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Re: Updated Final Field Report and Preliminary Response Program Activities, Fuel Release, BAF-3, Brevoort Island, NU

1.0 Introduction

Nunami Jacques Whitford (JW) has been requested by the Nasittuq Corporation (Nasittuq) to assist in an expedient assessment of a Jet A -1 fuel release at the BAF-3 radar site on Brevoort Island, Nunavut (NU) (Site). Nasittuq has a Government of Canada contract to operate and maintain the North Warning System (NWS) in Canada on behalf of the Department of National Defence (DND). Further to our discussions and based on comments received from Mr. Kevin Robertson, Resource Management Officer, Indian and Northern Affairs Canada, in correspondence dated March 22, 2007, JW is pleased to submit this updated report with detailed recommendations for future work to be carried out at the BAF-3 NWS site at Brevoort Island, NU.

The JW response activities were undertaken in the context of a phased response by Nasittuq that is summarized below.

- Phase I:
  - Initial response;
  - Release discovery reporting;
  - Containment at source; and
  - Other containment/clean-up activities.
- Phase II:
  - Delineation of impacts (based on visual and olfactory evidence); and
  - On-going mitigation and monitoring.
- Phase III:
  - Development of Response Action Plan; and
  - Intermediate and longer-term mitigation, containment, detailed soil delineation, remediation (as applicable) and monitoring.

This submission includes a summary of the work undertaken at the project site between March 9 and March 12, 2007, and provides recommendations for future work at BAF-3 with respect to the recent fuel release.

2.0 Site Description and Background

The site is situated at an altitude of 366 m above sea level on 2524 acres of land on Brevoort Island, NU. The geographical coordinates are: 63º 20'24" N, 64º 08'40" W. Brevoort is 40 km long and 10 km wide. BAF-3 is located 250 km NE of Iqaluit. A helipad is located on-site, as well as an abandoned airstrip which can be made useable.

The terrain at BAF-3 is irregular and hilly with prominent sea cliffs that rise from the water. The local geology consists mostly of igneous or metamorphic bedrock overlain in places by stony, sandy, glacial fill intermixed with fluvial and marine deposits. Water and wind generated erosion move the poorly-developed, thin, mineral soil into valleys and hollows, leaving slopes and hilltops bare. A key plan of the subject area is included as **Drawing No. 1**.

A fuel release was discovered at BAF-3 on January 12, 2007, and reported on January 13, 2007. Reportedly, the fuel release occurred due to a split in the threaded end of a one inch pipe in the vertical run of the sub-floor under the Technical Services Module (TSM) Building at the site. It is estimated that approximately 150,000 litres of fuel was accidentally released as a result of the pipe break. Additionally, a water release of approximately 40,000 litres occurred after the fuel release. The water release also originated from underneath the TSM Building. Technical details of the water release are not included in this report and can gained from the site operations managers as necessary. A general site location plan is included as **Drawing No. 2** and a site summit plan is included as **Drawing No. 3**.

An Inspector's Direction issued by Indian and Northern Affairs Canada (INAC) was received by the North Warning System Office (NWSO) on March 2, 2007, regarding the Deposit of Waste in Contravention of Water License NWB 6 BAF 0409 – Type "B". The letter directed NWSO to have completed by March 12, 2007, a detailed delineation of the BAF-3 site to determine if the contaminant is continuing to migrate, the location and extent of this migration to date, the migration pathways and any areas of pooling. The letter also directed NWSO to develop and implement a comprehensive clean up plan for the BAF-3 spill footprint as defined by the completed detailed delineation. The report is requested by March 19, 2007, and is to include but not be limited to discussion related to:

- Collection, control and clean-up measures for grounds around and under the TSM Building;
- Collection, control and clean-up measures along any path, route or area where the released contaminant may be located;
- Installation of absorbent barriers along all located migration paths, extending far enough (based on best science) outward so as to prevent any further expansion of the contaminant area; and
- Plans for the collection, storage and sampling of water collected as a result of the filtering and separating process until it may be determined the water may be released to the natural environment.

