Appendix A

Documents related to the undertaking

Phase II & III ESA

A-2736

PHASE II AND III
ENVIRONMENTAL SITE ASSESSMENT
AND REMEDIAL CONSIDERATIONS
MARINE EXTRACT LIMITED
PECHERIES FN FISHERIES LTEE
EASTPRE FEEDS LTD.
SHIPPAGAN, NB

For
MARINE EXTRACT LTD
PECHERIES FN FISHERIES LTEE/LTD
EASTPRE FEEDS LTD.
FINAL REPORT
DATE: MARCH 6, 2020

ACER *Environmental Services (2015) Ltd.*

ACER Environmental Services (2015) Ltd.
183 Talisman Crescent, Fredericton, NB, E3C 1M1

March 11, 2020
File: CBT 60-1
CONFIDENTIAL

Mr. Eric Smith
Chatham Biotec Ltd.
761 Hillsborough Road
Riverview, NB, E1B 3W1

ATTENTION: Eric Smith

RE: Phase II & III ESA, Marine Extract Ltd., Pecheries FN Fisheries Ltee/Ltd. and Eastpre Feeds Ltd. Final Report Dated March 6, 2020

Enclosed please find a PDF digital file copy of the Final Report for the above noted Phase II & III Environmental Site Assessment dated March 6, 2020. The Appendices for the report are provided as a separate file for ease of use and referencing. A copy of the report is to be submitted to the New Brunswick Department of Environment and Local Government in accordance with provincial requirements. Also note that the downhole video identified for Appendix 32 is a separate file.

Yours truly,

Gerald Pelkey, MSc. P.Eng.
President

gp/GP

enc: flash drive

Ref: smith200311

PHASE II AND III ENVIRONMENTAL SITE ASSESSMENT AND REMEDIAL CONSIDERATIONS MARINE EXTRACT LTD PECHERIES FN FISHERIES LTEE/LTD EASTPRE FEEDS LTD. SHIPPAGAN, NB

FOR MARINE EXTRACT LTD PECHERIES FN FISHERIES LTEE/LTD EASTPRE FEEDS LTD. FINAL REPORT DATE: MARCH 6, 2020

Prepared for: Marine Extract Limited, Pecheries FN Fisheries Ltee, Eastpre Feeds Ltd
761 Hillsborough Rd.
Riverview, NB, E1B 3W1

Prepared by: ACER Environmental Services (2015) Ltd.
183 Talisman Crescent
Fredericton, NB.
E3C 1M1

Date: March 6, 2020
File: CBT 60-1

Gerald Pelkey, MSc. P. Eng.
Site Professional

PRIVILEGED CONFIDENTIAL

Distribution: 1 Hardcopy – MEL, FN, EFL c/o ERIC SMITH
1 Digital Copy (email) – MEL, FN, EFL c/o ERIC SMITH

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FIGURE 4-8: TPH CONTAMINATE CONTOURS FOR GROUNDWATER FOR IOL SITE NOVEMBER 1992 ALSO SHOWN IN FIGURE 4-10 AS OVERLAY ON WMS SITE DRAWING.

1.0 INTRODUCTION AND SITE BACKGROUND

Mr. Eric Smith, President of EMS Engineering Ltd., retained ACER Environmental Services (2015) Ltd., (ACER) on behalf of Marine Extract Limited (MEL), Eastpre Feeds Ltd, (EFL) and Pecheries FN Fisheries Ltd. (FN) to carry out Supplemental Phase II and III Environmental Site Assessment (ESA) investigations for several properties located in Shippagan, NB. The general site location is shown in Figure 1-1, and a drawing showing the area of the site and property locations is provided on a site plan contained in Appendix 1 (Affidavit document FN A-1044). An historical aerial photograph showing the area is provided in Figure 1-2 and is also provided in Appendix 1.

Note that references to documents also include Affidavit designations to facilitate preparation and referencing of documents with respect to ongoing legal aspects and for ease of tracking references:

- Affidavit references for the FN and MEL properties (as well as the Eastpre Feeds Ltd. – EFL property) are identical for Affidavits A-1 to A-673, but are unique to each property thereafter. Therefore, to distinguish Affidavits, documents associated with FN will be designated as FN A-674 with MEL documents designated as MEL A-674 and EFL as EFL A-674 for Affidavits A-674 and higher.
- DFO defence affidavit documents are designated as AGC-1 that are associated with the DFO list of Affidavits for FN.
- DFO defence affidavit documents are designated as CA-1 that are associated with the DFO list of Affidavits for MEL.
- Irving Oil Limited defence affidavit documents are designated as IOL A-1 that are associated with the IOL list of Affidavits.
- Town of Shippagan affidavit documents are designated as T-1.

The properties investigated included:

- Pecheries FN Fisheries Ltd (FN), interest of Eric Smith, with Property Identification Number (PID) 20371266 and address at 99, 15th St.;
- Marine Extract Ltd. (MEL), interest of Eric Smith, with PID 20552352 and address at 103, 15th St;
- Eastpre feeds Ltd. (EFL), interest of Eric Smith, consists of Parcel Identification Numbers (PID#s) 20373957 and 20322517, being adjacent to each other and the IOL property. The Eastpre Feeds Ltd. property is located at 108, 12th Street, Shippagan, NB and.
- Former Irving Oil Ltd. (IOL) Bulk Plant and operations including an associated underground piping distribution system extending approximately 380 metres to the ocean going tanker boat unloading facility located on the Shippagan Wharf and a petroleum tanker car offloading facility located on the former CN property, which is now owned by the Town of Shippagan with PID 207045854. The former IOL Petroleum Bulk Plant property is located at 119, 14th Street, Shippagan, New Brunswick, consisting of PID#s 20321311 and 20371894 (referred to hereafter as the “IOL property”) and still owned by IOL.
- Small Craft harbours located on the Department of Fisheries and Oceans’ property with PID 20374203.
- Town of Shippagan Property including but not limited to the Former CN Right of Way (ROW), and Street ROWs.

