February 7, 2011

STATUS REPORT

Remediation of Diesel Contamination at the Power Generating Station in Tsay Keh Dene, BC (Band No. 609, CPMS No. 9078)

Submitted to:
First Nations’ Emergency Services Society of BC
102-70 Orwell
North Vancouver, BC
V7J 3R5

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If new information is discovered during future work, including excavations, borings or other studies, Golder should be requested to re-evaluate the conclusions presented in this report and to provide amendments as required.
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1.0 INTRODUCTION

Golder Associates Ltd. was requested by the First Nations’ Emergency Services Society (FNESS), on behalf of Indian and Northern Affairs Canada (INAC), to provide a status report regarding the remediation at a location of fuel contamination at the Power Generating Station in Tsay Keh Dene, BC. This report summarizes the project from the report of the spill at the Power Generating Station in 1997 to the present day.

Note that although this report is intended for a reader with limited experience in contaminated site remediation, use of key technical terms is unavoidable. We suggest Wikipedia (http://en.wikipedia.org/wiki/Wiki) as a source for definitions of these terms.

2.0 SYNOPSIS

In August 1997, a fuel spill occurred at the Power Generating Station when the shut off for a day tank located in the Power Generating Station failed (MECI, 1997a). Approximately 1,135 litres to 3,785 litres of fuel flowed through a vent pipe out the building and discharged to the ground immediately outside of the Power Generating Station. Later that year (October 1997), MECI returned to the Site to conduct an investigation into the extent of contamination and to remove contaminated soil. About 110 m³ (about 11 truck loads) of fuel-contaminated soil was removed from where the vent pipe exited the building on the east side. The depth of the excavation was about 4.5 metres, which is the maximum depth that excavations can practically be carried out. An additional 20 m³ (two truck loads) of soil was removed from a stained area immediately south of the generator building to a depth of about one metre. For both excavations, there was evidence of contamination remaining, but due to the proximity to the generator building and an underground cable, contaminated soil was left in place. The excavations were lined with polyethylene and backfilled with clean soil. Further investigations at the Power Generating Station confirmed that there was contaminated soil deep in the ground and that there were about five or six centimetres of liquid diesel floating on the groundwater near where the diesel was spilled. Some of the liquid diesel dissolved into the groundwater contaminating the groundwater with fuel-related chemicals.

Figure 1 shows a simplified and conceptual cross section of how the diesel fuel contamination that was spilled at the Power Generating Station moved in the soil and groundwater. When fuel is spilled, it becomes trapped in the pore spaces between soil particles (referred to as pores). When there is more fuel than can be held in the soil pores, the fuel drains downwards until it reaches a soil layer or rock with pores too small for the diesel fuel to enter, or until it reaches the water table where it would float. Once a fuel leak has been stopped, the fuel essentially stops moving in the soil where it will gradually be removed by natural processes such as volatilization into vapour, solubilization (dissolving) into groundwater, dispersion (spreading) and biodegradation (breakdown by soil microorganisms).
In 2005, Golder conducted some additional investigations at the Site and developed a plan to address the remaining contamination at the Power Generating Station in a safe and environmentally responsible manner. The plan included four steps: i) assessment of current conditions and potential human health and ecological health risks, ii) delineation of contamination in soil and groundwater, detailed risk assessment and pilot testing of potential remediation options, iii) implementation of remediation technology, and iv) monitoring the efficacy and progress of the remediation. Golder has assessed human and ecological health risks and how extensive the contamination is, using a combination of groundwater and soil gas monitoring wells.

Figure 1 is a conceptual cross section showing how the contamination looks and how the groundwater and soil gas wells can be used to determine the extent of contamination and assess risks to humans and the environment. Monitoring wells were drilled where the liquid diesel occurs in order to check the thickness of the liquid diesel. Monitoring wells outside the area with liquid diesel, in the direction of groundwater flow, are referred to as downgradient. These wells were used for assessment of how much and how far the dissolved diesel contamination had moved. Since groundwater flow is slow (a metres or two per day at the most, and the
natural clean-up processes are effective at this site, we knew that the dissolved contamination would not move too far. In other words, the clean-up processes are fast enough to remove the diesel contamination before the groundwater has time to flow too far.