2.1 Previous Response Activities and Reporting

The following reports documenting site assessment activities completed at BAF-3 were provided to JW by NWSO for review.

- Environmental Sciences Group, 1999. *Brevoort Island: 1998 Site Assessment/Delineation.* Prepared for NWSO and dated May, 1999.

- Environmental Sciences Group, 2001. *BAF-3, Brevoort Island, Nunavut 2000 Delineation.* Prepared for NWSO and dated February, 2001.
- Environmental Sciences Group, 2003. *Report on Installation and Monitoring of a Barrier System at BAF-3 and Use of Geomembranes and Geosynthetic Clay Liners in Contact with Arctic Diesel and Water Contaminated by Arctic Diesel.* Prepared for NWSO and dated April, 2003.
- Environmental Sciences Group, 2007. *(BAF-3) Field Report – Internal Draft Copy (ESG Report # 07-BAF-3-001).* Prepared for NWSO and dated February, 2007.

3.0 Objectives

The objectives of the work conducted by JW at BAF-3 are listed below:

- Meet the conditions outlined in the March 2, 2007, Inspector's Direction letter from INAC; and
- Develop a preliminary Response Action Plan (RAP) for post-initial response activities.

4.0 Scope of Work

The scope of work for the field activities conducted by JW between March 9 and March 12, 2007, consisted of the following:

- Delineate (with resources available) the product plumes originating from the Technical Services Module (TSM) Building based on visual and olfactory evidence only;
- Record GPS coordinates of the respective leading edges (toes) of the plumes and locations of placed absorbent materials;
- Generation of a photographic record of site activities;
- Supervise Nasittuq site personnel in the correct installation and attachment of the absorbent materials in appropriate locations as applicable;
- Report as appropriate; and
- Develop a Preliminary RAP complete with initial, intermediate and longer-term response activities.

5.0 Field Work

5.1 Health and Safety Plan

A Health and Safety Plan specific to this project was developed and communicated to all parties involved in the work. Prior to any field activity, JW conducted a project kick-off meeting involving all personnel who were working on the Site. Additional meetings to review health and safety requirements and changes were conducted at a minimum of once at the start of each shift.

5.2 Site Reconnaissance

Prior to mobilization to BAF-3, JW completed a review of the photographs, background reports and existing documentation, which were provided by Nasittuq on March 6, 2007.

Upon arrival at BAF-3, JW completed a comprehensive site reconnaissance consisting of the following tasks:

- An assessment of the impacted ice below the TSM Building and the surrounding topography;
- A preliminary assessment of the slope north of Culvert 2 (CV-2) and the slope west of the expected location of CV-3. CV-3 was not located due to excessive snow cover;
- A preliminary assessment of the drainage ditch on the south side of the main road between CV-1 to CV-2; and
- Interviews with station personnel and personnel from the Environmental Sciences Group (ESG) with respect to the recent fuel release and assessment/clean-up activities to date.

5.3 Snow Removal/Test Pit Program

A series of test pits was excavated by hand and by mechanical equipment (excavator) in the execution of this preliminary response program. Details of this work are presented below. No laboratory analyses were performed for this stage of the assessment as the frozen surface conditions and contaminant behavior are such that a reliance on visual and olfactory evidence was sufficient for proper delineation of the plumes. A test pit location plan is included as **Drawing No. 4**.

5.3.1 Hand Digging on the Slope North of CV-2

JW conducted a snow and ice removal program on the slope to the north of CV-2 to expose the ground surface to determine the potential impact from petroleum hydrocarbon contaminants (PHCs) based on olfactory and visual observations. Based on the local topography, and using hand digging tools (hand shovels and ice picks), the field team removed snow and ice in selected areas downgradient from CV-2 to determine the presence or absence of PHCs. A total of 21 test pits (TP-1 to TP-21) was excavated in the snow and ice by hand. The locations of the hand-dug test pits are indicated on **Drawing No. 4**.