LEGEND

- ACER BHs/MWs IN GREEN TEXT FOR MW21 TO MW42 FOR JUNE, 2010, 11MW8 TO 11MW17 APRIL 2011, MW30 TO MW42 JULY 2011, 12MW1 TO 12MW92 IN 2012 AND 13MW93 IN 2013, 16MW1 TO 16MW35 2016, 18MW120 TO 18MW162 AND 19MW150 IN BLUE TEXT.
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- TEST PIT LOCATIONS IN GREEN TEXT BY ACER, SEPT, 2010
- 3.2 TPH CONCENTRATION CONTOUR
- PROBABLE GROUNDWATER FLOW DIRECTION FOR SHALLOW AQUIFER

TRACE OVERLAY OF IRVING OIL LIMITED SITE PLAN FOR AS BUILT REMEDIATION SYTEM AND FORMER RAIL LOADING RACK SHOWN IN IN BLUE. REFERENCE: CAMPBELL, OCTOBER 30, 1992, INTER-OFFICE MEMO.

Some BHs/MWs and Feature locations approximate.BH/MW locations extrapolated from ASPEN, MARCH 2000, AMEC, 2001 and ARC documents, and railway siding features from Cambell, 1992.

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PHASE II & III ENVIRONMENTAL SITE ASSESSMENT
MEL, FN, EFL SHIPPAGAN, NB

FIGURE 1-1
GENERAL SITE LOCATION PLAN

FILE NAME: Fig 1-1	JOB NO.: CBT 60-1	MADE: GP	CHKD: GP	DATE: Nov 7, 2019

LEGEND

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PHASE II & III ENVIRONMENTAL SITE ASSESSMENT
MEL, FN, EFL SHIPPAGAN, NB

FIGURE 1-2
STUDY AREA LOCATION AERIAL PHOTOGRAPH

FILE NAME: Fig 1-2	JOB NO.: CBT 60-1	MADE: GP	CHKD: GP	DATE: Jan 29, 2020

Investigations extended over a long period of time due to the following:

- Efforts continued with IOL between 2002 and 2016 to obtain approval to carry out investigations on their properties including the bulk plant, former CN rail petroleum tanker car offloading facilities and underground petroleum transfer line that extended from the bulk plant to the end of the wharf at the former petroleum tanker ship offloading facilities. A court order was subsequently obtained in February 2016 to carry out investigations on the IOL properties.
- In the interim, sampling was carried out on the FN and MEL and property boundaries of the IOL bulk plant between 2009 and 2012. Sampling was done for the Royal Bank in 1995 and Three-D GeoConsultants Ltd. in 2002 on the EFL property.
- Efforts to obtain approval to carry out investigations on the DFO property continued between 2012 and 2018 with approval being obtained after a motion was made to court in 2018.

It is also critical to recognize that the property boundary for the Small Craft Harbours (SCH) property, shared with FN and MEL, is defined by the 1966 Mean High Water Level (MHWL), also referred to as the Ordinary High Water Mark (OHWM), as shown in the drawings. Therefore contamination that occurs on the SCH property in areas that are located between the property line and the current edge of the marine receiving waters, defined by the edge of the wharf structures, is actually occurring within the boundaries of the MHWL for the marine receiving waters. Not withstanding this and that contamination has been historically identified within 150 metres of receiving waters and therefore requires appropriate considerations in any assessment, but there are also multiple underground services including water supply, storm water, waste water and water supply lines that provide preferential pathways for migration of contaminants to the marine receiving environment.

The eastern edge of the FN Fisheries building extends across the MHWL with the MEL property being approximately 10 m from this boundary being separated by 15th St., and the EFL property being located about 30 metres from FN. Therefore, direct application of the Risk-Based Corrective Action (RBCA) and Environment Canada Canadian Council of Ministers of Environment (CCME) marine guidelines to the assessment of soils and groundwater for assessment of the groundwater to surface water pathway and risks to the marine environment is considered an appropriate screening approach for the FN, MEL, EFL and SCH/DFO properties.

1.1 Regulatory Framework

In New Brunswick, the roles and powers of the New Brunswick Department of the Environment and Local Government (DELG) when dealing with contaminated sites are outlined primarily in the Guideline for the Management of Contaminated Sites (DELG, Version 2.0, 2003, FN A-1896 in Appendix 3). As indicated on the website (http://www2.gnb.ca/content/gnb/en/contacts/dept_renderer.139.html#mandates), the DELG has a mandate to “ensure effective enforcement of, and compliance with, environmental legislation and regulations” and is “responsible for managing the impact of activities surrounding actual or potential contamination of the province's land”. The DELG deals with situations where there is an adverse effect or the likelihood of an adverse effect on the environment, associated with the presence or discharge of a contaminant. The Guideline for the Management of Contaminated Sites, Version 2, November 2003, provides advice and information to property owners and consultants to use when assessing the environmental condition of a property, when determining whether or not restoration is required, and in determining the kind of restoration needed to allow continued use or reuse of the site.

It is indicted that “The DELG considers the Atlantic RBCA process to be the most appropriate tool to be used when managing petroleum-impacted sites in New Brunswick.” and “This Guideline has been developed to support the Minister’s authority to address Responsible Parties and to provide guidance to all parties involved in situations where a contaminant release has occurred.” …. “Unless specifically enumerated in an Act or regulation, the

Minister (or designate) may choose a person (Responsible Party) from anyone whose conduct or failure to act caused or contributed to the contamination. In this context, the Minister has the discretion to determine who is responsible for ensuring the remediation of a contaminated site."

The comparative/screening assessment of issues of potential concern carried out by ACER on behalf of FN, MEL and EFL prior to 2012 also included the marine environment based on professional experience, judgement and applicability of the guidelines, referring primarily to the Environment Canada CCME guidelines and other guidelines as applicable. The RBCA guidelines did not contain any ecological criteria prior to 2012. ACER also subsequently included the ecologically specific criteria provided in RBCA Version 3.0 in 2012 and updated in 2015 for screening level purposes in recognition of provincial and federal jurisdictions.

The CCME Guidelines were also used for this assessment in recognition of the groundwater to surface water exposure pathway for Marine Aquatic Life (MAL) receptors associated with Shippagan harbour, and potential risks to human health. The CCME guidelines are applied at property boundaries with Federal properties in circumstances wherein contaminate migration onto federally regulated/owned lands is a concern. The Federal guidelines were also applied in consideration of possible future Federal occupancy of the Assessed Property (such as SCH/DFO) and adjacent Federal land use.

1.2 Background Review and Assessment

Information pertaining to historical investigations carried out for the FN, MEL and EFL properties as well as other investigations in the study area and historical information related specifically to IOL operations as well as water supply use are presented in this section.

