HEMMERA
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OCP REMEDIATION INFORMATION PACKAGE

Brooks Brook
Yukon Territory

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1.0 INTRODUCTION

The following information and drawings ("the information package") are intended for use in the development of a remediation plan ("the work plan") for organochlorine pesticide (OCP) contaminated soil ("the contaminated area") identified at Brooks Brook near Teslin, Yukon (Figure 1). This information package presents a summary of the available information on the contaminated area and provides requirements for the development and completion of the work plan.

1.1 Previous Investigation

Hemmera Resource Consultants Ltd (Hemmera) completed three phases of investigation in the vicinity of the contaminated area. Previous investigations by Royal Military College of Canada (RMC) Environmental Sciences Group (ESG) in 1997 had indicated that one soil sample collected south of the new cook shack (Figure 2) had elevated concentrations of OCPs. In 1997, Hemmera advanced three test pits in this area and collected soil samples for analysis. The results of these analyses indicated moderately elevated concentrations of OCPs. It was felt that further investigation was required in light of the concentrations of OCPs detected. A grid of surface and shallow near surface sampling locations was laid out and soil samples were collected from surface and at a depth of approximately 20 to 30 cm (Figure 3). These samples were submitted to the project laboratory for analysis of concentrations of OCPs. The results of the analysis of these soil samples indicated that OCPs were widely dispersed over the sampling grid and that the full extent of the contamination had not been delineated. It was decided that a third sampling event in 1998 was to required with field testing of soil samples in order for the full extent of the OCP contaminated soil to be determined in the field. In addition, test pits were advanced to a depth of 1.5 metres at four locations in the grid. Test pit locations were chosen based on the analysis of surface sample. Representative locations with high OCPs concentrations in surface soil samples were targeted. Samples were

collected every 0.25 metres of vertical depth in each test pit. An immunoassay field test kit was used to determine concentrations of total OCPs. Using the results of the field testing, the extent of the OCPs contamination was delineated. In order to ensure that the field testing results were valid, duplicates of the field testing samples were analyzed at the project laboratory in Vancouver, B.C. The results of the analysis of the soil samples at the project laboratory indicated that the full extent of the OCP contamination within the sampling grid had been delineated.

The results of the analysis of the soil samples indicated that the depth of the OCP contamination is less than 1.25 metres over the entire site. Since the test pits were advanced at locations that had the highest concentrations of OCPs in surface samples, at other areas with lower concentrations at surface, it is likely that the OCP contamination is much shallower. The estimated volume of material contaminated with concentrations of OCP in excess of 0.5 ppm individual OCPs is approximately 4125 m^3 if a contaminated depth of 1.375 metres is adopted. This depth of contamination was calculated based on one test pit with a sample at 1.25 metres having concentrations of individual OCPs in excess of 0.5 ppm and a sample at 1.5 metres having concentrations of individual OCPs less than 0.5 ppm. However, in three of the four test pits advanced to test the depth of OCP contamination, the maximum depth of contamination using the 0.5 ppm individual OCP criteria was 0.5 metres. Therefore, assuming that, over the entire area contaminated with individual OCPs in excess of 0.5 ppm, the average depth of contamination is 0.625 metres (using the same calculation for depth of contamination as above), then the total volume of contaminated soil is approximately 1875 m^3. This volume should be used as the approximate volume of soil requiring remediation. The volume of contaminated soil may increase due to the presence of areas with elevated OCP concentrations at depths greater than 0.625 metres. The test pitting was not extensive enough to fully delineate the vertical extent of OCP contamination across the entire grid. Figure 4 shows the extent of soil contaminated with concentrations of DDT in excess of 0.7 ppm.

During the previous investigations at the site, an area of soil contaminated with concentrations of heavy extractable petroleum hydrocarbons (HEPH) was detected. The location of exceedances are shown on Figure 5. This HEPH is limited to depths shallower than 0.2 metres and is entirely contained within the intended excavation for the removal of OCP contaminated soil.

1.2 Scope of Work and Objectives

The scope of work for his project will be the remediation of OCP contaminated soil in the vicinity of the new cook shack through excavation and off-site removal of soil (Figure 2).

The objective of this work is the remediation of OCP contaminated soil such that residual DDT concentrations in soil are less than 0.7 ppm.

1.3 Remedial Criteria

The remedial criteria to be used for this project is 0.7 ppm DDT. In order to obtain field confirmation of the concentrations of OCP remaining in the soil, an immunoassay test kit will be used on-site. This field test kit is unable to differentiate between DDD, DDE and DDT. Additionally, the test kit is set up such that one of the standard references to complete the test is set at 0.5 ppm DDD + DDE + DDT. Thus, in order to avoid unnecessary dilution of reference standards in order to get a 0.7 ppm reference standard, which may result in errors, a field criteria of 0.5 ppm DDD + DDE + DDT will be used. This will also provide for a margin of error. All confirmation samples will be split into duplicates and the split will be analyzed at the project laboratory in Vancouver to determine if indeed the concentration of DDT is less than 0.7 ppm. The field test kit has been used as part of the previous investigation at this site and it has proven to be an accurate tool for the assessment of OCP concentrations in soil. All soil samples will be

homogenized prior to testing to ensure that the field testing and laboratory testing will not be biased by the nugget effect.

2.0 WORK PROGRAM

The work program for this project will incorporate a number of key components:

- Health and safety;
- Site preparation;
- Logistics;
- Excavation;
- Materials handling;
- Materials disposal;
- Confirmation sampling; and
- Site closure.

2.1 Health and Safety

Health and safety will be a key component of this project. The following sections discuss the health and safety requirements for this project.

2.1.1 Site Safety Plan

A comprehensive Site Safety and Health Plan (Site Safety Plan) to be implemented at the Brooks Brook Camp site during the remediation program in accordance with the guidelines issued by the U.S. National Institute for Occupational Safety and Health (NIOSH) *(Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities)* and the *Yukon Occupational Health and Safety Handbook* (Yukon Workers Compensation Health and Safety Board 1992) as outlined below. The purpose of the Site Safety Plan is to establish requirements for protecting the health and safety of field personnel during the activities conducted on the site. The plan has been prepared to

ensure that the consulting and contractor's personnel are suitably protected during remediation operations until such time as the soils have been confirmed to be at non-hazardous levels. The plan contains safety information, instructions and procedures. This plan will be reviewed on an ongoing basis as the work progresses and will be modified as needed.

2.1.2 Scope and Objectives

The objectives of the Site Safety Plan are to protect the health and ensure the safety of personnel on the site by specifying standard safety procedures; outlining the types of personal protection and safety equipment which will be required on this site; describing clean up procedures; showing lines of authority, responsibility and communication; and providing emergency procedures should they be needed. The guidelines issued by the U.S. National Institute for Occupational Safety and Health (NIOSH) were used as a reference to develop this plan. Commonly practised Occupational Health and Safety (OH&S) requirements and specific Yukon WCB Health and Safety regulations will apply. The plan has been developed before site activities proceed and will be modified as needed for every stage of site activity.

The remediation activities that will be undertaken by the contractor involve:

- Implementation of health and safety procedures including this Site Safety Plan at the site;
- Implementation of site controls including marking work zones (discussed later in this document);
- Site preparation including demolition or removal of existing on-site building and removal of trees on-site using chain saws and possibly a wood chipper;
- Removal and disposal of contaminated soil and debris;

- Clean-up activities.

The advisory aspects of this project to be completed by the technical consultant include:

- Delineation of extent of excavation;
- Confirmatory sampling and field analysis of soils on walls and base of the excavation;
- Staging activities such as sampling/analysis of collected materials and labeling of containers;
- Observation of clean-up activities; and
- Ensuring proper closure of the site including backfilling and grading.

The plan includes the following:

- An evaluation of previous site reconnaissance, the identification of known hazards and evaluation of the risks associated with the site activities;
- A description of the actions to be taken to mitigate existing hazards to make the work environment less hazardous;
- A description of site control measures;
- A description of the protective clothing and equipment to be worn by personnel during various site operations;
- A description of any site-specific medical supply requirements;
- An outline of key personnel and alternates that should be identified regarding responsibility for site safety, emergency response and the protection of team members;
- A description of dust control measures if needed;
- Establishment of decontamination procedures for personnel and equipment;

- The site's Standard Operating Procedures (SOPs). SOPs are activities that can be standardized (such as decontamination) and where a checklist concerning completion of the procedure can be used;
- A Contingency Plan for safe and effective response to emergencies; and
- Outline of Site Safety meetings and inspections.