In Tsay Keh Dene, the leak was sufficiently large and the soil is sufficiently porous (consisting of mainly sand and gravel with some larger cobbles), to result in diesel fuel migration deep into the soil. Although the investigation of the diesel contamination migration at Tsay Keh Dene is complicated by the dramatic fluctuations in the water levels of the Williston Reservoir, we believe that the dissolved diesel contamination stopped far from the Williston Reservoir. Therefore, discharge of contaminated groundwater to the Williston Reservoir is not a concern.

We have also installed soil gas (vapour) monitoring wells which tell us whether diesel vapours are moving upwards in the soil, into outdoor air or into possible future buildings, in concentrations that would be of concern for people in the community. The data from these wells have consistently shown that vapour concentrations are not a human health concern. These vapour wells were also used to measure oxygen and other naturally occurring soil gases in the soil pores near the contamination. Oxygen is needed for biodegradation of the contamination by soil microorganisms.

As part of evaluating the remediation options, the results of the groundwater and soil vapour monitoring wells were reviewed. This information assisted in determining: i) where the diesel contamination is, ii) what health risks are to people or the environment, and iii) if there is sufficient oxygen near the contamination for natural degradation. We concluded that since: i) the contamination near the surface was removed back in 1997, ii) there are no human or ecological health concerns, and iii) the sandy soil allows oxygen to reach the diesel contamination, that the most practical and cost effective remediation option was to allow the diesel fuel contamination to continue to degrade naturally by biodegradation and other processes. This remediation option is referred to as Monitored Natural Attenuation (MNA), whereby the effectiveness and speed by which the natural clean-up processes are monitored over a sufficient period of time to confirm that it is working as expected.

Figure 2 shows how the initial excavation of contaminated soil resulted in a dramatic reduction in contamination within a short timeframe. Following the excavation, natural processes are expected to result in a clean site after a long period of time. Work at other sites has shown that, although the natural processes are effective, the removal of all the contamination can take decades, as illustrated in the figure. The actual time it would take depends on how much liquid fuel leaked into the ground and on the natural ground conditions at the site.
We are now in our fourth year of monitoring and have sufficient data to allow us to assess trends in the groundwater and soil vapour data. We have also identified areas where additional groundwater data could be useful to address any lingering questions regarding contaminant distribution during times when the reservoir level is low. With the Band’s permission, we have planned to return to the Power Generating Station Site in March 2011 to install some additional deep monitoring wells to answer these questions. With these additional monitoring well locations and another round of annual monitoring, we believe we are nearing the end of the monitoring necessary to confirm that the diesel contamination is degrading naturally by biodegradation and other processes. These processes will continue to slowly degrade the contamination and eventually it will be gone.

This report will outline in more detail what has been summarized above.
3.0 PROJECT HISTORY

3.1 MECI 1997 Investigations (MECI 1997a, b, 1999)

In 1997, Morrow Environmental Consultants Inc. (MECI) was hired by Indian and Northern Affairs Canada (INAC) to conduct a site visit in Tsay Keh Dene in response to a loss of fuel at the village's Power Generating Station, located at the eastern edge of the village approximately 100 metres west of the Williston Reservoir.

The power generator fuelling system consisted of two 1,150 litre above ground day storage tanks (MECI 1997a). The filling system was designed to turn on transfer pumps at a low level, and to shut off the transfer at a high level.

In August of 1997, a spill of approximately 1,135 litres to 3,785 litres of diesel fuel from an above-ground fuel storage tank in the diesel generator building occurred. The fuel loss had reportedly occurred because high fuel level shut-off valve located in one of the generator's day tanks had failed and did not stop the fuel transfer process (MECI 1997a). When the high fuel level shut-off valve failed, diesel fuel flowed through a vent pipe coming off of the top of the tanks and discharged on the ground outside of the generator building (MECI 1997a).