Observations from these test pits are presented at Table 6-1 in Section 6 of this letter report. The leading edges of the plumes were determined from the visual and olfactory evidence collected during the digging of the test pits identified in Drawing No. 4. Impacts were either observed throughout the 4 walls of the test pit, only in specific edges/walls (i.e., upgradient wall or lateral walls only with no evidence in the downgradient wall), or, in some cases, with no evidence of contamination at all, therefore allowing the confirmation of the boundaries of the plumes

Additional visual/olfactory observations were made downgradient of the leading edge of the plumes in shallower snow covered areas to confirm upgradient test pit findings; however, specific test pit locations were not recorded for these confirmatory activities as they were made in a sweeping fashion with clear visual and olfactory evidence of un-impacted snow cover. The approximate downgradient limits of confirmatory visual/olfactory observations made starting immediately at the leading edge of plume 1 is indicated on **Drawing No.4** (identified as the “Extent of Visual/Olfactory Confirmation”).

5.3.2 Mechanical Snow and Ice Excavation in the Ditch South of the Road between CV-1 and CV-3

JW conducted a snow and ice removal program in the ditch on the south side of the road between CV-1 and CV-3 to expose the ground surface to determine the potential impact from PHCs. Using the excavator that was available on-site, the field team removed snow and ice in selected areas downgradient from CV-1. A total of 21 test pits (TP-A to TP-U) were excavated in the ditch on the south side of the main road. The locations of the mechanically-dug snow/ice test pits are indicated on **Drawing No. 4**. As noted during the hand digging above, the lower edge of TP-G at the limit of Plume 2 provided the necessary visual and

olfactory evidence to ascertain the downgradient limits of the plume. Confirmatory test pits were excavated further downgradient to confirm the findings (TP-A to TP-F), and upgradient to confirm the eastern edge of Plume 2 (TP-O, TP-Q, and TP-T).

5.4 Preliminary Field Development of RAP

While deployed at the site, JW personnel completed the tasks listed below in preparation for the development of the RAP.

- Instructed Nasittuq site personnel to continue snow removal from around the station area to reduce the amount of run-off from the upcoming spring freshette.
- Examined the heated garage to determine the available resources (oil water separator and barrels) and to assess the remedial efforts to date.
- Examined the heated water storage building to determine the available resources (water storage tanks).
- Examined the POL storage tanks at the station summit area.
- Performed a preliminary assessment of the available access to lower slope below CV-2 via the slope beneath/west of the expected location of CV-3.
- Performed a preliminary assessment of the estimated site groundwater flow direction based on the available topographic information.

5.5 Visual Assessment of Sub-Floor of TSM Building

While on-site, JW performed a visual examination of the sub-floor of the TSM Building. With the support of the on-site Nasittuq personnel, a member of the JW field personnel, with the required Entry in to Confined Space training, entered the sub-floor from an access door located at the southwest corner of the TSM Building in the diesel plant. Residual fuel was observed on the surface of the sub-floor (**Photo 26** and **Photo 27, Appendix A**). PHC absorbent pads were placed on the surface of the sub-floor to absorb the residual fuel. A minor water leak was also observed while examining the sub-floor under the TSM Building. The source of the water was identified with the help of on-site Nasittuq personnel. On-site Nasittuq personnel indicated that they would repair the water leak as soon as possible.

6.0 Results

Three PHC plumes were observed at BAF-3 from the recent fuel release:

- **Plume 1** extends from the invert of CV-2 downgradient for approximately 300 m to the north. Based on field observations, the approximate area of Plume 1 is 31,500 m^2 (300 m x 105 m). The approximate extent of Plume 1 is illustrated in **Drawing No. 4.**
- **Plume 2** extends from the invert of CV-1 a distance of approximately 330 m downgradient from the station in the ditch on the south side of the main road. Based on field observations, the approximate area of Plume 2 is 495 m^2 (330 m x 1.5m). The approximate extent of Plume 2 is illustrated on **Drawing No. 4**.
- **Plume 3** occupies the area beneath the TSM building comprising an area of approximately 1800 m^2 (30 m x 60 m). The approximate extent of Plume 3 is illustrated in **Drawing No. 4**.