This Site Health and Safety Plan will apply to all persons working at the Brooks Brook Camp site during the remediation project. Any subcontractors involved in the activities will be made aware of the procedures and will be responsible for ensuring their staff conform to the most recent version of the Site Safety Plan. Prior to the commencement of the remediation project, all personnel will attend a health and safety workshop that will include information of the hazards of the work and work area and training in the proper care, use and limitations of the personal protective equipment. All unauthorised persons will be kept out of the work area.

2.1.3 Site Characterization and Background

Investigations completed in 1997 (ESG 1997, and Lorimer and Hemmera 1997) and 1998 (Hemmera 1998) indicated the soil surrounding the new cook shack at Brooks Brook is contaminated with concentrations of organochlorine pesticides (OCP). The estimated volume of material contaminated with concentrations of OCP in excess of 0.5 ppm individual OCPs is approximately 4125 m^3 if a contaminated depth of 1.375 metres is adopted. This depth of contamination was calculated based on one test pit with a sample at 1.25 metres having concentrations of individual OCPs in excess of 0.5 ppm and a sample at 1.5 metres having concentrations of individual OCPs less than 0.5 ppm. However, in three of the four test pits advanced to test the depth of OCP contamination, the maximum depth of contamination using the 0.5 ppm individual OCP criteria was 0.5 metres or less. Thus, assuming that, over the entire area contaminated with individual

OCPs in excess of 0.5 ppm, the average depth of contamination is 0.625 metres (using the same calculation for depth of contamination as above), therefore reducing the total volume of contaminated soil to approximately 1875 m^3.

The NIOSH guidelines for assessing chemical and physical hazards were used to determine the level of worker protection anticipated to be required when working around the excavated soils. The level of worker protection may be adjusted as required during the completion of the work program.

2.1.4 Pre-Excavation Activities

Prior to the excavation of the contaminated soils the site requires some preparation. It is assumed that the cook shack will be demoished or moved prior to the implementation of the remedial program. Field personnel involved with the cook shack demolition/removal will be required to follow applicable Yukon WCB regulations regarding building demolition, including wearing personal protective equipment as appropriate. At the very least this would involve wearing hard hats, steel toed/shanked boots and eye protection. Temporary fencing will be erected around the work zone and signs installed indicating the work zone area requiring personal protective equipment will be posted in highly visible areas. Some small trees on the site may require removal prior to the excavation. Chain saws used on-site must comply with the *Yukon Occupational Health and Safety Handbook* sections GS43 (1) to (3). These sections discuss the chain saw design requirements and handling techniques. Chain saw operators must where leg protective devices (as per section GS6 (2)), ear protection, protective eyewear and steel toed/shanked boots. It is expected that pre-excavation activities will not involve any exposure of sub-surface soil. If sub-surface soil is exposed, appropriate personal protective equipment must be worn and the Site Safety Plan requirements will be followed.

2.1.5 Remediation Activities - Hazards, Hazard Mitigation, Personnel Protective Equipment

The NIOSH guidelines for assessing chemical and physical hazards were used by the Consultant to determine the level of worker protection required when working around excavated soils.

Hazards that may be present at the site, hazard mitigation and personnel protective equipment required are detailed below.

2.1.5.1 Chemical Exposure

The hazardous chemicals on the site may be in gaseous, liquid and solid form. Substances can enter the unprotected body by inhalation, skin adsorption, ingestion or injection (through a puncture wound). The effects of exposure depend on the chemical, its concentration, route of entry, duration of exposure and by personal factors (sex, age, smoking habits, alcohol consumption, medication use and nutrition).

The principal contaminant of concern is organochlorine pesticides, primarily DDT (dichlorodiphenyltrichloroethane).

Table 1 provides a list of the individual chemicals and the exposure limits as listed in the NIOSH *Pocket Guide to Chemical Hazards* 1997. Not all of the individual chemicals are listed in the NIOSH Guide. Other contaminants of concern not listed in the NIOSH Guide are DDE and DDD.

Table 1
Exposure Limits for Contaminants of Concern

Chemical	Exposure Limits (TWA unless noted otherwise)	IDLH
Organochlorine Pesticides		
Aldrin	Ca; 0.25 mg/m^3 (skin) NIOSH/OSHA 0.25 mg/m^3 (skin) Yukon OH&S	25 mg/m^3 0.75 mg/m^3 (skin)
DDT	Ca; 0.5 mg/m^3 NIOSH 1 mg/m^3 (skin) OSHA 1 mg/m^3 Yukon OH&S	500 mg/m^3 3 mg/m^3
Dieldrin	Ca; 0.25 mg/m^3 (skin) NIOSH/OSHA 0.25 mg/m^3 (skin) Yukon OH&S	50 mg/m^3 0.75 mg/m^3 (skin)
Heptachlor	Ca; 0.5 mg/m^3 (skin) NIOSH/OSHA 0.5 mg/m^3 (skin) Yukon OH&S	35 mg/m^3 1.5 mg/m^3 (skin)

TWA: Time-Weighted Average (10 hour work day and 40 hour work week limit)
IDLH: Immediately Dangerous to Life and Health (30 minute escape time)
Ca: Carcinogen
OSHA: Occupational Safety and Health Association
Shaded areas indicate main contaminant of concern.

Since DDT has the lowest TWA exposure limit for air and is the contaminant with the highest concentration in the soil, the selection of respirator personal protective equipment will be based on the DDT exposure limit. Other personal protective equipment chosen will be based on aldrin and dieldrin due to their low skin exposure limit.

Since field personnel will be required to observe set decontamination procedures outlined below, ingestion is not considered a likely exposure route. The main exposure pathway is

likely the inhalation of contaminated airborne dust. The main receptors likely to be impacted by the dust would be field personnel involved with the supervision and monitoring of the excavation. Secondary receptors will likely be the operators of the excavation equipment and truck drivers.

The individual OCPs are semi-volatile to volatile. Volatilization loss will vary with the concentration of DDT, proportion of soil organic matter, proximity to soil-air interface and the amount of sunlight. The probable airborne concentrations of DDT and total organochlorine pesticides were estimated by Kerr Mellor Associates (See Attachment A) and compared against the exposure limit for DDT specified by NIOSH. Default values as specified in *Soil Screening Guidance: Technical Background Document, 2nd Edition*, USEPA Office of Solid Waste and Emergency Response (EPA/540/R95/128, May 1996) were used in the calculations. The estimated airborne concentration of DDT during the remedial work was estimated to be 2.17×10^{-5} mg/m^3. This concentration is well below the NIOSH and Yukon TWA exposure limits. Similarly, the estimated total airborne concentration of all organochlorine pesticides is 5.02×10^{-5} mg/m^3. This value is also well below the regulatory exposure limits.

Therefore, to prevent exposure from inhalation conventional good quality dust masks will be the required proper respiratory equipment to be used by all personnel at the site. If the remedial works are expected to continue for longer than one week air quality monitoring will be required. The air quality monitoring requirements are detailed in section 2.1.8. If indicated by the air quality monitoring results the respiratory equipment will be modified as required.

Heavy equipment operators will enter or exit their cabs on the periphery of the excavation area, away from the excavation. Truck drivers will not leave their cabs, except in the case of an emergency, while in the work zone. Both heavy equipment operators and

truck drivers should wear seat belts, and keep their windows rolled up and ventilation off in order to reduce the risk of exposure. The need for respiratory equipment for the secondary receptors will be evaluated on site depending on exposure risks and adherence to the outlined procedures.

The contaminants of concern are in solid form in the soil, therefore the main routes of exposure will be by inhalation of contaminated air borne dust and by dermal exposure. To control dust the excavation and any stockpiled soil will be wetted, using a pump and hose, by the contractor under the supervision of technical consultant's staff. Water will be pumped from the adjacent lake.

Direct contact of the skin and eyes by hazardous substances will be eliminated where possible by wearing protective equipment, not using contact lenses in contaminated atmospheres, keeping hands away from the face, and minimizing contact with the liquid and solid chemicals. Personnel at risk (working within the work zone) will be required to wear syranex coated tyvek suits that will be sealed using duct tape at the wrists and ankles. Rubber boots or tyvek booties will be worn to prevent contaminants from entering through footwear. Hands will be protected by nitrile gloves. Personnel will be required to wear safety goggles. All work clothes will be left at the site.

Personal habits such as chewing gum or tobacco, drinking, eating, smoking cigarettes, and applying cosmetics on site will be prohibited to prevent the risk of ingestion. To prevent injection, safety shoes with steel toes and steel shanks will be worn, physical hazards avoided and common sense precautions taken.

2.1.5.2 Explosion and Fire

Explosions or fires can result from site activities, such as moving drums, accidentally

mixing incompatible chemicals, or introducing an ignition source at or near to a flammable area. To prevent the risk of explosion or fire all potential ignition sources will be kept away from the site and safe practices will be followed when performing any task that might result in the agitation or release of chemicals.