1.2.1 Historical Environmental Investigations of FN, MEL and EFL Properties

Eric Smith retained Three-D GeoConsultants Ltd. (TDG) in 2001 (Affidavit A-281 a in Appendix 4) to undertake an historical assessment of the area. The assessment showed a footprint for contamination that extended from the area of the former IOL bulk plant and adjacent EFL and other properties, across the FN and MEL properties and across the DFO property toward the marine environment as shown in Figures 1-3 and 1-4 (Figures 3 and 5 in A-281 a also in Appendix 4). Due to contamination concerns identified on the EFL property a drilling program was provided, as requested by Steve Jarvis, IOL Operations Manager, and their consultant (AMEC Earth and Environmental Ltd) on September 11, 2001 (personal communication, Eric Smith), to further assess impacts associated with the IOL property. Mr. Steve Jarvis refused this request for drilling on the IOL property made on January 18, 2002 (personal communication, Eric Smith, Affidavit IOL A-586 (pg.32) in Appendix 5.

Investigations were carried out in 2002 by TDG on the Eastpre Feeds Ltd. property. Findings showed petroleum hydrocarbon contamination to be present in the diesel and fuel oil range at other locations not previously assessed on behalf of IOL (TDG, Dec 6, 2002, Affidavit document A-656 in Appendix 6). It was indicated that concentrations of petroleum hydrocarbons (PHCs) showed an increase on the EFL property from those reported by ARC in 1993 and 2000 for monitoring in association with the IOL bulk plant and it was further indicated that:

"…. tides in the area which flush or move the groundwater table not only in and out, but up and down twice daily." and

"Although Eastpre Feeds Ltd.'s property is classified Tier 1, Commercial Non-Potable range, two adjacent properties, namely, FN Fisheries and Marine Extract have potable water wells and thus because of water table movement and flushing, as previously discussed, will continue to receive contaminates via Eastpre Feeds Ltd.'s property. This being the case, then Eastpre Feeds Ltd.'s property exceeds Tier 1 Commercial Non-Potable range and should be classed along with FN Fisheries and Marine Extract as Tier 1 Commercial Potable Water for clean-up purposes."

LEGEND

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PHASE II & III ENVIRONMENTAL SITE ASSESSMENT
MEL, FN, EFL SHIPPAGAN, NB

FIGURE 1-3

CONTAMINATION PLUME IN SOIL 1998

FILE NAME: Fig 1-3 3D Sol	JOB NO.: CBT 60-1	MADE: GP	CHKD: GP	DATE: Jan 29, 2020

LEGEND

- ACER BHs/MWs IN GREEN TEXT FOR MW21 TO MW42 FOR JUNE, 2010, 11MW8 TO 11MW17 APRIL 2011, MW30 TO MW42 JULY 2011, 12MW1 TO 12MW92 IN 2012 AND 13MW93 IN 2013, 16MW1 TO 16MW35 2016, 18MW120 TO 18MW162 AND 19MW150 IN BLUE TEXT.
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PHASE II & III ENVIRONMENTAL SITE ASSESSMENT
MEL, FN, EFL SHIPPAGAN, NB

FILE NAME: Fig 1-4 3D GW	JOB NO.: CBT 60-1	MADE: GP	CHKD: GP	DATE: Jan 29, 2020

FIGURE 1-4

CONTAMINATION PLUME IN GROUNDWATER 1998

It was further indicated that:

"It is our belief that the past and current remediation programs will have little or no effect unless a wider area is covered and thus if clean-up is to be done, it should include all properties peripheral to Eastpre Feeds Ltd where contaminates are detected."

The assessment by TDG in 2002 recognized the potential risks associated with contaminates from the Eastpre Feeds Ltd. property and water supply well(s) usage for food grade operations on the adjacent properties.

ACER completed Phase II investigations for the EFL property in June 2009; A-291 contained in Appendix 7, and assessed that:

"based on this assessment the documentation collected to date on behalf of IOL and Eastpre Feeds Ltd. it indicates that petroleum contamination associated with the IOL property migrated onto the Eastpre Feeds Ltd. property, and contamination is still present in the soil and groundwater on the Eastpre Feeds Ltd. property that may represent a potential risk to human and ecological receptors."

It was further indicated that:

"The DOE and IOL consultant had ongoing concerns about groundwater containment being provided for the IOL site." and

"It is demonstrated in the documentation that IOL appears to make a number of admissions of liability/fault concerning the source and extent of contamination, as well as issues related to action, or lack of action, taken to address containment and remediation of contaminated soil and groundwater (see background, Section 1.2)."

ACER completed Phase II investigations for the FN property in April 2011, A-292 in Appendix 8, and assessed that:

"Site conditions, historical reporting and relative concentrations for contaminate parameters support that the IOL property and underground petroleum pipelines likely represents the apparent source of contaminates detected on the FN Fisheries Ltd. property."

ACER carried out additional Phase II and III ESAs between 2012 and 2019 in order to assess potential sources of contamination and potential risks to the environment, to delineate the horizontal and vertical extent of contamination, and in consideration of the development of remediation measures in accordance with the DELG 2003 "Guideline for the Management of Contaminated Sites, Version 2", Affidavit FN A-1896 in Appendix 3 (referred to hereafter as the DELG Guidelines) in combination with CCME guidelines.

The long time frame for the investigations resulted due to delays during efforts to negotiate in good will with adjacent property owners to obtain approval to carry out investigations on their properties, namely IOL and DFO. After several years of negotiation with IOL, it became necessary to obtain a court order, and initial intrusive investigations were eventually carried out in 2016 with monitoring carried out for the following two years. Negotiations were undertaken with the DFO between 2012 and 2018, and in 2018 a motion was submitted to court, with DFO subsequently agreeing to allow investigations to avoid a court order.

ACER completed additional intrusive sampling in 2012 and 2013 on the FN, EFL and MEL properties, former CN ROW owned by the Town, and ROW of 14th St. (FN A-944 in Appendix 9). The preliminary assessment supported the assertion that the IOL property and associated operations including the former CN rail taker car petroleum unloading facility and the two IOL underground gasoline transfer lines are a source of contamination to the EFL, FN, MEL properties with concentrations at the boundary of the SCH/DFO property representing a risk of concern to the marine environment, that was reported by SCH/DFO to show multiple contaminate parameters including petroleum hydrocarbons that exceed the CCME and RBCA criteria. A copy of the report was provided to the NBDELG.

