µg/g
Nickel	Ni	5	5	34	20	2	µg/g
Selenium	Se	<	<	<	<	0.5	µg/g
Silver	Ag	<	<	<	<	2	µg/g
Tin	Sn	<	<	<	11	5	µg/g
Vanadium	V	24	9	61	44	0.5	µg/g
Zinc	Zn	425	51	95	132	1	µg/g
Aluminum	Al	5320	3630	29000	20200	10	µg/g
Boron	B	8	6	23	16	0.5	µg/g
Calcium	Ca	1100	2340	2100	3420	1	µg/g
Iron	Fe	15300	8270	45100	33000	2	µg/g
Magnesium	Mg	876	526	5380	4000	0.1	µg/g
Manganese	Mn	125	226	441	296	0.2	µg/g
Phosphorus	PO4	1530	2700	3500	3520	20	µg/g
Sodium	Na	77	49	140	198	5	µg/g
Strontium	Sr	9	16.7	26.0	50.9	0.1	µg/g
Titanium	Ti	101	66	200	191	0.3	µg/g

% = percent

< = Less than detection limit

µg/g = micrograms per gram, on a dry weight basis.

REPORTED TO: Norecol, Dames & Moore, Inc.

REPORT DATE: September 24, 1996

GROUP NUMBER: 6090406

CANTEST

Metals Analysis in Soil

CLIENT SAMPLE IDENTIFICATION:		KS5	PS1	PS2	PS3		
DATE SAMPLED:		Aug 28/96	Aug 28/96	Aug 28/96	Aug 28/96		
CAN TEST ID:		609040045	609040046	609040047	609040048	DETECTION LIMIT	UNITS
Metals Analysis							
Moisture		19.9	14.1	35.2	36.8	0.01	%
Antimony	Sb	<	<	<	<	10	µg/g
Arsenic	As	0.19	0.47	0.57	0.41	0.05	µg/g
Barium	Ba	202	25.4	224	194	0.1	µg/g
Beryllium	Be	<	<	<	<	1	µg/g
Cadmium	Cd	0.28	1.73	0.87	0.84	0.25	µg/g
Chromium	Cr	23	18	20	18	2	µg/g
Cobalt	Co	9	14	9	9	1	µg/g
Copper	Cu	35	96	42	42	1	µg/g
Lead	Pb	23	113	19	19	1	µg/g
Mercury	Hg	0.02	0.02	0.04	0.04	0.001	µg/g
Molybdenum	Mo	<	<	<	<	4	µg/g
Nickel	Ni	23	29	25	25	2	µg/g
Selenium	Se	<	<	<	<	0.5	µg/g
Silver	Ag	<	<	<	<	2	µg/g
Tin	Sn	<	38	<	<	5	µg/g
Vanadium	V	29	18	35	31	0.5	µg/g
Zinc	Zn	65	216	131	122	1	µg/g
Aluminum	Al	10800	6420	11100	9330	10	µg/g
Boron	B	13	18	12	11	0.5	µg/g
Calcium	Ca	2110	34800	15400	15800	1	µg/g
Iron	Fe	26500	52600	25200	24400	2	µg/g
Magnesium	Mg	3710	10000	7030	6940	0.1	µg/g
Manganese	Mn	385	654	514	502	0.2	µg/g
Phosphorus	PO4	1490	4210	25200	3000	20	µg/g
Sodium	Na	102	87	165	120	5	µg/g
Strontium	Sr	20	50.5	37.8	36.7	0.1	µg/g
Titanium	Ti	168	19	243	211	0.3	µg/g

% = percent

< = Less than detection limit

µg/g = micrograms per gram, on a dry weight basis.

REPORTED TO: Norecol, Dames & Moore, Inc.