2.1.5.3 Oxygen Deficiency

If there is a risk of oxygen deficiency at the site appropriate personal protective equipment will be used. The person or persons working nearest the excavation will be required to wear self-contained breathing apparatus with a full face positive pressure mask. No confined space entry will be allowed.

2.5.1.4 Safety Hazards

Numerous safety hazards may be found on the site such as: holes or ditches, sharp objects, precariously positioned objects, slippery surfaces, steep grades, uneven terrain and unstable surfaces. Heavy equipment on site creates a hazard as does impairment of worker hearing, vision and agility due to protective equipment. Site personnel will be constantly on the look out for potential safety hazards and will immediately inform their supervisors of any new hazards so that mitigative action can be taken.

"Striking" injuries will be avoided by personnel walking cautiously around the site to avoid tripping. In addition a high level of housekeeping, orderly workplace conditions and effective environmental quality control will be implemented. "Struck-by" injuries will be avoided by personnel staying clear of the heavy equipment operating on the site. Care should especially be taken when the vehicles are reversing as the operator usually has a more limited field of view. All personnel on site will be required to wear approved hard hats and steel toed/shanked safety boots.

Heavy equipment operators will be required to wear seat belts when operating the equipment.

2.1.55 Heat Stress

Heat stress is a major hazard, especially for workers wearing protective clothing. Avoiding overprotection, careful training, monitoring of personnel wearing protective clothing, judicious scheduling and rest periods, and frequent replacement of fluids will help avoid this hazard.

2.1.5.6 Cold Exposure

To guard against cold injury, personnel will wear appropriate clothing, have warm shelter readily available, have carefully scheduled work and rest periods, and have physical conditions monitored.

2.1.5.7 Noise

If employees are subjected to noise equal to or exceeding an 8-hour time-weighted average sound level of 85 dBA, a continuing, effective hearing conservation program will be implemented. Heavy equipment operators and personnel working near heavy equipment for extended periods of time will be required to wear ear protection in the form of appropriate ear muffs or ear plugs.

2.1.6 Site Controls

Site controls minimize the potential contamination of personnel, protect the public from

the site's hazards and prevent vandalism.

The work zones are divided into three general areas outlined below:

- Exclusion Zone: the contaminated area;
- Contamination Reduction Zone: the area where personnel and equipment decontamination occurs; and
- Support Zone: the uncontaminated area where personnel should not be exposed to hazardous conditions.

The Exclusion Zone will be the area where primary remediation will take place. This area will be clearly marked by lines, placards and hazard tape and/or signs. All personnel working within the Exclusion Zone will be required to wear personal protective equipment appropriate to their work task. The Contamination Zone is the transition area between the contaminated and clean areas. Decontamination procedures for personnel and equipment will occur in this area. Personnel should remove any protective equipment in this area before exiting to the Support Zone. This area will be surrounded by a locked fence with clearly visible signage to keep out unauthorized persons.

2.1.7 Key Personnel and Medical Supplies

Emergency response and medical emergency procedures will be established prior to commencing the remediation project. A medical data sheet (see Attachment B) will be completed by all on-site personnel and will be located in the Support Zone. All personnel will familiarize themselves with the procedures prior to initiating the on-site work program. A list of emergency contact names and telephone numbers, including project managers and nearest medical personnel and emergency services, will be provided prior to the commencement of the remedial work. The Emergency Contact List will be readily

available at the site in the Support Zone. Personnel should immediately inform the Health and Safety Officer (HSO) if they are experiencing any distress or if an emergency situation arises. The employer will maintain a site record of injuries as per Section E, item 7, (1), Yukon *Occupational Health and Safety (OH&S) Handbook*

First aid will be provided in accordance with Section E, Minimum First Aid Regulations, Yukon *OH&S Handbook.* The remedial work would be classified as a Class "A" hazard. Since the site is more than 20 minutes of surface travel time to the nearest hospital, Table 3 (Section E) will be used for determining the first aid requirements. Requirements are based on the number of workers on-site per shift. For example, if 6 to 10 workers are on-site the first aid requirements would be: #2 Unit First Aid Kit (contents defined in Section E, OH&S Handbook); stretcher and three blankets; St. John Standard First Aid Certificate; and a designated Emergency Transportation Vehicle (ETV). The first aid requirements in Table 3, Section E, OH&S Handbook will be consulted and provided prior to the commencement of the remedial work. An eye wash station and the appropriate first aid kit will be available in the Contamination Reduction Zone. Additionally, an adequate means of communication will be provided and maintained between the site and base operations or outside assistance.

2.1.8 Air and Personnel Monitoring

Airborne contaminants may present a threat to worker health and safety. In an effort to identify and quantify the contaminants air monitors will be installed on the perimeter fence, on the excavator operator and on the worker nearest to the excavation (high-risk worker). Air monitoring will be conducted for concentrations of organic vapours in the air. Monitors installed at the perimeter of the fence will ensure that contaminants are not leaving the site above exposure levels. The air monitoring filters will be sent to the

project laboratory for analyses. The personal air monitor will allow the respiratory equipment required to be reassessed as the work progresses.

Personnel should endeavour to work upwind of the contamination.

2.1.9 Decontamination Procedures

All equipment will be washed before leaving the site. A wheel washing station will be set up to clean the wheels and undercarriage of all equipment leaving the site. Upon final demobilization from the site, all equipment will be steam cleaned. Wash water will be collected and disposed of as contaminated material.

Site personnel will be required to wear appropriate safety equipment while on site. All personnel leaving the site will be required to wash and rinse safety equipment, including gloves, boots and respirator. Safety equipment will then be removed and hands and face washed. Respirators will be kept on until all other equipment removal and washing (including face washing) have been completed.

2.1.10 Standard Operating Procedures (SOP)

The Health and Safety Officer (HSO) designated for this program will have the responsibility of ensuring that the appropriate safety procedures are followed with regard to the site activities. A HSO will be identified and be responsible for implementing health and safety requirements for the project.

2.1.11 Site Personnel Requirements

Site personnel must:

- Be aware of the potential hazards which they may encounter on the site and follow set procedures in the event of an emergency;
- Avoid unprotected contact with any contaminated soil or moisture from the soil due to walking through the soil, kneeling or sitting in the sampling area, or touching equipment which may have come in contact with the soil;
- Not wear contact lenses in the contaminated area;
- Wear required protective equipment at all times while in the sampling area. If vapours are encountered personnel having any facial hair or jewellery which would interfere with the proper functioning of the safety equipment should retreat from the site;
- Heavy equipment operators are required to wear seat belts when operating the machinery; and
- Shower at the end of each day.

Site personnel must NOT:

- Consume any food or drink, chew gum or tobacco, or smoke while on site;
- Consume any alcoholic beverages, or prescription drugs which may have a deleterious effect on their abilities to perform their tasks during the day in which they are working; and
- Act in any way which is less than completely professional and safe.

2.1.12 Emergency Response Plan and Chain of Command

First aid equipment and trained personnel will be provided on-site during the duration of the remedial works. The first aid equipment and personnel will be provided in accordance with the requirements of the *Yukon Occupational Health and Safety Handbook*, Section E. The requirements are based on the number of workers at the site, type of work being completed and the distance to medical attention. The requirements will be assessed after the details of the work plan are finalized and prior to any work from this plan being completed at the Brooks Brook Camp site.

In the event of a medical emergency the Health and Safety Officer should be notified immediately. If the problem is relatively minor, such as heat exhaustion, the standard clean up procedures outlined previously will be followed before medical care is administered. Other work may continue. In the event of a major medical emergency such as cessation of breathing, stroke, cardiac arrest, etc. lifesaving care must be administered immediately. The Health and Safety Officer will immediately contact the nearest medical attendant. If possible the injured worker should be decontaminated as most hospitals will not treat a contaminated person. If ingestion, inhalation, or contact with a potential toxin is responsible for the medical emergency, the patient must be brought into the care of a physician as soon as possible. In the event of contact with an irritant with the skin or eyes, the area must be immediately flushed with copious amounts of water.

In the event of a severe emergency such as a fire or explosion the area should be evacuated immediately with workers exiting through the predetermined exit route to a safe area. The HSO, in conjunction with the Site Supervisor, will ensure the evacuation of the area. If emergency assistance is required the HSO will contact the appropriate nearest fire services. The Project Manager will be notified, who in turn will notify the appropriate authorities.

If the air monitoring equipment indicates contaminant concentrations above the exposure limits, the work will be shut down immediately and the work plan reassessed. The HSO and Site Supervisor will notify the Project Manager. Concerned parties will be informed of the situation by the Project Manager.