The plumes are currently frozen and stable (i.e. not moving downgradient due to cold temperatures); therefore, PHC absorbent booms and pads were not installed during the March 2007 site visit.

Table 6-1 provides a summary of visual/olfactory evidence of impacts (or no impacts in some cases) for each test pit identified on Drawing No.4.

Table 6-1: Absence or Presence of Impact in Test Pits

Test Pit	APEC	Visual/Olfactory Evidence of Impacts
TP1	1	Impacts observed at this location
TP2	1	Impacts observed at this location
TP3	1	No impacts observed at this location
TP4	1	Impacts observed at this location
TP5	1	Impacts observed at this location
TP6	1	Impacts observed at this location
TP7	1	No impacts observed at this location
TP8	1	Impacts observed at this location
TP9	1	No impacts observed at this location
TP10	1	No impacts observed at this location
TP11	1	Impacts observed at this location
TP12	1	Impacts observed at this location
TP13	1	Impacts observed at this location
TP14	1	No impacts observed at this location
TP15	1	Impacts observed at this location
TP16	1	No impacts observed at this location
TP17	1	Impacts observed at this location
TP18	1	Impacts observed at this location
TP19	1	Impacts observed at this location
TP20	1	No impacts observed at this location
TP21	1	No impacts observed at this location
TPA	2	No impacts observed at this location
TPB	2	No impacts observed at this location
TPC	2	No impacts observed at this location
TPD	2	No impacts observed at this location
TPE	2	No impacts observed at this location
TPF	2	No impacts observed at this location
TPG	2	Impacts observed at this location
TPH	2	Impacts observed at this location
TPI	2	Impacts observed at this location
TPJ	2	Impacts observed at this location
TPK	2	Impacts observed at this location
TPL	2	Impacts observed at this location
TPM	2	No impacts observed at this location
TPN	2	Impacts observed at this location
TPO	2	No impacts observed at this location
TPP	2	No impacts observed at this location
TPQ	2	No impacts observed at this location
TPR	2	Impacts observed at this location
TPS	2	Impacts observed at this location
TPT	2	No impacts observed at this location

TPU	2	Impacts observed at this location

6.1 Areas of Potential Environmental Concern

Based on the collection of visual and olfactory evidence, the following Areas of Potential Environmental Concern (APEC) in were identified by JW at BAF-3 during the March, 2007 site visit:

- APEC 1 is the slope north of Culvert 2 (CV-2) (**Drawing No. 4**, **Photo 12, Appendix A**). This area was designated as a potential environmental concern due to the potential migration of the fuel to the marine environment (Arctic Ocean). This area is characterized by a steep slope (>40%) covered with boulders, snow, and ice. Based on topographic information, and the site reconnaissance, melt-water and groundwater is expected to travel to the north until it reaches the slope bottom. Once water reaches the bottom of the slope it is anticipated to travel west to a channel that feeds an inland lake, which in turn outfalls to the sea (**Photo 13, Appendix A**).
- APEC 2 is the drainage ditch on the south side of the main road to the site summit and the slope to the west of the station from Culvert 1 (CV-1) towards Culvert 3 (CV-3) (**Drawing No. 4**, **Photo 14, Appendix A**). This area was designated as a potential environmental concern due to the potential eventual migration of the fuel to the marine environment and the potential migration of fuel to the freshwater lake that is used as a drinking water supply for the BAF-3 station.
- APEC 3 is the area under the TSM Building (**Drawing No. 4**, **Photo 20** to **Photo 25, Appendix A**). Fuel-impacted ice remains within the footprint of the TSM building. This area was designated as a potential environmental concern due to the potential human health risk from exposure to the product and potential for subsequent migration to the environment. Since APEC 3 is upgradient from APEC 1 and APEC 2, impacts at APEC 3 could potentially be a source of impact to APEC 1 and APEC 2. Also of concern in APEC 3 are the residual fuel impacts to the sub-floor of the TSM Building and the fuel line that runs beneath the corridor that connects the TSM Building to the Accommodations Building.