REPORT DATE: September 24, 1996

GROUP NUMBER: 6090406

CANTEST

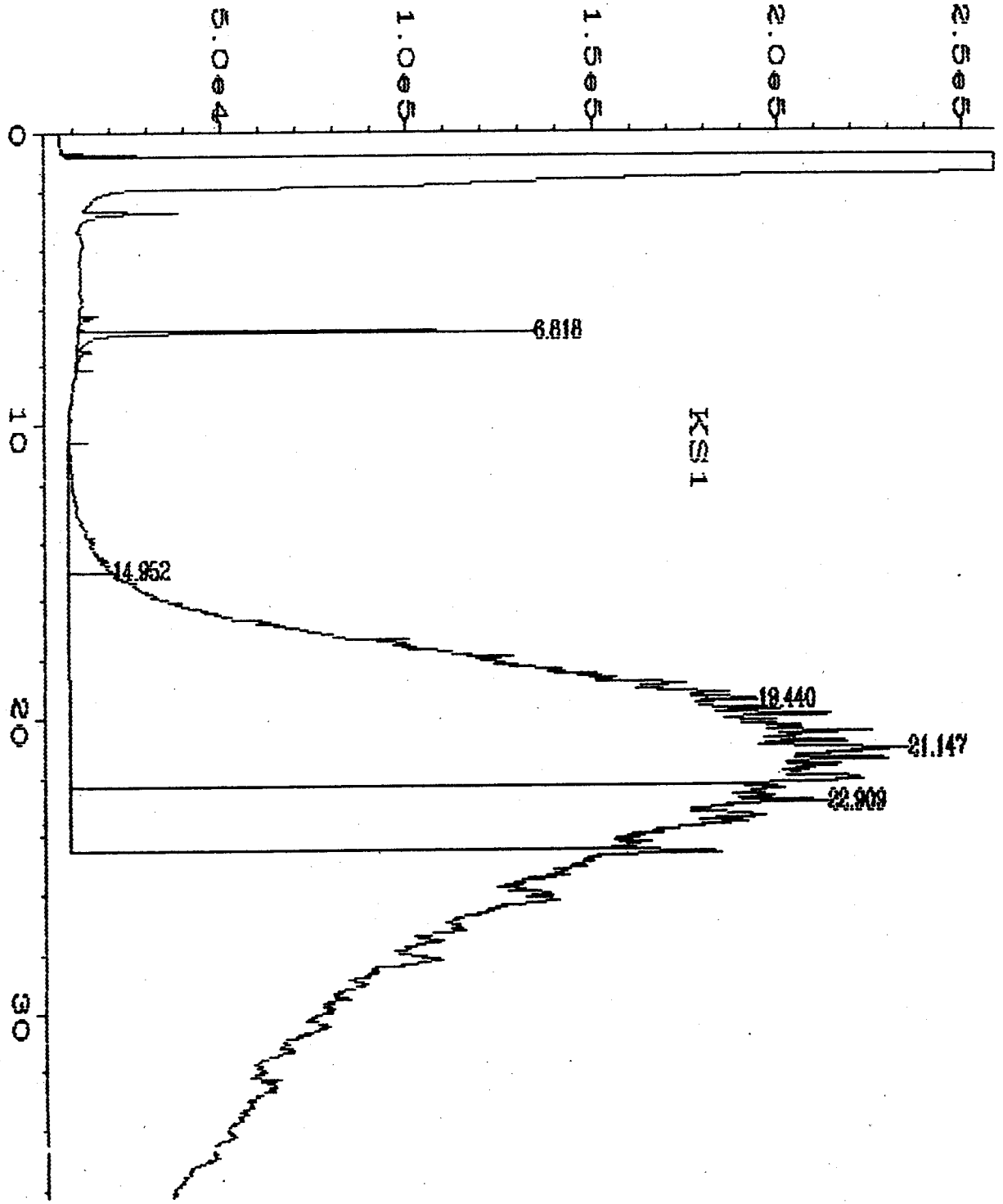
Metals Analysis in Soil

CLIENT SAMPLE IDENTIFICATION:		WS2	WS3	WS4	PWS1	DETECTION LIMIT	UNITS
DATE SAMPLED:		Aug 29/96	Aug 29/96	Aug 29/96	Aug 29/96		
CAN TEST ID:		609040050	609040051	609040053	609040054		
Metals Analysis							
Moisture		16.6	20.5	29.8	9.8	0.01	%
Antimony	Sb	37	59	110	<	10	µg/g
Arsenic	As	0.20	0.14	0.18	0.47	0.05	µg/g
Barium	Ba	49.8	123	63.2	46	0.1	µg/g
Beryllium	Be	<	<	<	<	1	µg/g
Cadmium	Cd	242	35.4	222	18.2	0.25	µg/g
Chromium	Cr	35	18	7	8	2	µg/g
Cobalt	Co	2	12	<	4	1	µg/g
Copper	Cu	79	91	61	110	1	µg/g
Lead	Pb	2730	2350	2720	1720	1	µg/g
Mercury	Hg	1.5	0.06	1.4	0.19	0.001	µg/g
Molybdenum	Mo	<	<	<	<	4	µg/g
Nickel	Ni	12	33	10	14	2	µg/g
Selenium	Se	<	<	<	<	0.5	µg/g
Silver	Ag	35	33	51	<	2	µg/g