2.1.13 Site Safety Meetings and Inspections

To ensure that the Site Safety Plan is being followed, the Site Safety Officer will conduct a safety meeting prior to initiating each site activity and at the beginning of each work day. The purpose of the meetings is to:

- Describe assigned tasks and their potential hazards;
- Co-ordinate activities;
- Identify methods and precautions to prevent injuries;
- Plan for emergencies;
- Describe any changes to the Site Safety Plan;
- Get worker feedback on conditions affecting safety and health; and
- Get worker feedback on how well the Site Safety Plan is working.

The Site Safety Officer will also conduct frequent inspections of site conditions, facilities, equipment and activities. The Site Safety Officer and personnel will be responsible for inspecting the condition of their personal protective equipment and ensuring its operating condition.

2.1.14 References

National Institute for Occupational Safety and Health (NIOSH), Occupational Safety and

Health Administration (OSHA), U.S. Coast Guard (USCG), U.S. Environmental Protection Agency (EPA). October 1985. *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*. U.S. Government Printing Office, Washington, D.C.

NIOSH. Pocket Guide to Chemical Hazards. U.S. Department of Health and Human Services. June 1997.

Yukon Workers' Compensation Health and Safety Board. *Occupational Health and Safety Handbook with Mine Safety Regulations*. December 1992.

American Conference of Governmental Industrial Hygienists. *Threshold Limit Values and Biological Exposure Indices*. ACGIH, Cincinnati, Ohio. 1994.

2.2 Site Preparation

In order to ensure that the excavation proceeds with minimal delay, the preparation of the site must take into account all aspects of the excavation. Previous investigations of the site have used the south east corner of the new cook shack as a benchmark for the sampling grid. All sample locations to date are referenced to this point. In order to ensure that the extent of the excavation is accurately laid out and that confirmation sample locations can be accurately referenced, new benchmarks will have to be established outside of the anticipated excavation extent. It is recommended that at least two benchmarks be established outside of the excavation extent. These benchmarks should be constructed using 15 cm metals spikes embedded in concrete such that the head of the spike is clearly visible and accessible above the concrete. The surveyors will use these benchmarks to locate the new sampling points and the extent of the excavation relative to the old sampling grid.

All vegetation will have to removed from the excavation area. It is recommended that a 10 metre zone around the maximum anticipated excavation extent be cleared in order to facilitate the movement of equipment. The vegetation should be removed from site and disposed accordingly. All contaminated soil associated with the vegetation must be treated as contaminated and disposed of accordingly.

The new cook shack is located inside the area to be excavated. Removal of the new cook shack will be necessary prior to the initialization of the excavation. All material that was in contact with the soil will have to be treated as contaminated material.

Following the removal of vegetation and the new cook shack, temporary fencing should be installed around the work zone to prevent accidental falls and to delineate the area where all of the requirements of the health and safety plan must be followed. Appropriate signs should be installed along this fencing advising the general public that the area is restricted and that health and safety precautions must be followed in order to enter the excavation area.

2.3 Logistics

In order to ensure that the work proceeds efficiently, all individuals and organizations should be made aware of the specific goals of the work. Prior to the commencement of the work, meetings should be scheduled to discuss all of the logistical aspects of the work. It is recommended that a daily reporting requirement be introduced and daily meetings between the principal individuals involved be scheduled such that each day can be planned. Accurate records of all activities that take place on site will be required in order to complete the final report on the remediation.

Staging of the excavation will be critical, particularly with regard to the flow of trucks into the site if off-site disposal at a distant facility is chosen as the ultimate fate of the contaminated soil. If, for example Swan Hills is chosen as the disposal facility for the contaminated soil, then a truck turnaround time of at least 2 days is anticipated. Excavation of the contaminated soil is expected to proceed much more rapidly than the contractor's capacity to ship the soil off-site. It may become necessary to create a temporary holding facility for excavated material such that the excavation and confirmation testing can proceed without stoppage. The design of this facility will have to be determined in consultation with the selected contractor. It may be possible to use some of the existing concrete foundations as a pad for the storage of excavated soil.

2.4 Excavation

The area to be excavated encompasses approximately 3000 m^2 (Figure 6). The minimum depth of excavation is 0.5 metres (recall that the AVERAGE depth of contamination is approximately 0.625 metres). However, there are areas that will require excavation to greater depths. A contingency should be made for the handling and disposal of greater volumes than indicated. In order to ensure that a minimum of material is excavated and disposed, it is suggested that the excavation be advanced to a depth of at least 0.5 metres over the entire area. Confirmation samples should be collected at this depth and field tested to determine if the excavation requires advancement to greater depths. Wherever it becomes necessary to advance the excavation to greater depths, the walls of the excavation should be sloped to ensure stability. The field supervisor will ensure that stable slopes are cut for all excavations greater than 0.5 metres. No field personnel are to enter into excavations greater than 1.22 metres in depth. All sampling of these deeper excavations will be accomplished using the bucket of the excavator.

The excavation should be advanced in manageable cells or strips, appropriate to the reach and capabilities of the equipment used. The truck circulation path once on-site will have to be determined based on the size of the trucks used and the logistical constraints. It would be desirable to have the contaminated soil placed in trucks and transported to the disposal facility immediately rather than being stockpiled. Stockpiling of soil may create other contaminated areas which will have to be remediated. However, temporary stockpiles could be created if necessary, as discussed above.

2.5 Materials Handling

Materials handling will largely be left to the discretion of the contractor hired to complete the work. In general, a materials transfer point is to be established such that a minimum amount of contaminated soil is spilled onto uncontaminated ground. In order to ensure that contaminated soil is not tracked over the rest of the site and onto the highway during truck transfer, a wheel wash station should be established. Wheel wash water is to be considered contaminated and disposed of at the appropriate facility. Following the completion of the excavation, surface samples of the materials transfer point should be tested on a 2 metre grid in order to ensure that a new area of contamination has not been created.

The materials handling point is to be located within the temporarily fenced area. A such, all health and safety precautions are to be followed. In particular, truck drivers are to stay in their cabs with their windows rolled up. A person using appropriate health and safety gear will tarp the trucks as appropriate.

Other aspects of materials handling will depend on the ultimate fate of the contaminated soil.

2.6 Material Disposal

It has not yet been determined how and where the contaminated soil will be disposed. This will be dependant on the remedial contractor chosen.

2.7 Confirmation Sampling

Confirmation samples will be collected from the base of the excavation on a 5 metre grid. These will be tested in the field using a immuno assay field test kit. If the results of the field testing indicate that the concentration of total OCPs (DDD + DDE + DDT) is less than 0.5 ppm, then an area of approximately 25 m^2 around the sampling point will be considered to have been remediated. Particular attention will be paid to areas that had very high concentrations of OCP in surface samples. In these areas, the sampling frequency may be increased to four samples per 25 m^2. In areas where the analysis of confirmation samples indicate that concentrations of total OCPs are greater than 0.5 ppm, further excavation will be completed under the direction of the technical consultant.

Confirmation samples of the walls will be completed at a frequency of 1 sample per metre depth per 10 metre section of wall. These samples will also be field tested. Further excavation may be required if concentrations of OCPs in the wall samples are greater than 0.5 ppm .

All confirmation samples will be split in two, with half of the sample field tested and the other half laboratory tested. It is important to note that laboratory testing will be completed on samples that are to be used to designate final confirmation of the completion of remediation. Field testing will only be used to provide information on the effectiveness of the remedial effort and indicate were further excavation is required.

In order to ensure that the excavation proceeds with maximum efficiency, confirmation sampling will be completed in tandem with the excavation.

2.8 Site Closure

The results of the field testing will be used to determine when the remediation is complete. The excavation will be backfilled with certified clean backfill and compacted using available equipment. It is not anticipated that any substantial structures will be constructed on-site. Therefore, backfill will not require compaction to a specified density. All temporary fencing will be removed and the site graded to return it to its pre-excavation appearance. The replacement of vegetation will be at the discretion of the Teslin Tlingit Council.

All equipment must be washed prior to demobilizing from the site. This wash water must be contained and disposed along with the contaminated soil. All protective equipment that cannot be cleaned will be treated as if it were contaminated and disposed along with the soil. This equipment will likely be stored in barrels.

2.9 Sequence of Events

In order to ensure the efficient completion of this project, the following sequence of events is envisioned. This may have to be modified in accordance with the particular approach adopted by the selected remediation contractor. It is assumed that the remediation contractor will have already been selected prior to the following events unfolding.