6.2 Fuel Impacted Material

Based on field observations made by JW, a preliminary estimation of impacted material that may require treatment was calculated. In general, ice will become water at a similar volume it occupies as a solid. Snow will become water at 10% of its volume as a solid. Based on the results of this delineation and approximate depth of snow and ice in the impacted areas, it can be expected that if all the snow and ice in the plume areas is collected and melted, a volume of fuel-impacted water of approximately 2,950,758 litres can be expected to be generated. It will thus be necessary to treat melted material in a phased approach so as to work within the limitations of using a one million litre storage capacity obtained by using a former water storage tank on site converted specifically for this RAP. As required, additional storage capacity can be considered using collapsible bladders should their availability and capacity to bring on-site is feasible.

According to field observations, there remains approximately 25 litres of residual fuel on the surface of the sub-floor of the TSM Building.

Based on a preliminary examination of the existing fuel lines around the TSM Building, JW observed a fuel line, which runs beneath the corridor that connects the TSM Building to the Accommodations Building (**Photo 23**), that is susceptible to damage due to frost-heaving. The fuel line is partially encased in ground

ice and could fracture under the stress of expansion of the ice. This situation is a result of the recent water line break previously mentioned in this report and any mitigation implemented could be seen as a proactive measure in the eventuality of future accidental water damage at the summit.

7.0 Conclusions

Based on the results of the response activities undertaken by JW, the following conclusions are presented:

- Three PHC plumes exist on site (**Plume 1**, **2,** and **3**, **Drawing No. 4**) which originated from the fuel release from underneath the TSM Building.
- **Plume 1** is approximately 31,500 m^2 and exists from the invert of CV-2 in a downgradient direction approximately 300 m to the north.
- **Plume 2** is approximately 495 m^2 and exists from the invert of CV-1 a distance of approximately 330 m downgradient from the station in the ditch on the south side of the main road to the summit.
- **Plume 3** exists below and around the TSM building comprising an area of approximately 1800 m^2.
- The plumes are currently frozen and stable (i.e. not moving downgradient due to cold temperatures). As long as the temperature remains well below 0ºC, it is expected that the plumes will remain frozen (the dilution of the glycol additive in the fuel from the 40,000 litres water leak should not greatly affect the ability for the fuel to mobilize at temperatures nearing the 0ºC mark).
- A reported water leak of 40,000 litres took place below the TSM building shortly following the fuel release. The result of this is that the fuel has likely been pushed farther down gradient on the slope and in the ditch south of the main access road to the site summit. Evidence of the excess water was observed on the slope where the fuel was completely encased by a layer of ice covering the surface of the plume. It is likely that this water/ice has become impacted to some degree with petroleum hydrocarbons and will require removal and treatment.
- Based on estimated volumes of impacted snow and ice, a preliminary estimation of impacted water that may require treatment is in the order of 2,950,758 litres.
- Residual fuel remains on the surface of the sub-floor of the TSM Building and a minor water leak was also discovered. On-site Nasittuq personnel were informed of the minor water leak.
- The fuel line, which runs under the corridor that connects the TSM Building to the Accommodations Building (**Photo 23**), is susceptible to damage due to frost-heaving as it is completely encased in ground ice at places.

8.0 Preliminary Response Action Plan (RAP)

The proposed remedial objectives have been developed based on the results of the March 2007 field observations conducted by JW, as well as our understanding of the current and future land usage requirements and other receptors of environmental concern.

The APECs and associated PHC plumes of concern have been identified: around the TSM Building, in the ditch on the south side of the road downgradient from CV-1, and on the slope to the north of CV-2, as shown on **Drawing No. 4**. The plumes were observed in the snow and ice in the mechanically and hand-dug snow and ice excavations. The initial objective of the RAP is to remove the PHC impacted snow and ice to prevent contaminant migration to the nearby fish-bearing waters. The secondary objective will be to monitor and address residual soil contamination that may exist after the spring freshette.