Tin	Sn	<	16	<	<	5	µg/g
Vanadium	V	21	24	12	11	0.5	µg/g
Zinc	Zn	16700	1910	17200	1480	1	µg/g
Aluminum	Al	2680	25400	1830	43900	10	µg/g
Boron	B	55	84	46	12	0.5	µg/g
Calcium	Ca	12100	29400	4420	6630	1	µg/g
Iron	Fe	161000	103000	112000	24200	2	µg/g
Magnesium	Mg	16600	2880	9120	2520	0.1	µg/g
Manganese	Mn	23400	2000	40400	2290	0.2	µg/g
Phosphorus	PO4	3020	2740	1760	1700	20	µg/g
Sodium	Na	49	421	116	40	5	µg/g
Strontium	Sr	15.6	182	6.8	12	0.1	µg/g
Titanium	Ti	21.8	18.8	7.9	27	0.3	µg/g

% = percent

< = Less than detection limit

µg/g = micrograms per gram, on a dry weight basis.



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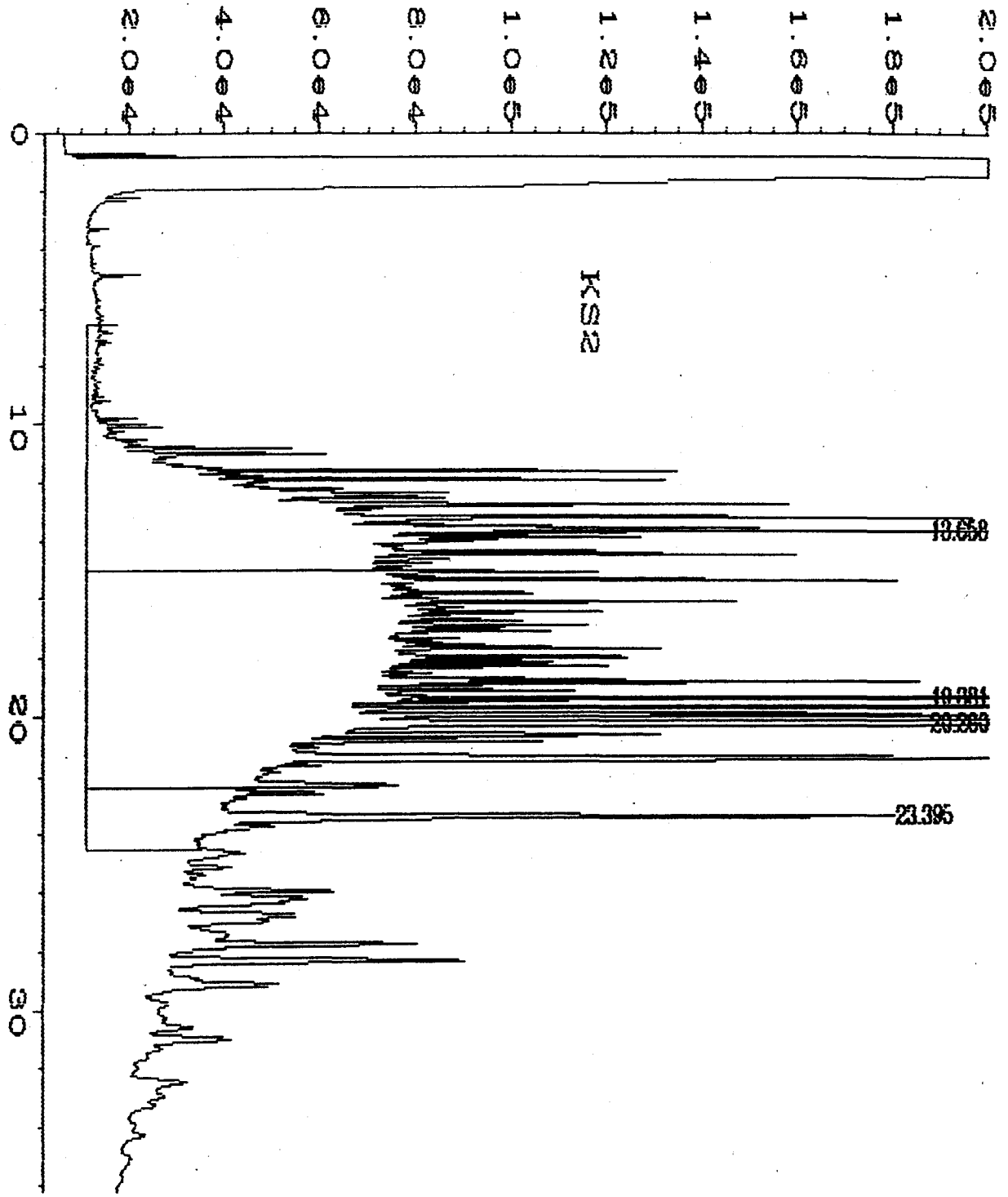
Operator : MK
Instrument : FID
Sample Name : 609040041-60ML
Path Time Bar Code:
Acquired on : 07 Sep 96 06:28 AM
Report Created on: 11 Sep 96 11:01 AM