During the site visit in August 1997, MECI saw additional areas of fuel stained soil in the vicinity of the building and where fuel drums containing waste oil and turbo fuel were stored, indicating that fuel had leaked. Four test pits were excavated near to where the fuel spill had occurred and soil sampled confirmed that the soil was contaminated with diesel fuel (MECI 1997a). Analysis of water samples from the village wells indicated that the water was not affected by the fuel spill.

In October 1997, MECI returned to the Site to conduct a detailed subsurface environmental investigation at the site of the diesel fuel spill (MECI 1997b). As part of this investigation, MECI excavated contaminated soil from two areas:

1) The main excavation was on the east side of the building, in the area of the day tank vent pipe, where the fuel spill occurred. MECI excavated approximately 110 m³ (about 11 truck loads) of contaminated soil at this location to a depth of up to 4.5 metres where possible. It was not possible to excavate all of the contaminated soil because some of it was under the generator building, a fan support pad and fuel pipeline supports; disturbance of the soil under these structures would have jeopardized the stability of these structures. Therefore, residual diesel contamination of the soil remained under the generator building.

2) MECI also excavated approximately 20 m³ (about 2 truck loads) of contaminated soil to a depth of up to one metre along the south side of the building, where some of the fuel had apparently pooled after the spill. MECI was unable to excavate deeper than one metre at this location because they encountered a cable.

The excavations were lined with polyethylene and backfilled with clean soil. The excavated soil was placed on polyethylene sheeting at a nearby gravel pit for temporary storage, covered with polyethylene, and left to degrade over time. In July 1998, this stockpiled excavated soil was moved to an engineered storage/treatment cell next to the former location.

Samples of the suspect soil remaining in the ground were taken and found to be contaminated with fuel-related chemicals.
MECI conducted an investigation into the remaining soil and groundwater quality following the excavations. Soil samples taken from the boreholes were found to be contaminated. Groundwater, at a depth of 8.2 to 9.6 metres below the ground surface, was observed to have a layer (about five centimetres) of liquid diesel floating in one of the monitoring wells, indicating that the fuel had migrated down through the soil until it reached the water table. Once the fuel reached the water table, it spread across it and migrated in the direction of groundwater flow, which is towards the Williston Reservoir. Some of the liquid diesel dissolved into the groundwater causing the groundwater to be contaminated with fuel-related chemicals.

In July and October of 1998, MECI attempted to measure groundwater levels and sample the groundwater quality in the monitoring wells. However, MECI was unable to do so, because the level of the groundwater was lower than the bottom of the well screens. The low groundwater level was attributed to the low level of the water in Williston Reservoir.

![Photograph 1 Location of 1997 fuel spill and excavated soil at the Power Generating Station.](image)

### 3.2 Golder 2005 Investigation – Development of Remediation Plan (Golder 2006)

In 2005, FNESS requested that Golder develop a remediation plan to deal with the remaining diesel fuel contamination in soil and groundwater at the Power Generating Station in a safe and environmentally responsible manner. The plan included four steps to be conducted sequentially on a yearly basis (Golder 2006). Year I was to assess current conditions and potential human health and ecological health risks. Year II was to delineate contamination of soil and groundwater, refine the risk assessment and pilot test potential remediation solutions for the three locations. Year III was to be the implementation of the remediation technology. Year IV, the fourth step, was monitoring progress of remediation.
In order to determine current conditions, Golder conducted a site investigation which included the drilling of five boreholes completed as monitoring wells, and sampling of soil and groundwater. Golder confirmed that the diesel fuel spilled at the surface had migrated down to the water table and that the liquid and dissolved diesel had migrated in a southeast direction towards Williston Reservoir (see Figure 3). Golder also found that soil at a depth of about nine to eleven metres had been contaminated with diesel migrating with groundwater. As the level of groundwater fluctuates with season and the level of water in the Williston Reservoir, it creates a smear zone of contamination that spans the range of the groundwater level at the interface of the sand/gravel and silt layers. Golder used the information from this investigation to conduct a preliminary human health and ecological risk assessment. The risk assessment indicated that an assessment of soil vapour was needed for the human health risk assessment and additional groundwater monitoring wells were needed for the ecological risk assessment.