It is recommended that a remedial program be conducted in three stages: immediate actions, intermediate-term actions (prior to spring freshette) and longer-term actions. It can not be stressed enough that the success of this RAP is dependent upon the effective removal of as much snow and ice as possible from the impacted areas (APEC 1, 2 and 3) prior to the spring freshette. The removal of PHC-impacted surficial snow and ice will greatly reduce the potential impact to surface soils and downgradient water bodies. The three proposed RAP stages are outlined below.

8.1 Stage 1: Immediate (on-going) Actions

8.1.1 APEC 1: Slope Plume

- Delineate the PHC plume which extends from the CV-2 down the slope to the north (completed as part of this field report).
    - Using hand-digging tools and/or portable heaters remove the PHC impacted ice and snow from the slope north of CV-2 (**to be completed prior to spring freshette**).
    - Impacted snow and ice should be placed in drums in the heated garage and stored until the snow and ice melts.
    - After the impacted snow and ice melts, the impacted water should be passed through the on-site oil-water separator (**Photo 28, Appendix A**, primary water treatment system). The resulting treated effluent should then be stored in one of the available one million litre water storage tanks located in the Water Storage Building (**BV5**, **Drawing No. 3)** until such a time as a secondary water treatment system can be established to remove residual contaminants. Details of a proposed water treatment system are provided below in Section 8.1.4 below. As required, additional storage capacity can be considered using collapsible bladders should their availability and capacity to bring on-site is feasible. The recovered free product should be stored in 205 litre barrels, within a secondary containment system until such a time when disposal can be arranged.

8.1.2 APEC 2: Ditch Plume

- Delineate the PHC plume which extends from CV-1 down the slope to the west of the station (completed as part of this field report).
- Using an excavator, remove the PHC impacted snow and ice from the ditch on the south side of the road downgradient from CV-1 (to be initiated immediately).
    - Impacted snow and ice should be placed in drums in the heated garage and stored until the snow and ice melts.
    - After the impacted snow and ice melts, the impacted water should be passed through the on-site oil-water separator (**Photo 28, Appendix A**, primary water treatment system). The resulting treated effluent should then be stored in one of the available one million litre water storage tanks located in the Water Storage Building (**BV5**, **Drawing No. 3)** until such time as a secondary water treatment system can be established to remove residual contaminants. Details of a proposed water treatment system are provided below in Section 8.1.4 below. As required, additional storage capacity can be considered using collapsible bladders should their availability and capacity to bring on-site is feasible. The recovered free product should be stored in 205 litre barrels, within a secondary containment system until

such time when treatment/disposal can be arranged.

8.1.3 APEC 3: TSM

- Delineate the PHC plume below and around the TSM Building (completed as part of Phase II of NWSO Response Program – this report).
- Confirm and locate the buried utilities in the station area (to be initiated immediately).
- Using hand-digging tools, remove the PHC impacted ice from the area beneath the TSM Building (to be continued once the buried utilities have been located).
    - Impacted snow and ice should be placed in drums in the heated garage and stored until the snow and ice melts.
    - After the impacted snow and ice melts, the impacted water should be passed through the on-site oil-water separator (**Photo 28, Appendix A**, primary water treatment system). The resulting treated effluent should then be stored in one of the available one million litre water storage tanks located in the Water Storage Building (**BV5**, **Drawing No. 3)** until such a time as a secondary water treatment system can be established to remove residual contaminants. Details of a proposed water treatment system are provided below in Section 8.1.4 below. As required, additional storage capacity can be considered using collapsible bladders should their availability and capacity to bring on-site is feasible. The recovered free product should be stored in 205 litre barrels, within a secondary containment system until such a time when disposal can be arranged.
- Remove the residual fuel in sub-floor of the TSM Building (**Photo 26** and **Photo 27, Appendix A**) to prevent further environmental impact and to reduce the risk to human-health from exposure to PHC vapours.
- Due to the susceptibility to damage from frost-heaving, JW recommends raising the fuel line that runs under the corridor between the TSM Building and the Accommodations Building (**Photo 23, Appendix A**). At present the line is supported at the ground surface with timber blocking. It would be prudent to fix the fuel line at a level above the seasonal ice elevation to ensure it is not affected by the expansive forces of ice formation (from the recent water leak) under the station.