Page Number : 1
Vial Number : 59
Injection Number : 1
Sequence Line : 11
Instrument Method: TEHBAKE.MTH
Analysis Method : !TEH.MTH



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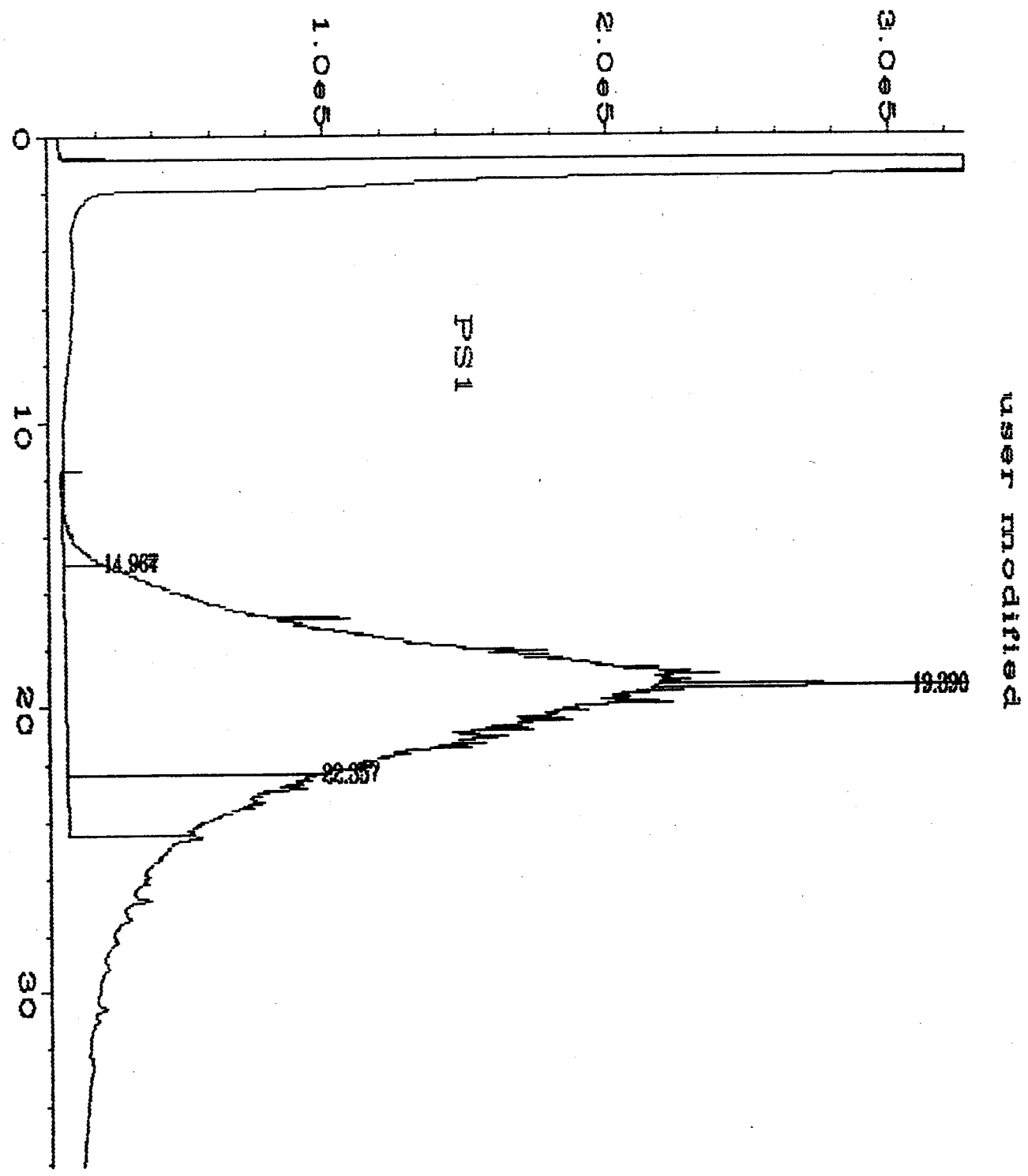