- Complete field testing for the development of health and safety plan;
- Finalize health and safety plan;

- Site meeting for all concerned parties to develop and discuss remedial approach;
- Mobilization of remedial contractor to site;
- Set up of equipment and related infrastructure for remedial contractor;
- Train all field personnel in health and safety precautions and equipment;
- Establish benchmarks for surveying;
- Establish working zone using temporary fencing;
- Implementation of health and safety plan;
- Removal of the new cook shack to facilitate the excavation;
- Removal of trees and shrubs to facilitate the excavation;
- Removal of OCP contaminated soil over the area delineated in Figure 6 to an minimum depth of 0.5 metres (deeper in some areas);
- Collection of confirmation samples over the base and sidewalls of the excavation to confirm that the concentration of OCPs in soil is less than 0.5 ppm DDD + DDE + DDT using immunoasssay field test kit;
- Ship split samples to laboratory in Vancouver for analysis;
- Further excavation if necessary;
- Following confirmation of the removal of OCP contaminated soil to concentrations less than 0.5 ppm DDD + DDE + DDT using immunoasssay field test kit, backfill the excavation with certified clean fill using appropriate compaction standards;
- Grade the excavation appropriately;
- Remove truck wash station;
- Remove truck transfer point and test and excavate contaminated soils if necessary;
- Ship stockpiled soil if necessary;

- Remove soil stockpile infrastructure and test and excavate/decontaminate stockpile area if necessary;
- Remove all temporary fencing and other infrastructure
- Decontaminate equipment;
- Ship all personnel protective gear and other contaminated material to disposal facility;
- Remedial contractor demobilize from site; and
- Termination of field portion of project.

Following the termination of the remediation, a detailed report on all aspects of the remediation will have to be prepared by the technical consultant.

3.0 PROJECT TEAM

It is anticipated that the project team will consist of a remedial contractor, a technical consultant and the Teslin Tlingit Council. The following outlines the potential areas of responsibility of the remedial contractor and the technical consultant.

3.1 Remedial Contractor

The remedial contractor will be responsible for the following aspects of the remediation:

- Supply of all equipment and personnel for the completion of the remediation;
- Supply health and safety equipment required for field personnel;
- Supply and installation of all temporary fencing;
- Construction and removal of truck wash station;
- Construction and removal of truck transfer point;
- Construction and removal of decontamination area;
- Construction and removal of soil stockpile area if necessary;
- Excavation and disposal of contaminated soil;
- Collection of confirmation samples in deeper portions of the excavation using the backhoe or excavator under the direction of the technical consultant;
- Monitoring of compliance with health and safety plan for their own personnel;
- Completion of all required manifests for shipment of contaminated soil and equipment to disposal facility; and
- Permitting, which shall be completed in consultation with the technical consultant.

3.2 Technical Consultant

The technical consultant will be responsible for the following aspects of the remediation:

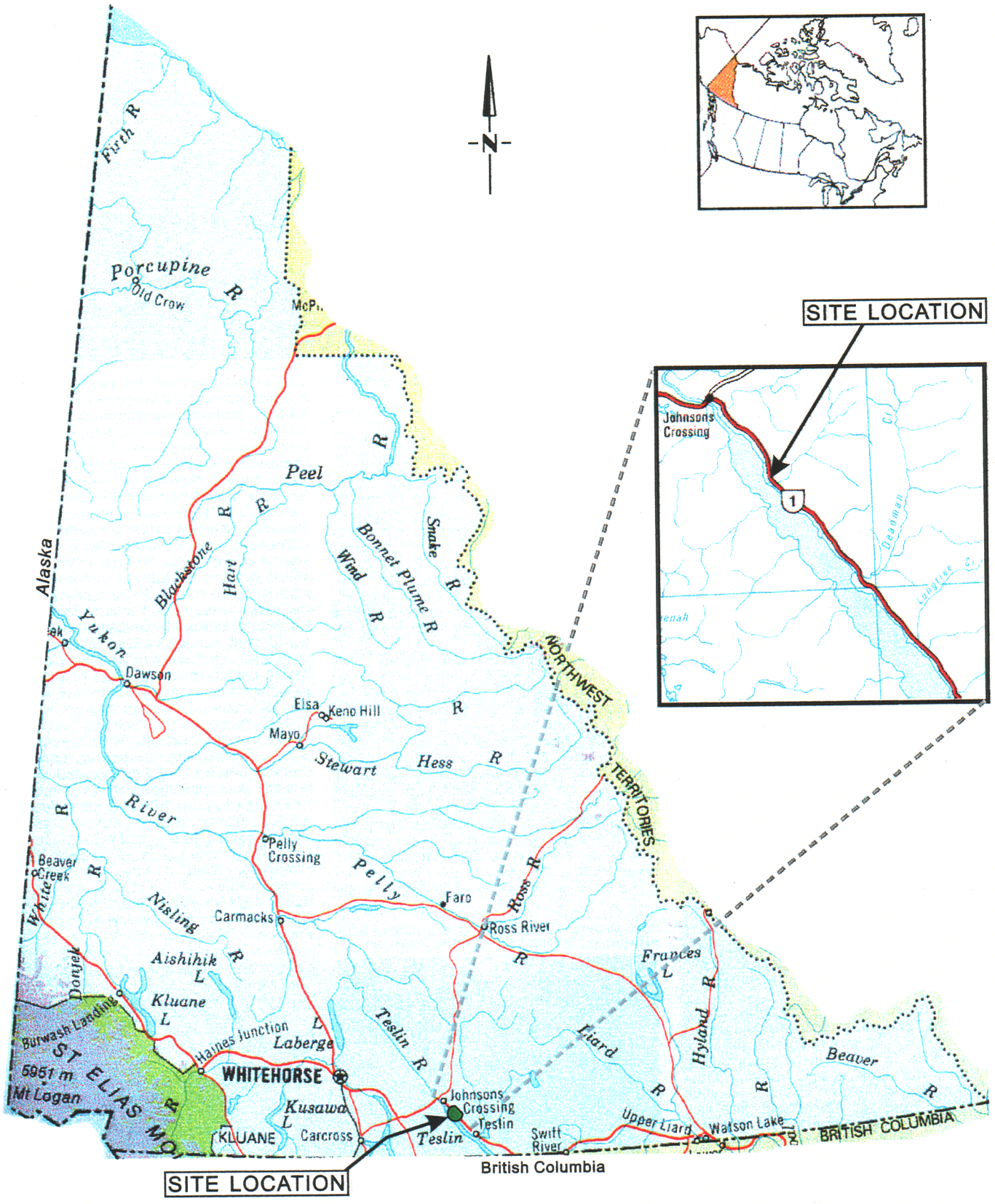
- Develop the health and safety plan;
- Review of remedial contractor bids in conjunction with the Teslin Tlingit Council;
- Management of logistics with remedial contractor;
- Permitting requirements in conjunction with remedial contractor;
- Implementation of health and safety requirements, including air quality monitoring;
- Confirmation sampling and direction of field personnel;
- Determination of excavation extent;
- Supervision of laboratory technician for field testing;
- Determination of safe slopes in excavation side walls;
- Liaison between Teslin Tlingit Council and remedial contractor;
- Project documentation; and
- Project reporting.

4.0 CLOSURE

This information package presents the requirements for, and information on, the remediation of OCP contaminated soil at the Brooks Brook Camp. This information package in no way restricts any of the interested parties to the development of alternative approaches to complete the remediation. A final remedial action plan should be developed in consultation with the interested parties.

Bruce Willmer, M.Sc., P.Geo
Principal

Phil R. Scalia, B.Sc., B.Ap.Sc., Dip., M.Sc., E.I.T.
Environmental Specialist



HEMMERA RESOURCE CONSULTANTS LTD.
Suite 410, 1190 Hornby Street
Vancouver, B.C. V6Z 2K5