Golder prepared an application for FNESS to submit to the federal government for funding to carry out the remediation plan. The application for remediation funding included worst-case assessments of the extent of contamination and potential health risks for humans and the environment and confirmed that remediation was necessary.

### 3.3 Golder 2006 Investigation (Golder 2007)

In 2006, Golder conducted additional sampling at the location of fuel contamination to: i) refine the human health and ecological risk assessment, ii) investigate the extent of soil, soil vapour and groundwater contamination, and iii) to test remediation methods (Golder 2007).

#### 3.3.1 Human Health and Ecological Risk Assessment

A human health and ecological risk assessment was used to determine if people or the environment could be exposed to hazardous concentrations of diesel in soil or groundwater. Since the contamination at or near the surface of the soil had been removed, inhalation of soil vapour potentially migrating through the soil to indoor or outdoor air was considered the only potentially significant exposure pathway.

Exposure to diesel contamination through consumption of drinking water was not considered to be an operable exposure pathway as the drinking water wells for the community are located sufficiently far away that they could not be impacted by the contamination at these locations. It is important to note that the community needs to be informed that drinking water wells should not be installed at these contaminated areas in the future.

Exposure to diesel contamination through dermal (skin) contact, ingestion or inhalation of dust was not considered to be significant as the contamination is deep in the soil.

For ecological receptors, terrestrial plants and animals would be unlikely to be affected by the contamination since it was generally located more than four metres below the ground surface. However, at the time of the 2006 investigation, it was unknown if contaminated groundwater extended as far as the Williston Reservoir. If it did, there was concern that aquatic organisms could be affected.
Therefore, the scope of work for the 2006 investigation included: i) installation of soil vapour probes to investigate whether people could be exposed to contamination from breathing air, ii) installation of groundwater monitoring wells to determine how far the contamination has migrated and if aquatic organisms could be exposed to contamination from groundwater entering into the Williston Reservoir, and iii) conducting tests to determine what methods of remediation would work best for the residual contamination.

The results of the soil vapour sampling indicated that the concentrations of fuel-related chemicals in soil gas were low and not a concern for human health. The results of the additional groundwater investigation indicate that contamination from the fuel leaks/spills was not getting as far as the Williston Reservoir. Figure 3 shows the extent of the liquid and dissolved diesel contamination. This figure shows that there is some uncertainty regarding the extent of the liquid diesel and dissolved diesel plumes. Based on the information we have collected from the Site and experience from other sites, we believe the liquid diesel plume is likely to extend as shown in the figure. We have a high degree of confidence that the dissolved diesel contamination does not extend as far as the Williston Reservoir because the dissolved diesel contamination is readily degradable under conditions like at the site, and as it does not extend as far as MW06-08 to the southeast. However, the extent to the southwest has not been confirmed.

### 3.3.2 Remediation Options Testing

Tests were conducted to determine which remediation technology would be most appropriate for the conditions at the Power Generating Station. Remediation technologies tested included diesel recovery and methods to enhance natural degradation. The following conclusions were drawn from the results of the tests:

- i) The soils are highly permeable indicating that there is good air exchange and they are suitable for bioventing (adding oxygen to the contaminated soil);

- ii) Soil gas concentrations indicated that natural biodegradation of petroleum hydrocarbons in the unsaturated zone (area above the water table where the spaces between the soil particles include air and may contain some water) is likely occurring;

- iii) Soil gas concentrations did not indicate oxygen-limiting conditions;

- iv) The low dissolved oxygen concentrations within the plumes compared to higher concentrations outside of the plumes suggest that aerobic biodegradation of hydrocarbons is occurring;

- v) The low nitrate and high ferrous iron concentrations within the plumes compared to higher concentrations of nitrate and lower concentrations of ferrous iron outside of the plumes suggest that anaerobic biodegradation of hydrocarbons is also occurring; and,

- vi) The groundwater sample analysis of nutrients did not indicate a deficiency of nutrients in groundwater at the Site.
The monitoring results indicated that biodegradation of the diesel contamination is occurring within the unsaturated zone under natural aeration. The pilot test indicated that the addition of oxygen through bioventing may increase biodegradation rates to some degree, but the addition of oxygen has limited applicability as contamination in the unsaturated zone is limited in extent and oxygen levels are relatively high throughout the unsaturated zone.