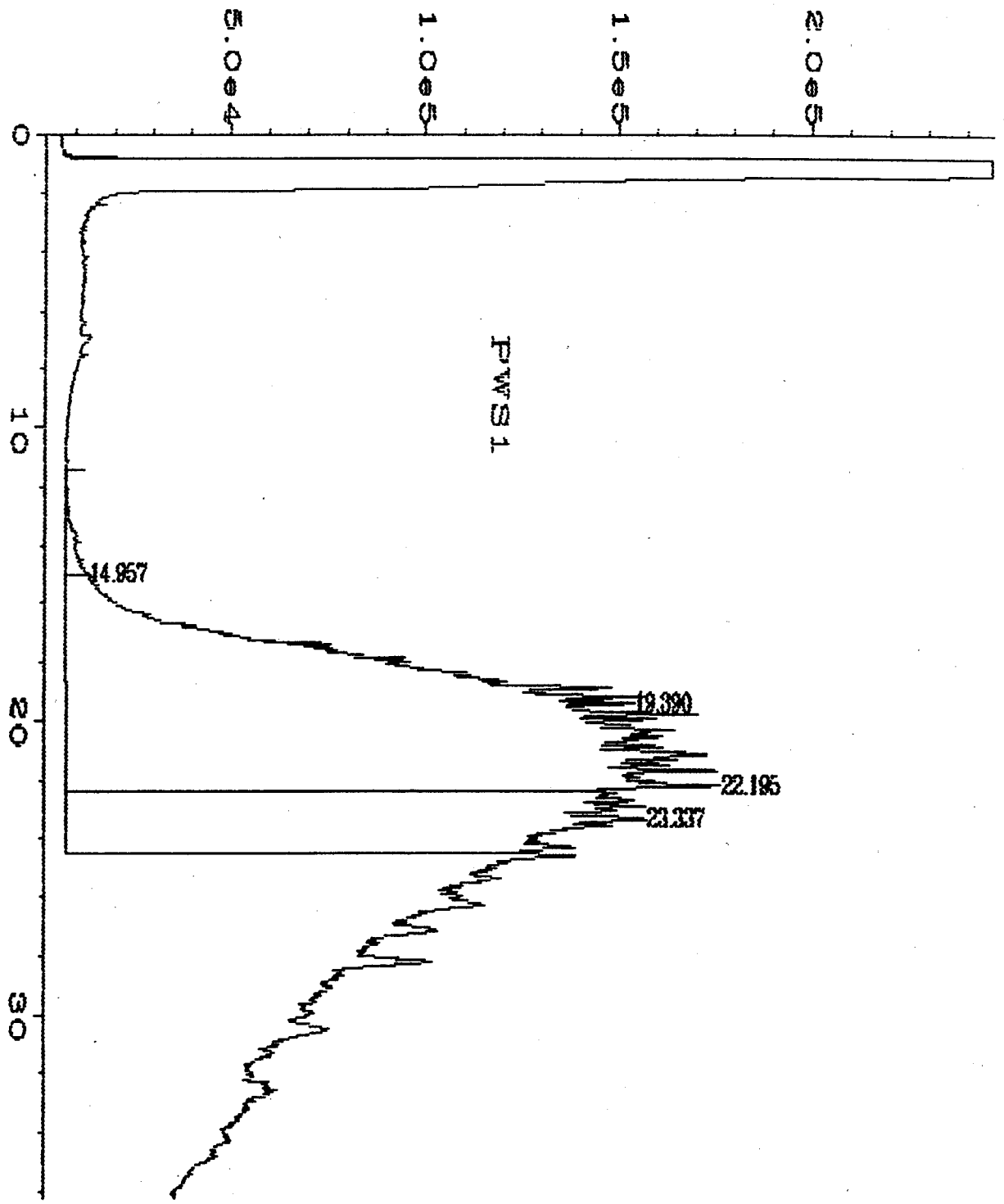
Operator : MK
Instrument : FID
Sample Name : 609040042
Run Time Bar Code:
Acquired on : 07 Sep 96 07:11 AM
Report Created on: 10 Sep 96 06:19 PM