OCP REMEDIATION INFORMATION PACKAGE
BROOKS BROOK, Yukon Territory

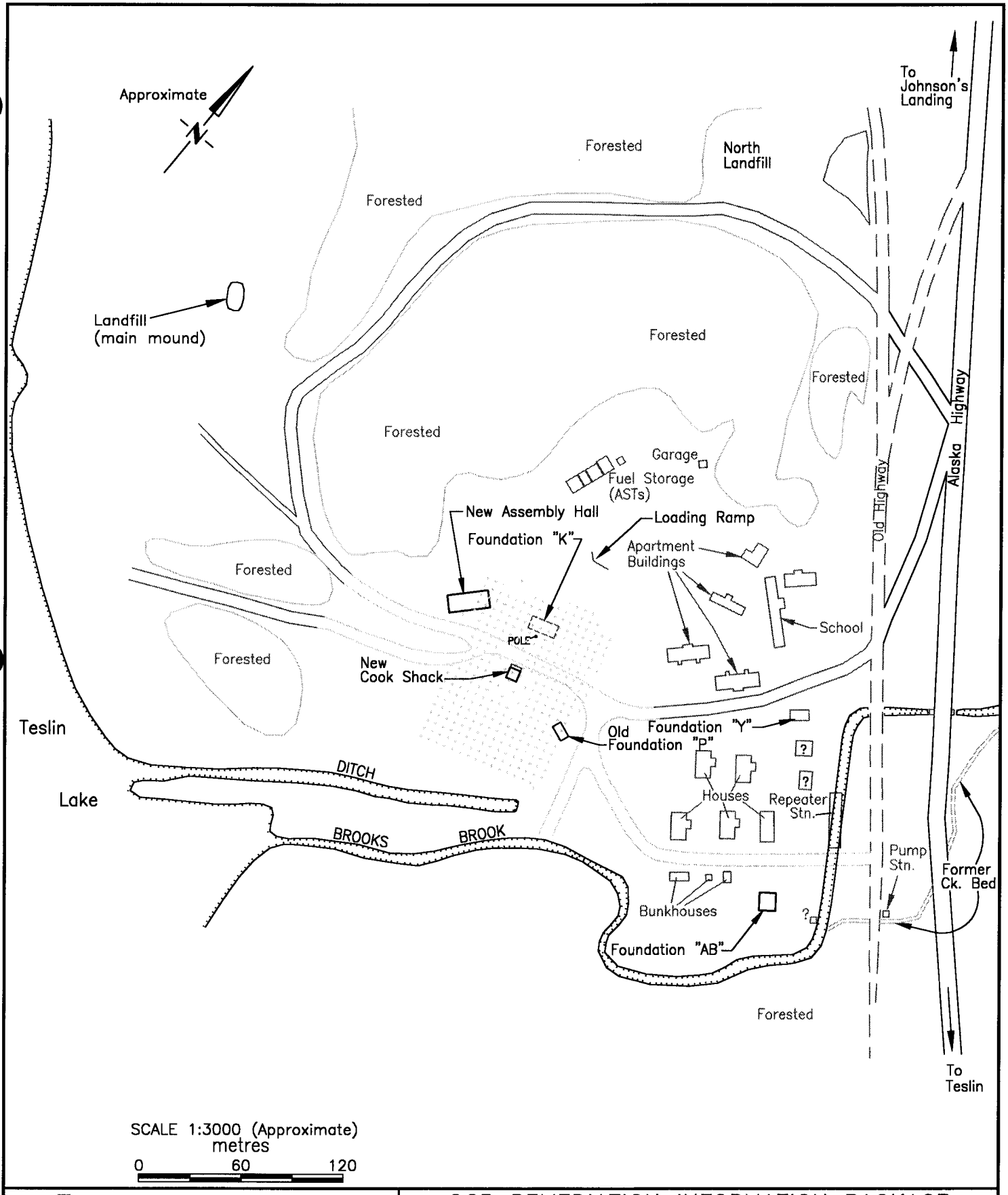
Location Map

CLIENT:
INDIAN & NORTHERN AFFAIRS CANADA

PROJECT No.
316-003.01

June 1999

Figure 1



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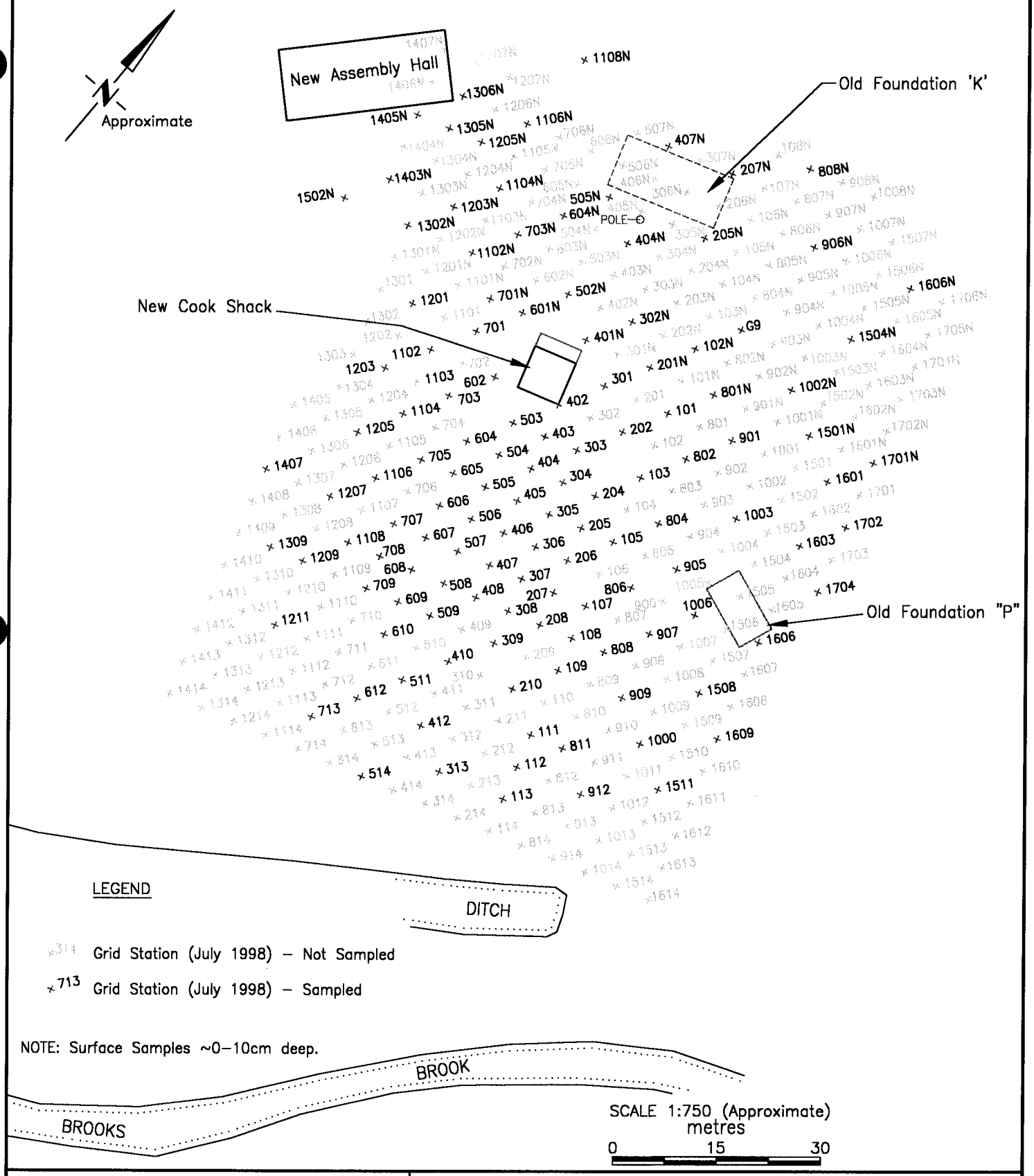
BROOKS BROOK, YUKON TERRITORY