Since the contamination was not causing harm to humans or the environment, the accessible contamination had already been excavated, and measurements of soil gases near the contamination indicated that biodegradation was occurring; Golder concluded that the most appropriate remediation approach for the Site is monitored natural attenuation (MNA) for groundwater and soil vapour. This approach is described further below.

### 3.3.3 Monitored Natural Attenuation

Remediation by monitored natural attenuation is a commonly used remediation strategy for petroleum hydrocarbon contamination, especially after the shallow source of contamination has been excavated. Natural attenuation relies on natural processes to clean up or attenuate contamination in soil and groundwater. The right conditions are needed underground for the process to work. These conditions are monitored for a period of time to evaluate how well the process is working. The monitoring of these conditions is called “monitored natural attenuation” or MNA.

Natural processes including biodegradation, sorption, dilution and volatilization work to reduce concentrations of fuel in the ground. Some microbial organisms that live in soil and groundwater can use fuel-related chemicals for food, and when they consume the chemicals, they can break them down into simple compounds. In addition, chemicals can stick to soil particles (also known as sorption). This can keep the chemicals in place and reduce and delay the contamination from migrating with the groundwater. Thirdly, as contaminated groundwater moves, it mixes with clean water around it, therefore diluting the contamination. Finally, some fuel-related chemicals can volatilize into soil vapour and migrate through the soil causing the amount of contamination left in the soil and groundwater to decrease.

The advantages of monitored natural attenuation over other remediation options are that it:

1) Involves limited disruption to the community as the contamination is managed in-place;
2) Generates no waste;
3) Is maintained deep in the soil therefore limiting the exposure of contaminants to the environment where humans, plants and animals live;
4) Requires no power to maintain; and,
5) Is less expensive than other remediation options.

The main disadvantage of monitored natural attenuation over other remediation options is the longer period of time it takes to achieve a clean site.
3.3.3.1 **MNA Contingency Plan**

Golder developed the monitoring program that we have been implementing and have also developed a contingency plan in case we measure contamination where we have not previously. The objective of the contingency plan is to reduce chemical exposure to humans and the environment. For soil vapour, the plan includes re-sampling and, depending on the location where the contamination is found, may include installation of a system to remove vapours from below a building. For groundwater, the contingency plan includes confirmatory sampling and assessment and depending on where the contamination is measured, may include the implementation of a groundwater management plan.

3.3.3.2 **Monitoring Duration**

Monitoring of natural attenuation is conducted to confirm that the conditions are right and that the process is working. Once it is determined that the process is working, monitoring of the degradation can be reduced in frequency or discontinued. In order to confirm that the natural attenuation is working, Golder proposed that monitoring should continue until the following criteria were met:

- **For dissolved diesel in groundwater** – The measured concentrations in the dissolved diesel are stable or decreasing over three or more consecutive monitoring events (using professional judgement and statistics such as the Mann-Kendall test for trend, or testing if new data fall within a standard deviation of the mean of previous monitoring data);

- **For liquid diesel** – Measureable thickness of liquid diesel is stable or decreasing over three or more consecutive monitoring events (using professional judgement and statistics such as testing if new data fall within a standard deviation of the mean of previous monitoring data); and

- **For soil vapour** – Soil vapour concentrations continue to indicate that there are no unacceptable health risks under the current and potential future Site conditions; and soil vapour concentrations are stable or decreasing over three or more consecutive monitoring events (using professional judgement and statistics such as testing if new data fall within a standard deviation of the mean of previous monitoring data).