8.1.4 Proposed Water Treatment

- The secondary water treatment proposed (following initial settling in the one million litre water storage tank located in the Water Storage Building and separation in oil/water separators with coalescing media) consists of a treatment train with initial air stripping (and treatment of the off-gas in an activated carbon vessel) followed by adsorption of residual contaminants in activated carbon vessels set up in series. The final effluent would be collected in a holding tank/bladder until confirmatory sampling can provide for an acceptable discharge option on site. Testing of the treated effluent will be performed based on throughput flows of the system and storage capacity. Preliminary planning will assume testing to be performed for both water and air effluents on a bi-weekly schedule.

8.2 Stage 2: Intermediate-Term Actions (PRIOR TO SPRING FRESHETTE)

8.2.1 APEC 1: Slope Plume

- Following the removal of as much snow and ice as practicably possible, using clean, empty barrels, gravel if available, sand bags or a suitable alternative, create a berm to collect upgradient water and

line the berm with an impermeable geotextile/geomembrane system. Install an underflow dam at the bottom of the slope downgradient from CV-2 to intercept residual PHC impacted surface run-off from Plume 1. Use absorbent pads and booms to collect residual PHCs. The proposed location of a control structure (underflow dam) is indicated on **Drawing No. 4**.

8.2.2 APEC 2: Ditch Plume

- Following the removal of the snow and ice located in the ditch, as with the slope plume, using clean, empty barrels, gravel if available, sand bags or a suitable alternative, create a berm to collect upgradient water and line the berm with an impermeable geotextile/geomembrane system. Install multiple underflow dams at various locations in the ditch on the south side of the main road downgradient from CV-1 to intercept residual PHC impacted surface run-off from Plume 2. Use absorbent pads and booms to collect residual PHCs. The proposed locations of two control structures (underflow dam) are indicated on **Drawing No. 4**.

8.2.3 APEC 3: TSM

- Following the location of the buried utilities and subsequent ice removal below the station TSM building, using clean, empty barrels, gravel if available, sand bags or a suitable alternative, create a berm to collect upgradient water and line the berm with an impermeable geotextile/geomembrane system. Install an underflow dam at the downgradient side of CV-1 to intercept residual PHC impacted surface run-off from the TSM Building plume (Plume 3). Use absorbent pads and booms to collect residual PHCs. A test pit excavated at the mouth of the culvert indicated that a large area and grade difference is present. This will work to an advantage in constructing a large dammed pond near the source from which to collect PHC impacts. The proposed location of a control structure (underflow dam) is indicated on **Drawing No. 4**.

8.3 Stage 3: Longer-Term Actions

8.3.1 APEC 1: Slope Plume

- Monitor and maintain underflow dams and change absorbent pads and liners as required.
- Collect soil samples from the slope, north of CV-2, in the area where the PHC impacts were observed. Analyze the soil samples for the applicable contaminants of concern and compare to the Canada Wide Standards (CWS) as well as other applicable standards for contaminants of potential concern.

8.3.2 APEC 2: Ditch Plume

- Monitor and maintain underflow dams and change absorbent pads and liners as required.
- Collect soil samples from the ditch on the south side of the main road, downgradient from CV-1, in the area where the PHC impacts were observed. Analyze the soil samples for the applicable contaminants of concern and compare to the Canada Wide Standards (CWS) as well as other applicable standards for contaminants of potential concern.