DETAILED LOCATION MAP

PROJECT No.		
316-003.02	June 1999	FIGURE 2



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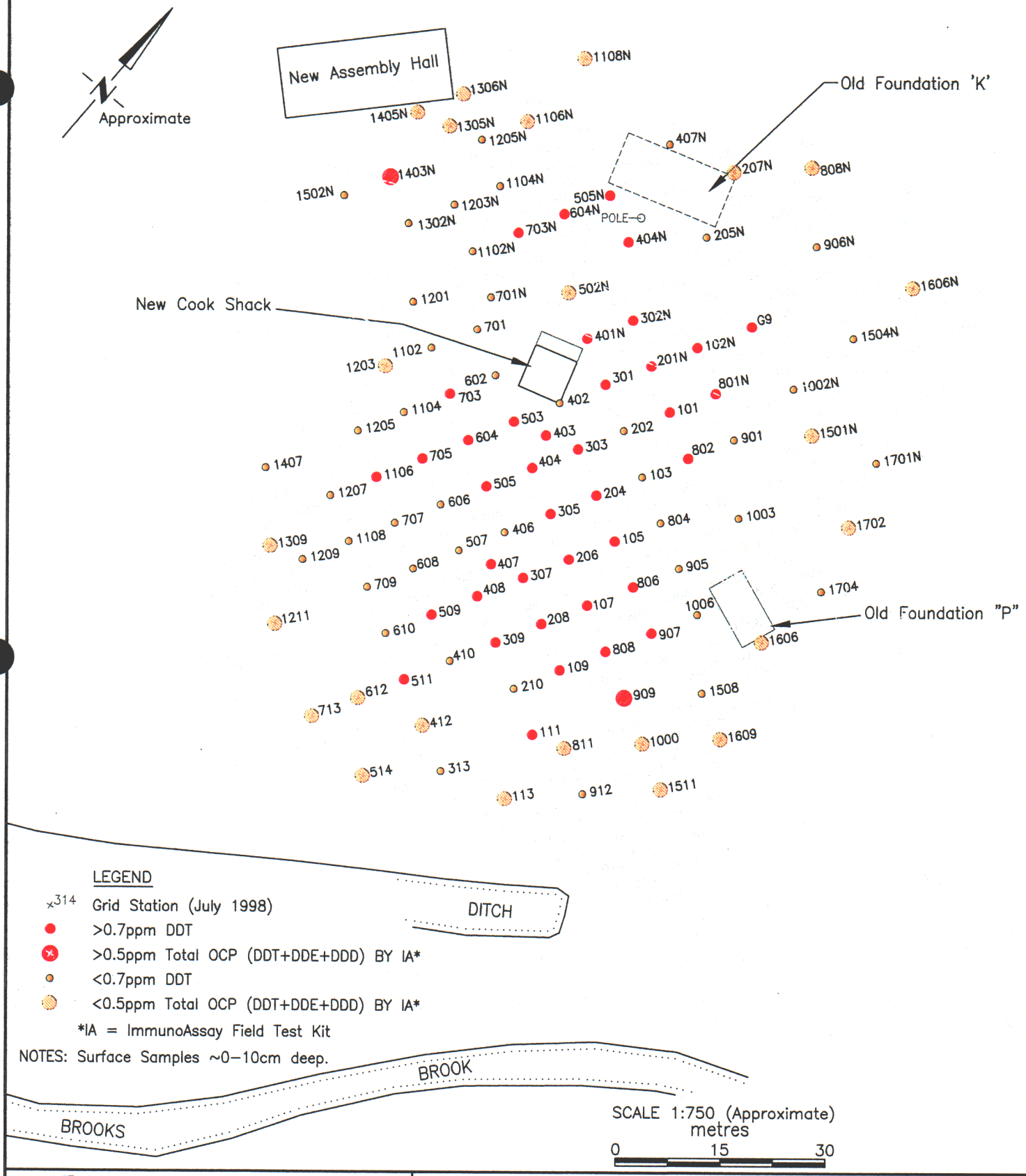
1998 GRID & TESTPIT SAMPLING LOCATIONS

PROJECT No. 316–003.01 | June 1999 | Figure 3



LEGEND

- ×314 Grid Station (July 1998)
- ● >0.7ppm DDT
- ⊗ >0.5ppm Total OCP (DDT+DDE+DDD) BY IA*
- ○ <0.7ppm DDT
- ◍ <0.5ppm Total OCP (DDT+DDE+DDD) BY IA*

*IA = ImmunoAssay Field Test Kit

NOTES: Surface Samples ~0–10cm deep.

SCALE 1:750 (Approximate)
metres
0 15 30

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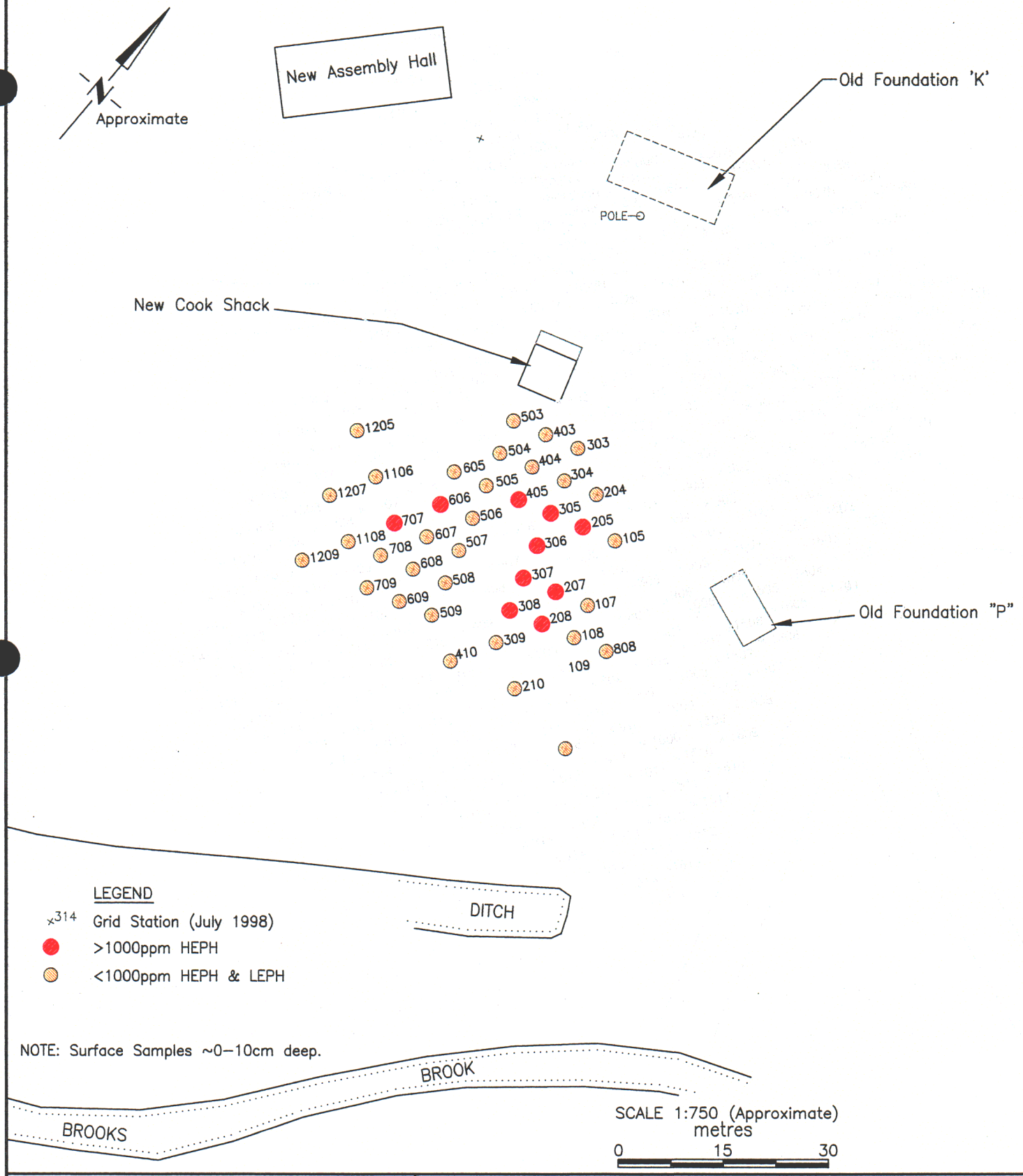
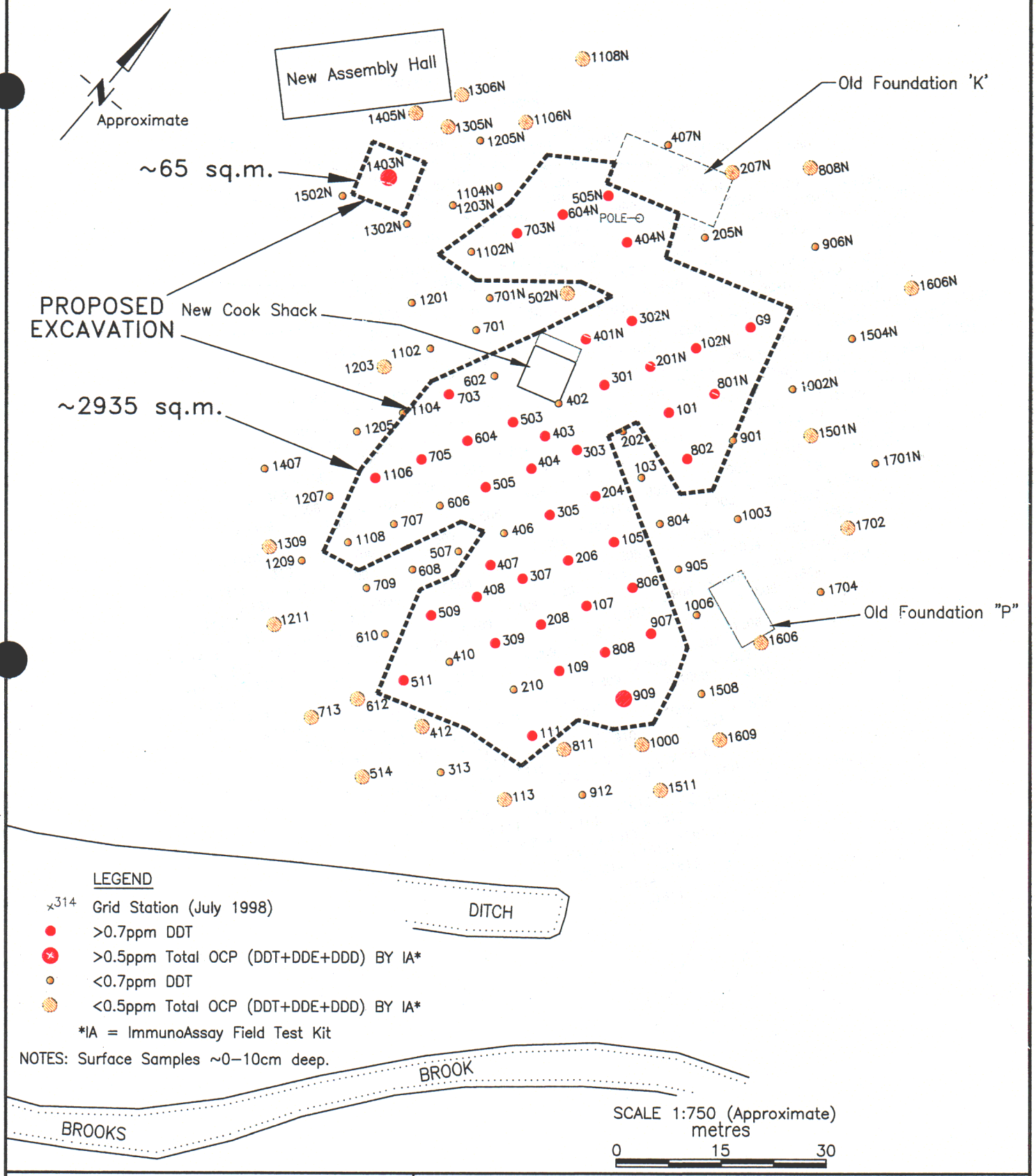
RESULTS of ANALYSIS of SOIL SAMPLES for DDT USING 0.7ppm CRITERIA