3.4 **Golder 2007, 2008 and 2009 Monitoring**

In 2007, 2008 and 2009, Golder implemented the monitoring program designed in 2006. In 2007, work included one trip, and in 2008 and 2009, work included two trips each year to monitor groundwater and soil vapour wells in order to: i) assess the potential health risks to humans or aquatic organisms, ii) check if the liquid diesel and dissolved diesel plumes are increasing, stable, or decreasing in size, iii) confirm the groundwater velocity and flow direction, and iv) determine if there were seasonal differences in concentrations of contaminants in soil vapour or groundwater.

In each year, soil vapour and groundwater results indicated similar conditions to those measured in 2006; risks to human health from exposure to diesel vapours and risks to the environment were acceptable. The contaminant plumes appeared to be stable although there were insufficient data to make those conclusions.
Photograph 2: Photograph of groundwater sampling of monitoring well BH-3 in 2008

Photograph 3: Photograph of soil vapour sample collection from soil vapour well SV06-03 in 2008.
3.5 Golder 2010 Monitoring

The main objective of this work was to continue the monitoring of the natural attenuation to confirm that the remediation is working and to make recommendations with regard to future monitoring. Due to the influence of the Williston Reservoir level on the groundwater levels in the community, Golder monitors the water levels in the Williston Reservoir in order to plan the timing of the trip to Tsay Keh Dene. Figure 4 shows the water levels in the Williston Reservoir for the last 28 years. This figure shows a number of important points. First, the water levels in the reservoir fluctuate dramatically on an annual basis (peak levels typically occur during August/September). Second, the peak reservoir level in 2010 was at least three metres lower than the typical peak for the last 28 years. Third, most of the wells installed at the Power Generating Station site are sufficiently deep to capture groundwater only at the peak reservoir level (i.e., wells are dry for most of the year).

Given the low water levels in 2010, groundwater was found only in BH-2D, a monitoring well considered to be near the edge of the dissolved diesel contamination plume. Diesel contamination was not detected in this well.

The limited data set caused by the fluctuating water levels in the reservoir has also limited the statistical analysis of trends in groundwater dissolved diesel concentrations. Figure 5 shows the data from two wells considered to be within the dissolved phase plume: MW05-05 and MW06-04. There is no clear trend, although the concentrations range from the detection limit to the provincial groundwater standard. Similarly, a statistically significant trend was not observed for the soil vapour data, although, based on visual inspection of the data shown in Figure 6, a decreasing trend in the concentrations seems to be developing.
Figure 5  Dissolved Diesel Concentrations in MW05-05 and MW06-04 over Time
Figure 6  Concentrations of Volatile Chemicals (TVOC) in Soil Vapour Probe SV06-03 over Time
4.0 SUMMARY AND CURRENT STATUS

The objective of this project was to bring closure to this Site in a safe and environmentally responsible manner. Monitored Natural Attenuation of the remaining diesel contamination was determined to be the most appropriate solution for this Site following detailed investigations including human health and ecological risk assessments. We have been monitoring the natural degradation at the Site for four years and are seeing similar results from our sampling analysis each time we go. Although we are confident that the contamination is stable or decreasing, we have identified areas where additional groundwater data could be useful to address lingering questions regarding contaminant distribution during times when the reservoir level is low. We have planned to return to the Power Generating Station Site in March 2011 to install some additional deep monitoring wells to answer these questions. With the addition of these sampling locations and another round monitoring to collect of groundwater and soil vapour data, we feel that we may be coming to the end of the monitoring part of the Monitored Natural Attenuation program, as we expect to confirm the lack of an exposure pathway to the Williston Reservoir. Following this next round of monitoring, Golder may recommend that future monitoring events could be reduced in scope and/or frequency or may be discontinued. The natural degradation of the contamination will continue slowly until, eventually, the site will be fully remediated.