On December 3, 2012, the DOE requested a meeting with IOL representatives (Affidavit document FN A-906 a,b,c,d in Appendix 10). On May 10, 2013, the DOE wrote to Michelle Paul-Elias of Cobalt Properties Corporation (Cobalt), part of the Irving Group of Companies, and reiterated that there had been no additional environmental information provided since June 2004 and that "The DELG is of the opinion that Petroleum contamination in the immediate area likely originated from historical operations/spills at the former bulk plant or pipeline. Based on available file information, petroleum hydrocarbon contamination appears to have impacted a number of properties including but not limited to, PIDs20371894, 20321311, 20322517, 20373957, 20704854, 20804829, and 20371266." and therefore **requested "that a comprehensive environmental site assessment report be submitted to the Department on or before September 15, 2013."(FN A-898 in Appendix 11). This was not done.**

PIDs 20373957 and 20322517 are the EFL properties and PID 20371266 is the FN property. PIDs 20321311 and 20371894 are the former IOL property.

The DELG sent a reminder e-mail to Cobalt Properties Corporation dated October 28, 2013 to request an updated report on the IOL bulk storage site and pipeline to bring properties into voluntary compliance with the DOE Contaminated Sites Management Process (FN A-896 in Appendix 12). A response from Cobalt was to be provided by the end of January, 2016. Subsequently Eric Smith undertook a motion for a court order to undertake investigations on the IOL bulk plant property in February 2016 given that his property interests were adversely impacted, with the IOL bulk plant operations including the former CN Rail tanker car petroleum offloading facility/area and two IOL underground gasoline transfer lines being the apparent source(s). Concentrations of petroleum hydrocarbons and naphthalene (PAH parameter) were present on the EFL, FN and MEL properties that exceeded criteria in consideration of risks to land use, historical industrial water supply/wells for food grade operations, the marine environment and protection of workers involved in earthwork related activities for installation of infrastructure.

Investigations were carried out by ACER on the IOL property between 2016 and 2018, the DFO property in 2018 and 2019 and also included additional intrusive investigations on the FN and MEL properties as well as the SCH/DFO property including sediment sampling.

The additional drilling including land and marine/harbour based sampling was required on adjacent/nearby properties to:

- further assess apparent and other potential sources of contamination;
- verify the horizontal and vertical extent of land based contamination;
- establish the movement of contamination in the groundwater in consideration of the design of a remediation plan given IOL did not provide any indication of implementing any remedial measures;
- verify the horizontal and vertical extent of contamination in the sediment of the marine environment; and
- further evaluate risks to human health and the ecological environment.

1.2.2 Groundwater Aquifer and Water Supply Use

As indicated in the previous section, the assessment by TDG in 2002 recognized the potential risks associated with contaminates from the Eastpre Feeds Ltd. property and water supply well(s) usage for food grade operations on the adjacent properties. There are several saltwater supply wells that have been historically utilized in the area. Two wells are used for ice processing for fisheries operations. Since 1950 or earlier, FN utilized the brackish/saltwater *supply aquifer* in the area of the FN and MEL properties with an operational range from 200 to 350 Gallons per minute (GPM) for food grade fish processing operations. See Figure 4-2, also included in Appendix 97, with the location of the well identified as WS/FN WELL.

A private food grade water supply well must first satisfy drinking water supply criteria with respect to chemical contaminants prior to any further refinement. For federal information on potable saltwater (brackish) wells used by fish and pharmaceutical processing plants, reference is made to the Canadian Food Inspection Agency "Facility Inspection Manual" FN A-1105, May 8, 2013 (in Appendix 30).

– 6. Registered Processing Vessels on page 28, "sanitary seawater for processing". This clearly verifies that saltwater from wells is acceptable for seafood processing.

– 6.0 Sanitation on page 86, "Compliance Guidance. The source and/or supply of water used for cleaning and/or sanitizing facilities and equipment using in the unloading, handling and transporting of fish must not be a source if biological, chemical or physical contamination. Clean sea water is acceptable for cleaning. Clean sea water is sea water which meets the same microbiological standards as potable water and is free from objectionable substances. Potable water is fresh- water fit for human consumption. Standards of potability shall not be less than those outlined in Tables 7.1 and 7.2 for microbial contaminants and Table A3.3 for chemical contaminants of the latest edition of the WHO "International Guidelines for Drinking Water Quality"."

The water supply aquifer was tapped into utilizing a 6 inch water supply well, that is approximately 120 feet deep with a well casing installed to about 100 feet. An assessment for groundwater supplies was carried out in 1993 to assess the aquifer as a supply source for Marine Extract Ltd. and the possibility of increasing the supply for FN Pecheries Ltd. operations. During drilling for the MEL water supply wells (two wells drilled) four levels of petroleum contamination were encountered (14 to 16 feet, 20.5 to 21.5 ft., 38 plus/minus, to 44 plus/minus ft.) to the 44 ft. depth. Subsequent testing of the FN water supply well was carried out and showed petroleum hydrocarbon contamination to be present and the saltwater supply well was no longer suitable for use for food grade seafood operations. With respect to detectable petroleum hydrocarbon contaminants, a saltwater/brackish well must meet the same chemical contaminant standards established for a potable water well and **in this instance RBCA residential criteria for petroleum contaminates is acceptable**. As such, c**oncentrations of BTEX exceeded RBCA residential criteria and the CCME guidelines, with TPH exceeding RBCA residential criteria as well,** and therefore the **brackish/saltwater *supply aquifer*** could no longer be used for food grade seafood operations.

A downhole video was taken in 2000 for the water supply well servicing the FN property and it is reported that oil like globules were evident in the water column (A-57, Appendix 32 is provided as a digital video included as a separate digital file that can be opened using the open source video program "VLC media player") A still photo at time frame 14h18m17s247 from the aforementioned video and a photo of a water sample collected during purging of the well is provided in Appendix 99. A cross section of the overburden and bedrock conditions is provided in Figure 3-2, (also included in Appendix 72) with the FN well identified as WS/FN WELL. The location of the well is shown on Figure 4-2, also included in Appendix 97.

The top 5 metres of the bedrock is completely to highly weathered and significantly fractured. Photos of the fractured bedrock conditions observed during excavation activities and downhole videos of monitoring wells on the IOL property and central area of FN/MEL properties about 18 metres from the FN well and several metres from the IOL underground gasoline pipelines are also provided in Appendix 72.