PROJECT No.		
316–003.02	June 1999	FIGURE 4



EMMERA RESOURCE CONSULTANTS LTD. Suite 410, 1190 Hornby Street Vancouver, B.C. V6Z 2K5	OCP REMEDIATION INFORMATION PACKAGE BROOKS BROOK, YUKON TERRITORY		
	RESULTS of ANALYSIS of SOIL SAMPLES for HEPH		
CLIENT: INDIAN & NORTHERN AFFAIRS CANADA	PROJECT No. 316–003.02	June 1999	FIGURE 5



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EXCAVATION EXTENT (Proposed)

PROJECT No.		
316–003.02	June 1999	FIGURE 6

Attachment A

Letter from Kerr Mellor Associates

Kerr Mellor Associates
Environmental Consultants

June 7, 1999

SENT BY FAX

FAX MESSAGE

FROM:	TO:
Company KMA	Company HEMMERA
Name ARTKERR	Name BRUCE WILLMER
Date 7/6/99	Fax No.
Time sent	
No. of pages sent 3	
If only part received 'phone	

Mr Bruce Willmer
Partner
Hemmera Resource Consultants
Suite 410
1190 Hornby Street
Vancouver
V6Z 2K5

Dear Bruce

Subject: **Remedial works**
Brooks Brook, Yukon

I have now looked at the data set, which you forwarded to me sometime ago and would make the following comments regarding potential health risks during remedial works.

It has been assumed that appropriate clothing will be worn during the remedial works and that field personnel involved in the remedial works will be required to observe set decontamination procedures. The potential risk from dermal contact with the contaminated soils therefore is considered to be low. Because of the location of the site and the fact that the main receptors will be adults, ingestion of contaminated material is not considered to be a credible exposure route and therefore will not be considered further.

The main exposure route therefore is likely to be inhalation of contaminated airborne dust generated during removal of the contaminated soils. The main receptors likely to be impacted by airborne dust will be individuals responsible for the active supervision and monitoring of the remedial works and contract staff carrying out the works. Secondary receptors are likely to be operators of mechanical excavation equipment and truck drivers. Potential risks to these latter receptors can be readily reduced by requiring that they stay in their vehicles and keep their doors closed.

The main contaminants detected in soils on the site were p,p DDT; o,p DDT; and p,p DDE, with lesser amounts of o,p DDE and p,p DDD. Slightly elevated levels of gamma chlordane and Dieldrin were also detected locally.

DDT is a nonsystemic contact and stomach insecticide consisting predominantly of p,p DDT, the o,p isomer being present as an impurity (up to 30%). DDE is carcinogenic and is an impurity contained in commercial DDT as well as being a product of degradation of DDT. Both Dieldrin and gamma chlordane are insecticides. The former is a known carcinogen while histopathological changes have been noted in the livers of rats fed with this chemical.

Although stored in the body fat and excreted in the milk of lactating females, no ill effects were noted in seventeen human volunteers who ate 35mg of DDT per man per day for a 21 month period.

Based on the contaminant levels detected within the fill material AT THE Brooks Brook site and our assessment of site conditions based on our recent telephone conversation, it is probable that the use of dust masks will be sufficient to prevent inhalation of significant amounts of contaminated dust.

In order to provide a gross indication of the potential health risk and the exposure levels likely to be encountered during the remedial works, however, the probable airborne concentrations of DDT and total organochlorine pesticides were estimated and compared against the occupational exposure limit for DDT currently specified by NIOSH.

NIOSH currently specify an 8 hour time weighted average reference concentration for DDT of 1 mg/m^3. To enable the averaged laboratory data to be compared with the occupational exposure limit for DDT the concentration of airborne contamination was estimated based on the following:

- an average o,p and p,p DDT concentration of 2.82ppm and 11.27ppm,
- an average total organochlorine pesticide concentration of 32.59ppm, and
- on the assumptions outlined below.

Therefore, using relationships developed by the United States Environmental Protection Agency (USEPA) for screening of contaminated sites it is possible to estimate the volume of air which 1kg of soil will occupy (in m^3/kg). Hence:

$$\text{The Particulate Emission Factor } (m^3/kg) = Q/C \times \frac{3600}{0.036 \times (1-V) \times (U_m/U_t)^3 \times 0.194}$$

where
Q/C is a factor derived from wind direction, speed, etc (the default value of 90.8 has been used)
V is the fraction of vegetation cover (0.5 = 50% vegetation cover)
U_m is the mean annual windspeed in m/s. A wind speed of 4.7m/s has been assumed.
U_t is the equivalent threshold value of windspeed at 7m above ground level. A threshold value of 11.3 m/s has been assumed.

Using the above relationship and assuming vegetation cover is nil a Particle Emission Factor of 6.5×10^8 is obtained. That is, 1kg of soil is likely to fill 650 million cubic meters of air due to wind loss alone. This is equivalent to a dust concentration of 0.00154 mg/m^3. However the rate of airborne dust emissions due to wind erosion will be increased by physical disturbance of the contaminated soil during excavation. For the purpose of the present assessment it has been assumed that physical disturbance of soil during excavation will increase the rate of dust generation by a factor of 1000.

Based on the above the above assumptions and the laboratory data, therefore, the likely airborne exposure concentrations to DDT and organochlorine pesticides can be expressed by the relationship:

$$\text{Contaminant Air Concentration (mg/m}^3\text{)} = \frac{\text{Soil concentration in mg/m}^3 \times 0.00154}{1{,}000{,}000} \times 1{,}000$$

The estimated airborne concentration of DDT therefore during the remedial works is likely to be approximately 2.17×10^{-5} mg/m^3 This figure is well below the TWA exposure limit of 1 mg/m^3

Similarly taking the average total organochlorine pesticide concentration of 32.6ppm, the estimated total airborne concentration of all organochlorine pesticides is likely to be 5.02×10^{-5} mg/m^3 , well below the TWA DDT level of 1 mg/m^3 . It is unlikely therefore that there will be a significant risk due to excessive generation of airborne contaminated dust.

Conventional good quality dust masks should therefore be sufficient to reduce the risk of inhaling contaminated dust.

We trust this information is sufficient for your requirements, should you wish to discuss any aspect of the report please do not hesitate to contact the undersigned.

Yours Sincerely

KERR MELLOR ASSOCIATES

Patrick F. Kerr
Principal

Attachment B

Medical Data Sheet

ATTACHMENT B

MEDICAL DATA SHEET

This brief Medical data Sheet will be completed by all on-site personnel and will be kept in the Support Zone, (located in the clean area), during the site investigation. This data sheet will accompany any personnel when medical assistance is required or if transportation to a hospital facility is required. If you wish to add additional information please use the back of this sheet.

Name _____ Home Telephone No._____

Address _____

_____

_____

Age_____ Height _____ Weight _____

Who to contact in case of emergency _____

Address _____ Telephone No. _____

_____

_____

Allergies _____ List

medication currently being taken _____

Particular sensitivities _____Do

you wear contact lenses _____

Provide a checklist of previous illness and past exposure to hazardous chemicals

_____

_____

_____

Name of Personal Physician _____

Telephone No. _____

Additional Information _____

_____