Page Number : 1
Vial Number : 60
Injection Number : 1
Sequence Line : 11
Instrument Method: TEHBAKE.MTH
Analysis Method : !TEH.MTH



Data File Name : C:\HPCHEM\FID\DATA\090696\065F1301.D
Operator : MK
Instrument : FID
Sample Name : 609040046
Run Time Bar Code:
Acquired on : 07 Sep 96 11:35 AM
Report Created on: 10 Sep 96 06:36 PM

Page Number : 1
Vial Number : 65
Injection Number : 1
Sequence Line : 13
Instrument Method: TEHBAKE.MTH
Analysis Method : !TEH.MTH



Data File Name : C:\HPCHEM\FID\DATA\090696\071F1501.D
Operator : MK
Instrument : FID
Sample Name : 609040054-40ML
Run Time Bar Code:
Acquired on : 07 Sep 96 04:43 PM
Report Created on: 10 Sep 96 07:26 PM

Page Number : 1
Vial Number : 71
Injection Number : 1
Sequence Line : 15
Instrument Method: TEHBAKE.MTH
Analysis Method : !TEH.MTH

APPENDIX C

PHOTOGRAPHS

View of waste rock piles and abandoned tramway.

PHOTO 1

View of abandoned tramway and electrical poles.

PHOTO 2

View of trenches, waste rock and shaft structure.