Several downhole video stills showing the extensive and significant fracturing in the bedrock are provided in Photos 3-15 to 3-18 for 16MW20A located on the IOL bulk plant and adjacent to 14th St. and Photos 3-16 to 3-19 for 16MW 22B located about 140 metres down gradient of 16MW20A and are also included in Appendix 72. Monitoring Well 16MW22B is located near the northeast corner of the MEL building about 140 metres from 16MW20 located on the IOL bulk plant property, in the direction of the wharf and several metres from the IOL underground gasoline transfer line and the FN water supply well that is constructed to 120 foot depth. The cobble

and cave fractures appear to represent zones of significant fracturing and vertical fractures are evident that extend several metres, providing an interconnection with the two highly fractured zones in the bedrock, that show a downward dip from the IOL site toward the FN/MEL properties and the wharf. Several downhole video stills showing the extensive and significant fracturing in the bedrock are provided in Photos 3-15 to 3-18 for 16MW20A located on the IOL bulk plant and adjacent to 14th St. and Photos 3-16 to 3-19 for 16MW 22B located about 140 metres down gradient of 16MW20A and are also included in Appendix 72.

Well 16MW22B is located near the northeast corner of the MEL building about 140 metres from 16MW20 located on the IOL bulk plant property, in the direction of the wharf and several metres from the IOL underground gasoline transfer line and the FN water supply well that is constructed to 120 foot depth. The cobble and cave fractures appear to represent zones of significant fracturing and vertical fractures are evident that extend several metres, providing an interconnection with the two highly fractured zones in the bedrock, that show a downward dip from the IOL site toward the FN/MEL properties and the wharf.

Comments regarding the Ministerial Orders issued by the New Brunswick Department of Environment (DOE) to Irving Oil Ltd. (IOL) pertaining to the IOL Shippagan bulk storage facility dated February 3, 1993, tracked as reference document A-472, (provided in Appendix 30), and water supply considerations are provided in a letter from ACER to Eric Smith dated December 4, 2014 (FN A-942 in Appendix 30). This letter was used by Eric Smith in preparation of a letter to the DELG dated December 5, 2014 (FN A-976 in Appendix 30) inquiring as to why the original ministerial order had been changed from a sensitive water use condition to a non-sensitive site, thereby ignoring the afore mentioned water supply wells. The IOL consultant and the DELG were aware of the brackish/saltwater aquifer being used for commercial operations in the area.

MEL made an application for industrial potable water well in 1993 to DOE and was approved in 1996 with an 8 inch diameter well at 120 ft. deep, and capacity of 350 gal/min. Refer to MEL environmental approval # 1/579, see A-279 a b c d e f g h (also included in Appendix 30) specifically c and e page 1 site assessment: sensitive and Michel Poirier, Remediation Engineer, Impact Management Branch, DOE e-mail 1-17-14 as FN A-979 (also in Appendix 30). **Permits issued by DOE for petroleum storage facilities in this area have recognized the existence of potable water wells nearby and designate the site as "sensitive".**

An assessment of the zone of drawdown influence under existing Department of Environment approved pumping rates was carried out by Craig Hydrogeologic Inc., April, 2011, for the MEL and FN properties, (Affidavit document A-662, Appendix 30). As can be seen in Figures 2, 3, 5, and 6 of the report, the groundwater capture area for the Marine Extract and FN Fisheries pumping wells reflected by a pumping rate of 250 GPM for FN operations (operational range from 200 to 350 GPM) includes the adjacent DFO and DNRE properties. Craig indicates that "Any properties which are located within the groundwater capture areas of the pumping wells and which have sources of groundwater pollution/contamination pose a risk to the pumping wells."

Document A-143 in Appendix 105 refers to a Town potable water well located on 15 th. Street that is no longer in use as it "Would likely have influence on area and could possibly pull in contaminates." The Irving Oil Ltd. bulk storage facility is located on 14th street. The potential risk of contamination was considered high and the Town proceeded to replace this well at a cost of $110,000.

Consultants for IOL were also aware of the water supply wells in the area. In a report by ARC in May, 1998 (A-109, IN Appendix 25) regarding investigations on the nearby DFO property, it is indicated that "Near the shoreline, saltwater intrusion has taken place into the aquifer at shallow depths (<20m). This intrusion has been caused in large part by historic extraction of fresh water by the Town of Shippagan and various commercial enterprises. **It is**

likely that ARC would have been aware of water supply usage by the commercial enterprises wells before 1998. The use of commercial water supply wells is also documented in the report for historical investigations carried out by AMEC is 2001 on behalf of IOL (A-280 in Appendix 78).

IOL was aware of the water supply well located on the FN/MEL property and that food grade production was carried out at the facility, as indicated in the Court Discovery File M/C/1793/02 V1&V2 for Steve Jarvis of IOL, located in Attachment 9 of A-943, in Appendix 122, see page 74 of the court document located on page 752 of the letter report PDF file.

It appears from the above that the IOL consultant, IOL representatives and DELG did not acknowledge the risk to several water supply well(s) located on adjacent properties that have been associated with food grade operations and ice plants supplying the fishing industry, although the NBDELG guidelines require that groundwater use be assessed within 200 metres, or at greater distance if the water supply is potentially at risk. It is reported that IOL formally adopted the DOE "Guidelines for the Management of Contaminated Sites" to demonstrate their personal commitment to protect the environment, but appear to have frequently been non-compliant with DELG requests to carry out and implement measures consistent with the aforementioned Guidelines and Ministerial Orders for this project and apparently numerous others and may have intentionally disregarded or sidestepped liabilities related to sensitive receptors such as the water supplies.

Remediation for the IOL property at the time was being carried out using criteria to be applied for a non-sensitive (reflecting non-potable water) site. However, the Guidelines for the Assessment and Remediation of Contaminated Sites issued by the DOE in May 1992 indicated that "Any site that, in the opinion of the Minister, has the potential to contaminate existing (or reasonable future use) private, municipal, or industrial water supply sources or is within an area designated for water quality protection by federal, provincial, or municipal government agencies." was to be designated as a "Level I (Sensitive Site). The 1992 guidelines were updated in 1999 with the DOE applying RBCA criteria that also distinguished between potable and non-potable water sites, equating to Level I (Sensitive) and Level II (Non-Sensitive), respectively. The environmental consultant acting on behalf of the client was responsible for identification of sensitive receptors that included water supplies, marine/aquatic resources and other environmental components of concern.