While we have sufficient confidence in the data and our interpretation to make these conclusions and recommendations, our opinion is also based on experience and professional judgment from working on similar sites over the last 20 plus years. However, there is a certain amount of variability and uncertainty in soil and groundwater quality monitoring data. Therefore, it is understood that INAC may want to have some additional data collected to reduce uncertainty and increase their level of confidence.
5.0  CLOSURE

We trust the information contained in this report is sufficient for your present needs. Should you have any additional questions regarding the project, please do not hesitate to contact the undersigned.

GOLDER ASSOCIATES LTD.

Thalia Zis, B.Sc.  Reidar Zapf-Gilje, Ph.D, P.Eng.
Environmental Scientist  Environmental Remediation Expert

Associate, Project Director

TZ/RDZ/TAM/nib
6.0 REFERENCES


LEGEND

- MONITORING WELL LOCATION
- SOIL VAPOUR PROBE LOCATION
- PILOT TEST WELL LOCATION
- WELL DESTROYED OR NOT LOCATED
- FENCE LINE
- ROADWAY
- ESTIMATED EXTENT OF LIQUID DIESEL PLUME
- ESTIMATED EXTENT OF DISSOLVED PLUME

NOTE
1. LOCATIONS ARE APPROXIMATE.

REFERENCES
MORROW CONSULTANTS V7-2298-002

SITE PLAN

FIRST NATIONS’ EMERGENCY SERVICES SOCIETY
REMEDICATION OF DIESEL CONTAMINATION
POWER GENERATING STATION, TSAY KEH DENE, B.C.

FIGURE 3

MONITORING WELL LOCATION
SOIL VAPOUR PROBE LOCATION
PILOT TEST WELL LOCATION
WELL DESTROYED OR NOT LOCATED
FENCE LINE
ROADWAY
ESTIMATED EXTENT OF LIQUID DIESEL PLUME
ESTIMATED EXTENT OF DISSOLVED PLUME
MONITORING WELL WHERE GROUNDWATER IS NOT CONTAMINATED
MONITORING WELL WHERE LIQUID DIESEL HAS BEEN DETECTED
MONITORING WELL WHERE DISSOLVED DIESEL HAS BEEN DETECTED

SCALE IN METRES

DRAFT
Historic Water Elevations at Williston Reservoir
Power Generating Station, Tsay Keh Dene, BC

Proposed Monitoring Wells (2011)

Wells in Liquid Diesel Plume (MW05-05)
Wells in Dissolved Phase Plume (BH2-D)

Low Waters Level During the Spring

High Waters Level During the Late Summer/Fall

Proposed Monitoring Wells (2011)
APPENDIX A

LIST OF ACRONYMS
# APPENDIX A
## List of Acronyms

<table>
<thead>
<tr>
<th>Acronyms</th>
<th>Definition</th>
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</thead>
<tbody>
<tr>
<td>BC</td>
<td>British Columbia</td>
</tr>
<tr>
<td>BH</td>
<td>borehole</td>
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<td>FNESS</td>
<td>First Nations’ Emergency Services Society</td>
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<td>Golder</td>
<td>Golder Associates Ltd.</td>
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<td>INAC</td>
<td>Indian and Northern Affairs Canada</td>
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<td>MECI</td>
<td>Morrow Environmental Consultants Ltd.</td>
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<tr>
<td>MNA</td>
<td>monitored natural attenuation</td>
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<td>MW</td>
<td>monitoring well</td>
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<tr>
<td>SV</td>
<td>soil vapour</td>
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<tr>
<td>TVOC</td>
<td>total volatile organic compounds</td>
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## Units

<table>
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<tr>
<th>m</th>
<th>metres</th>
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<td>m³</td>
<td>cubic metres</td>
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At Golder Associates we strive to be the most respected global company providing consulting, design, and construction services in earth, environment, and related areas of energy. Employee owned since our formation in 1960, our focus, unique culture and operating environment offer opportunities and the freedom to excel, which attracts the leading specialists in our fields. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees who operate from offices located throughout Africa, Asia, Australasia, Europe, North America, and South America.