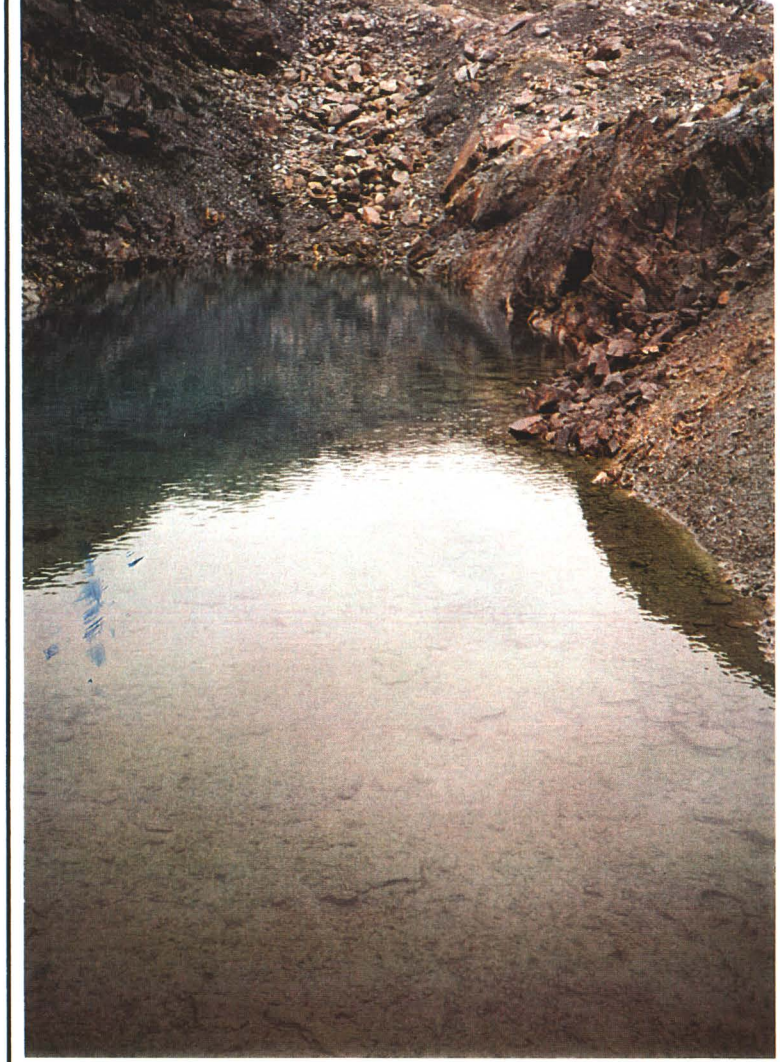
PHOTO 3

View of surface water in trenches and waste rock.

PHOTO 4

Surface water draining off-site.

PHOTO 5



Surface water in trench.

PHOTO 6

APPENDIX D

CANTEST LABORATORY QA/QC

CANTEST HISTORY AND DESCRIPTION

CANTEST Ltd. is a full service laboratory offering a broad spectrum of analytical services. In addition to providing superior, professional support in the air quality, environmental and industrial fields, CANTEST is often called upon by those in the areas of nutrition and biology as well as clinical and veterinary medicine.

Since incorporation in 1969, CANTEST has grown to become one of the largest independent laboratories in Western Canada. Originally started with a staff of five and two thousand square feet, the company now employs 85 chemists and technicians and occupies ten times the original laboratory space. As a member of the CANAM Group of Laboratories, CAN TEST belongs to an environmental testing network which ranks in the top twenty within North America based on revenues obtained through a survey conducted by IAETL. Revenues have generally doubled every five years and the client base now exceeds 1500.

It should be noted that CANTEST has clearly exhibited innovation with respect to methodology as the company was the first independent facility in Western Canada to employ Gas Chromatography/Mass Spectrometry (GC/MS), Inductively Coupled Argon and Plasma (ICAP) Spectroscopy, and Liquid Chromatography/Mass Spectrometry (LC/MS).

Located in Vancouver, B.C., the 25,000 square foot laboratory was designed specifically for a diversified and safe working environment. There are thirty one fumehoods, three walk-in refrigerators for sample storage, and twenty one individual working areas.

QUALITY ASSURANCE

CANTEST provides a comprehensive program of laboratory services in the areas of environmental, industrial food microbiological and air quality testing Conclusions based on the analytical data generated by CANTEST may have significant impact on the assessment of environmental quality and workplace safety as well as on the economic burden placed on industry and the public. Therefore,

Confidentiality

These policies are consistent with regulatory guidelines and establish traceability of reagents, standards, samples, and analytical data. The standard operating procedures also provide for the complete documentation relative to the analysis and the reporting of data. This ultimately assures the validity and legal defensibility of the results reported by CANTEST.

Documentation

Chain of Custody relative to the collection of samples begins in the field. As such, the appropriate documentation is initiated at the time of collection by the client. The information submitted with the samples includes specific sample collection data, the identity of the sampler, time and date of collection and the analyses required. Field sampling by CANTEST personnel is documented in this fashion on CANTEST Chain of Custody Form.

At the time of receipt, the CANTEST sample custodian inspects the shipment, and assigns the sample a unique specific identifying number automatically generated by the Laboratory Information Management System (LIMS). With the assistance of the LIMS, the sample custodian enters the following information into the permanent sample record:

Date of receipt
Client demographic information
Client sample identification
Analyses requested

For all sample submissions, a sample transfer sheet is generated as part of the documentation package and follows the sample set through the laboratory during storage, sample preparation, generation of raw data and final reporting.