The guidelines require an assessment of the extent of contamination and potential receptors at risk **in the vicinity of the site.** It is indicated in the guidelines on Page 1 that:

"A site assessment is the characterization of a site at a sufficient level of detail to establish the presence or absence of contaminants and their potential impacts on human health and the environment. In some cases, assessment of a "site" may involve *more than one property.*"

and on Page 3 that

"Site remediation involves the treatment of contaminated soil and/or groundwater, or both, to reduce the risk to human health and the environment to acceptable levels. **Remediation** may be required in those cases **where the assessment reveals that contaminants are present in the soil, rock or groundwater at levels greater than the limits established by the regulatory authority** and (and is underlined in the document) **where such contamination is judged to pose an unacceptable risk to human health and the environment**."

The environment is not limited to the source property, but includes adjacent properties or any part of the environment considered to be at risk as indicated on Page 6 that indicates that:

"The objectives of a site assessment are:

-To determine if a site is contaminated;

-To determine the level **and extent** of contamination: and

-To assess the risk to human health and the environment."

and it is of particular importance to also note that on Page 9 it indicates that:

"Potential receptors of contamination *in the vicinity of the site* should be identified in order to assess the level of risk to human health and the environment. Potential receptors may include one or more of the following:

- Aquifers, wells and groundwater supplies…

- Recreational, agricultural or industrial facilities: and….'.

It is further stated on Page 8 that "The approach used for the characterization of potential pathways may include:

-The identification of service lines or other potential man-made pathways..".

It is further indicated on Page 9 that:

"The report should be structured so as to adequately describe the sources(s), pathway(s) **and receptor(s)** as discussed in the preceding sections."

The Minister was using the definition of sensitive and non-sensitive defined in the guidelines in the first place in defining the order and would be expected to continue to do so. **The on-site water supply source was suitable for FN and MEL commercial use and met the DELG Guidelines definition for a Level I (Sensitive Site)**.

In the Ministerial Order issued February 3, 1993, A-472 (in Appendix 30). It is stated in the Order that "…the Company (being Irving Oil Limited) is hereby ordered to carry out and complete all of the following work in the manner and within the time herein specified.

1. As outlined in the "Guidelines for the Assessment and Remediation of Contaminated Sites" – May 1992 (hereinafter called the "Guidelines",…".

It is indicated on page A-1 in the Introduction in Appendix A of the Guideline that;

"Clean-up of petroleum contaminated sites consists of reducing the concentration of spilled petroleum from the groundwater and soil to levels which do not restrict reasonable future use of the site **and surrounding property**."

and

"Level I (Sensitive site) is defined as "Any site/property that, in the opinion of the Minister, has the potential to contaminate existing (or reasonable future use) **private**, municipal, **or industrial water supply sources**…".

For FN, MEL, EFL the "**on site water supply source**" **via on site private wells** installed in the brackish/saltwater aquifer was considered acceptable and used for food grade operations of a commercial/industrial nature and therefore fit the definition of the guidelines as a Level I sensitive site. There are grounds to argue that the wells were for private use for food grade operations. Petroleum hydrocarbon contamination of the groundwater on the IOL and adjacent properties including FN, MEL, EFL and other properties represented an unacceptable risk to the **"on site water supply source"**

The letter from the Minister of Environment dated November 25, 1993 (Affidavit A-506 in Appendix 30) indicated that "We have recently completed a study of the municipal water supply for the Town of Shippagan, and, as a

result, have redefined the zone of protection. This letter is to advise that the above-noted site is now outside this protected area. Therefore, the clean-up criteria for this site is now changed to non-sensitive.". It should be noted that the Minister made a determination that the clean-up criteria could be changed to non-sensitive **based on a study of the municipal water supply for the Town of Shippagan**. It should be further noted that the only item to be changed in the Order was to Item 1 related to the clean-up criteria. All other items remained unchanged. As indicated in the ACER letter to Eric Smith dated December 4, 2014 (FN A-942 in Appendix 30) "**The documents indicate that cleanup is to be carried out to meet the New Brunswick Department of Environment requirements, but failed to recognize the risk to several water supply well(s) located on adjacent properties. The wells have been associated with food grade operations and ice plants supplying the fishing industry.**

Although the Minister made a determination based on the municipal water supply, as indicated above, the Order still requires that "…the Company (being Irving Oil Limited) is hereby ordered to carry out and complete all of the following work in the manner within the time herein specified.

> As outlined in the "Guidelines for the Assessment and Remediation of Contaminated Sites" – May 1992 (hereinafter called the "Guidelines",…"

It would appear that presence of other water supply wells were not apparent or otherwise included in the decision by the Minister, however, **as indicated in the Oder "the Company is hereby ordered to carry out and complete all of the following work in the manner…"**. As outlined in the "Guidelines ….." it is also still the responsibility of the IOL consultant "to provide high quality, objective, technical services" as indicated on Page 5, and on Page 9 as indicated above that "Potential receptors of contamination in the vicinity of the site should be identified in order to assess the level of risk to human health and the environment." including "wells and aquifers". **The IOL consultant was aware of the commercial water supply wells near the IOL site and should have acknowledged the risks to these water supplies in consultation with the DELG. IOL did not acknowledge causing any contamination to adjacent properties and as such apparently did not acknowledge any risks to water supplies, and on that basis it appears that the DELG was not consulted regarding potential risks to commercial water supply wells.**

As indicated, with respect to detectable petroleum hydrocarbon concentrations or concentrations of other contaminates, a saltwater well must not exceed the same criteria established for a potable water well that would be used for residential purposes. As such, **concentrations of BTEX and TPH were compared with RBCA potable water criteria for residential use and the CCME guidelines**.

1.2.3 Other Historical Documents

The following information is primarily related to the contamination and remedial measures associated with the IOL Bulk plant and associated operations.

The IOL property has historically been used for petroleum bulk storage and retail operations. The facility was initially constructed in approximately 1938, IOL A-8 in Appendix 13, with 2 large petroleum tanks and 12 smaller petroleum tanks with a combined storage of over 5,487,162 litres (1,206,000 gallons). Petroleum products stored on site consisted of mainly diesel, furnace fuel and gasoline. The existing petroleum storage tank system Registration form Schedule B at page 4 shows heating fuel tanks 12 and 14, leaded gasoline tank 13, stove tanks 5 to 11, waste oil tank 15 (Affidavit document A-431, Appendix 14).