8.3.3 APEC 3: TSM

- Monitor and maintain underflow dams and change absorbent pads and liners as required.
- Collect soil samples from underneath the TSM Building in the area where the PHC impacts were observed. Analyze the soil samples for the applicable contaminants of concern and compare to the Canada Wide Standards (CWS) as well as other applicable standards for contaminants of potential concern.

A secondary water treatment system should be installed at BAF-3 to process the water that passes through the oil-water separator and is stored in the one million litre water tank (or bladders as practicable) as soon as is practically possible. A remediation system is currently being brainstormed to treat the contaminants of concern based on the analytical results and the chemical composition of the fuel provided to JW by Nasittuq for a sample analyzed on February 28, 2007. Confirmatory water samples should be collected from the treated effluent and sent to a CAEL accredited laboratory for analysis of the applicable discharge criteria before any discharge to the natural environment.

9.0 Project Schedule

The development of the schedule considers possible impediments, such as limited site access, the availability of equipment, the unpredictable timing of the spring freshette, possible inclement weather, and difficult terrain on which the work will be carried out. A preliminary proposed RAP schedule has been included in a work breakdown structure/GANTT chart in **Appendix B**. Once all of the necessary equipment and tools are identified through more detailed planning and design efforts to be completed, they should be delivered to BAF-3 as soon as possible.

10.0 Project Communication Plan

Communication between the Project Manager and Team Members for the various tasks will take place regularly to ensure that consistency, schedules, budgets and scopes are being met and all information is linked between activities to attain the broader goal of incorporating all information collected into concise reports.

The Project Manager will correspond with the Nasittuq project manager on a regular basis to ensure all aspects of the project are communicated in a timely manner. In addition, conference calls will be scheduled to discuss project milestones and/or at the request of Nasittuq.

11.0 Project Health and Safety Plan

The current Health and Safety will be adjusted to address the following phases of the RAP and communicated to all parties involved in the work. Prior to additional field activities, the designated Health and Safety officer will conduct an orientation meeting involving all personnel who will be working on the site. Additional meetings to review health and safety requirements and changes will be implemented as needed. The Health and Safety officer will be available to all site personnel throughout the implementation of the RAP.

12.0 Closure

This report has been prepared for the sole benefit of Nasittuq and their clients. The report may not be used by any other person or entity without the express written consent of Nunami Jacques Whitford Limited, and Nasittuq and their clients.

Any use that a third party makes of this report, or any reliance on decisions made based on it, are the responsibility of such third parties. Nunami Jacques Whitford Limited accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made, or actions taken, based on this report. The information and conclusions contained in this report are based upon work undertaken by trained professional and technical staff in accordance with generally accepted engineering and scientific practices current at the time the work was performed. Conclusions and recommendations presented in this report should not be construed as legal advice.

The conclusions presented in this report represent the best technical judgement of Nunami Jacques Whitford Limited based on the data obtained from the work. The conclusions are based on the site conditions observed by Nunami Jacques Whitford Limited at the time the work was performed at the specific testing and/or sampling locations, and can only be extrapolated to an undefined limited area around these locations. The extent of the limited area depends on the soil and groundwater conditions, as well as the history of the site reflecting natural, construction and other activities. Due to the nature of the assessment and the limited data available, Nunami Jacques Whitford Limited cannot warrant against undiscovered environmental liabilities.

If any conditions become apparent that differ significantly from our understanding of conditions as presented in this report, we request that we be notified immediately to reassess the conclusions provided herein.
This report was prepared by Nathaniel Novosad and Rob McCullough and senior review was provided by Pierre Maheux and Francois Lauzon.

Respectfully submitted,

JACQUES WHITFORD LIMITED

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Attachments:

Drawing No.1 Key Plan
Drawing No.2 General Site Location Plan
Drawing No.3 Site Summit Plan
Drawing No.4 Sample Location and Estimated Plume Delineation
Appendix A Photographs
Appendix B Preliminary Response Action Plan and Schedule

APPENDIX A

Photographs

APPENDIX B

Preliminary Response Action Plan and Schedule

Jacques Whitford