The samples are stored under conditions which maintain the viability of the parameters being analyzed. Typically this involves storage at 4 degrees Celsius for environmental samples. Special storage facilities are available for samples requiring additional security storage.

steps are taken to identify the source and eliminate or minimize the contaminant. Blanks are analyzed at a minimum frequency of one blank per sample set or at a level of ten percent.

The Analytical Method determines whether or not the blank values are subtracted from the analytical data prior to reporting.

Accuracy

Accuracy refers to the relationship of an analysis value to the true value. Accuracy can be determined by analysis of Standard Reference Materials (SRM's) obtained from reliable sources (e.g. NIST, EPA). Where SRM's or performance samples are not available, samples are "spiked" with a known quantity of the analyte at the beginning of the analysis. If the value obtained for the reference material or spike is not within a statistically acceptable range of the true value, the procedure is reworked to identify and correct the problem, and the sample set is reanalyzed. Accuracy Checks (SRM's or Spikes) are analyzed at a minimum frequency of one per sample set or at a level of ten percent.

Precision

Precision is a the measure of the reproducibility of an analysis. Precision is monitored by replicate analysis of samples. If the percentage variation between replicates is not within acceptable limits for the specific test, the procedure is reworked to make the precision acceptable and the sample set is reanalyzed. Precision checks (analysis of samples in duplicate) is performed at a minimum frequency of one per sample set or at a level of ten percent.

Standard Calibration Curves

At the beginning of each applicable analysis, a minimum of three standards are run in conjunction with the samples to provide a working standard curve. Calibration verification standards are analyzed upon completion of the standard curve. These solutions of known concentrations serve to verify the validity of the standard curve prior to the analysis of the samples. The samples are then quantified using the responses of the calibration curve. Samples are diluted or concentrated if necessary to fall within the working limits of the standard curve. The standard curve also functions as a check of the

1. CAEAL/SCC: CANTEST is accredited for a number of chemical and microbiological tests and as such are registered with the Canadian Association of Environmental Analytical Laboratories (CAEAL) and Standards Council of Canada (SCC).

The CAEAL/SCC accreditation is the formal recognition that an environmental analytical laboratory is competent to carry out specified tests. This implies that a laboratory's capability and performance be evaluated through the use of site inspections and performance evaluation samples. The current program encompasses a site inspection once every two years and the satisfactory participation in interlaboratory comparisons twice a year. Failure to meet specified requirements results in the withholding or removal of accreditation. The CAEAL/SCC certificate(s) are included in Appenix I.

Interlaboratory Studies (Round Robin Data)

Capacity and experience is only a secondary measure o a laboratory's capability as a commitment to the highest achievable quality result must be paramount. CANTEST clearly demonstrates this objective through its involvement in performance evaluation studies, both internally and externally.

As part of its effort to ensure excellent data quality, CANTEST has participated in approximately 140 environmentally orientated interlaboratory studies over the last three years. A brief list of some of the most recent undertakings include:

- CAEAL Certification and Accreditation Program
- B.C. MOELP EDQA Program
- U.S. EPA Performance Evaluation Samples
- Fisheries and Oceans Mercury in Fish Quality Assurance Program
- Ontario Ministry of Environment Interlaboratory Studies
- Federal/Provincial Quality Assurance Program (GLAP)
- Canadian Association of Pesticide Control Officers(CAPCO)
- Agriculture Canada Accreditation Check Sample Programs
- AIHA/NIOSH PAT program
- Regional Asbestos Round Robin Program
- UBC Clinical Microbiology Proficiency Testing

PRICING

Pricing is based on the proposed number of samples expected over the contract period. A volume discount has already been calculated based on this volume and is reflected in the quoted prices. Thus, the number of samples submitted at any one time will not affect the analytical charges for that submission. In some cases the analysis time can be decreased to accommodate specific requests. These rush turnaround times are typically in the order of 48 hours and normally result in a surcharge of approximately 25%. These surcharges may be waived if adequate advance notice is provided and laboratory capacity is such that "rush" work can be accomodated. There are certain instances where it is physically impossible to complete an analytical procedure in 48 hours and thus it is recommended that non-routine turnaround requests be handled on a job-by-job basis. See the attached tables for details on specific pricing for soil or water.