The IOL bulk storage, boat unloading facility and the two associated interconnecting gasoline pipelines were established in approximately 1938 (Affidavit document IOL A-8 in Appendix 13). A third pipeline was reportedly

installed by IOL in 1953 as well as two additional petroleum storage tanks (Affidavit document IOL A-1 in Appendix 15).

A rail tanker unloading facility was reportedly installed adjacent to the IOL bulk plant property in 1953 (Affidavit document IOL A-8 in Appendix 13).

Based on a review of historical documents related to reported and unreported spills, a volume of 4,617,406 litres was determined to have been spilled with respect to the IOL operations (section 1.3).

A background review and assessment of environmental and other documents associated with the IOL bulk plant and associated operations including the truck tanker unloading facility, truck loading rack, rail car unloading facility, and underground fuel oil and gasoline petroleum transfer lines that extended to the ocean going tanker boat unloading facility located about 380 metres to the end of the wharf, was carried out as part of the Phase II ESA completed by ACER for the EFL property (Affidavit 291 in Appendix 7). A number of the key findings follow.

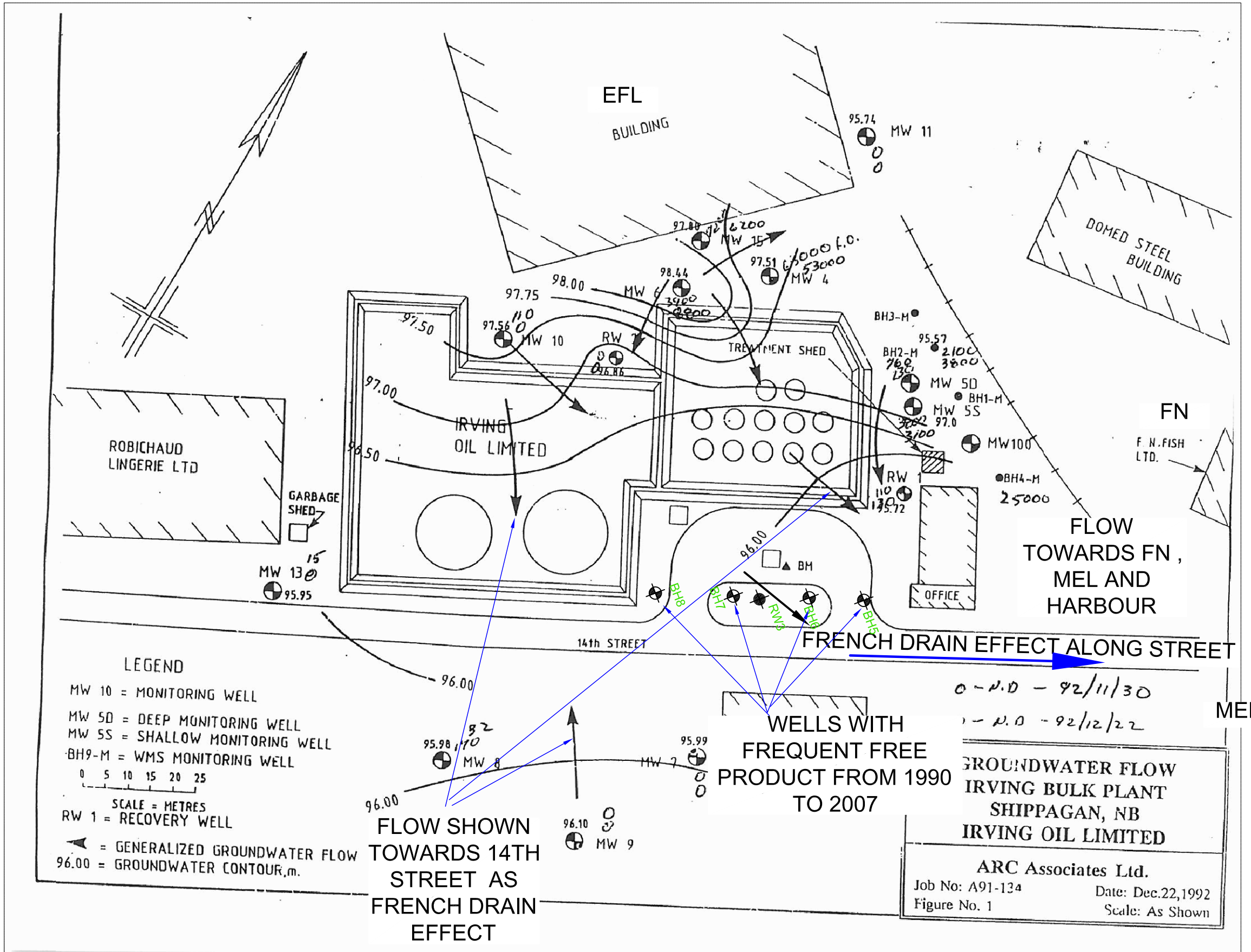
- **IOL reported to the DOE on September 25, 1989 that a spill of petroleum hydrocarbons occurred on September 24, 1989** involving an estimated release of 3,600 litres of non-leaded gasoline (but IOL never provided blue book documentation to verify the amount) (Affidavit document A-433, in Appendix 16).
- Sampling of soil and groundwater by ACER in areas previously sampled on behalf of IOL as part of the follow up to a spill incident in September 1989, showed concentrations of petroleum hydrocarbon components that exceeded various regulatory guidelines. Strong petroleum odours were detected at sampling locations established on the Eastpre Fees Ltd. property as part of the ACER investigation in 2009.
- There is no record or documentation indicating that Petroleum storage tanks were located on the Eastpre Feeds Ltd. property for heating (electrical heat) or vehicle refuelling (propane operated moving equipment used at site) purposes.
- Two 45 gallon storage drums containing refrigeration oil and stained surface soils were the basis for DOE indicating that the Eastpre Feeds Ltd. property required some remedial clean-up in November 1992. The two 45 gallon storage drums and seven 45 gallon drums of stained soils excavated from a localized area to a depth of about 20 cm, containing unidentifiable products in the heavy petroleum hydrocarbon range were removed, and sampling carried out by DOE in July 1993 confirmed remedial clean-up was acceptable. The remedial file was officially closed in March 1994 based on the July 1993 sampling.
- A release of gasoline on the IOL property (3,600 litres but not confirmed) was reported by IOL to DOE in September 1989. **Floating product was reported for the groundwater and overburden soils and DOE indicated that "based on a site visit and observed test pit excavations it is obvious that a rather large amount of free product and consequently contaminated soil still remains in the ground"**. Petroleum product was pumped from groundwater sumps and stored in a large (20,000 gallon capacity) soil lined diking system having a high permeability that was not in compliance with Regulatory requirements). It was indicated in a field checklist that there was gasoline spillage in June 1993, in the area of MW5S and MW5D. There was no evidence of the incident having been reported to the DOE in the available documentation. An accidental spill of gasoline of unknown quantity, due to a gasket failure for a petroleum storage tank, was reported in July, 1994. Two back to back accidental spills were reported at IOL in April, 1998 involving diesel oil and stove oil. A 90,920 litre storage tank used for unknown storage purposes was reported to have leaked and was last used in 1984. There was no other information indicated such as quantity of the spill or soil excavated. Fifteen tanks were on site with a combined storage of approximately 5.5 million litres (1.2 million imperial gallons).
- The IOL site appears to have been subject to frequent releases of petroleum product (estimated 5,000,000 litres as indicated in Section 1.3). Reporting of spills to the DOE was not mandated until NB Regulation 87-97,

the Petroleum Product Storage And Handling Regulation, under the Clean Environment Act was enacted in 1987. The bulk plant was constructed in 1944 or earlier based on older documentation. The blue book of daily inventories for tank contents would provide an indication of the quantity released for the documented spill events and would also provide an indication of any spills and associated quantities that may have occurred prior to formal spill reporting to the DOE being mandated 1987. The book for daily inventories could not be located by IOL.

- It is the position of IOL that the Ministerial Orders only require IOL to assess and remediate contamination identified on the bulk plant property. (Discovery Court File Number M/C/0793/02, March 2004, in Appendix 88).
- The permeability of the soil lined bulk storage petroleum containment diking system was not in compliance with Regulatory requirements, with the permeability being 50 times higher**. Due to the large quantity** spilled in 1989 (over 3,600 litres), groundwater sumps installed to capture petroleum had to be pumped into the on-site 20,000 gallon diking system. Quantities spilled and pumped to the 20,000 gallon diking system and time frames could not be confirmed. Pumping from groundwater sumps typically results in quantities being several times greater, representing in the order of 10,000 litres in this instance.
- It is likely that overburden soils in the tank farm were significantly impacted during storage of recovered product in the reservoir for the 1989 spill. In addition, the bedrock immediately underlying the overburden consists of completely too highly weathered sandstone/siltstone (ARC, 1992) that is described as follows: “The upper part of the bedrock behaves like sand” (ARC, 1990A). It was also indicated that “The transmissivity and permeability of the lower section of the overburden soil and the upper sections of the weathered bedrock are high.” (ARC, 1992A), and therefore, would also do little to prevent contaminates from migrating into the soil, bedrock and groundwater.
- The groundwater remediation system was not operational until October 1992, three years after the reported spill in September, 1989. A soil treatment system was not installed until the fall of 1994 and in our opinion was considered very inadequate and did not reflect the originally approved soil remedial approach. There was no documentation found to indicate soils had been remediated to satisfy appropriate remedial guidelines.
- The DOE and IOL consultant had ongoing concerns about groundwater containment being provided for the IOL site based in particular on concentrations obtained for MW3 located down gradient on the CN ROW in the direction of the FN, MEL and DFO/Marine properties.
- Petroleum hydrocarbon contamination including gasoline, diesel, fuel oil and lube oil range petroleum hydrocarbons as well as Naphthalene were detected in the soil and groundwater on the IOL property as part of investigations and monitoring carried out for the IOL bulk plant site. **Similar contaminates** were detected on the Eastpre Feeds Ltd. property during the ACER investigations.
- Based on monitoring for this investigation and IOL directed investigations, it is our opinion that groundwater mounding effects likely caused localized shallow groundwater flow to occur in a northerly (towards Eastpre Feeds Ltd.) and easterly/south-easterly direction towards 14th St., with respect to the tank farm impoundments, with shallow groundwater flow being in a northerly direction in a broader regional context, but also being subject to influences by underground services and tidal effects.
- The IOL consultant commented in a monitoring report dated January 9, 1993 (A-481a and A-470 in Appendix 24 including Figure provided in this report as Figure 1-5) that "Outside of the influence of the two remedial wells, groundwater flow appears to be taking place in a south-easterly direction towards 14th Street. This street appears to act as a groundwater sink as the three monitoring wells to the southeast of 14th Street flow towards the northwest. The groundwater contour centred on MW13 also indicates that there is a groundwater sink between 14th Street. It is likely that the installation of services such as sewers and water mains and the

ensuing backfill with coarse material may in fact act to provide a “french drain effect” along the pipeline. This could account for the apparent observed groundwater data." See Figure 1-5.

- For the IOL property, gasoline range hydrocarbons were reported in November 1989 at all sampling locations, with fuel oil range hydrocarbons reported for the second monitoring event in July 1990, and gasoline and fuel oil range hydrocarbons reported for the third sampling event in December 1990, with free phase fuel oil product reported in the area of BH5M and BH7M in the area of the former loading rack. Naphthalene concentrations increased by several orders of magnitude at these locations for this event as well.
- **Free phase (floating) petroleum product was detected/reported on the IOL property in December 1990 with sampling in November 1989 showing gasoline at all locations, and free phase product thicknesses in the order of 35 cm subsequently being reported frequently. Free product was detected on the IOL property until February 1999. (ACER note added: updated information indicates free product detected on IOL at BH6M and MW14 on the EFL property by Dillon for 2007, Dillon, 2014, in FN A-1028 in Appendix 17, but with no reporting provided thereafter.).**
- Initial sampling and analysis of groundwater samples on the Eastpre Feeds Ltd. property in April 1992, at locations established by an IOL consultant on behalf of IOL, did not show any free phase product to be present and indicated only gasoline range hydrocarbons to be present at low concentrations. Gasoline and fuel oil range hydrocarbons were reported for the second, fourth and fifth events, with resemblance not reported for the third event.
- **Trace amounts of free phase product were reported in water samples collected from several locations established on the Eastpre Feeds Ltd. property in April 1993, after sampling in April**1992, conducted on behalf of IOL assessment and remedial efforts showed gasoline at all locations. However, concentrations reported for the Eastpre Feeds Ltd. property samples did not appear to be of a magnitude that would reflect/indicate free phase product to be present. Free product was still being detected on the EFL property for the last reported monitoring event in 2007. **Free product was not detected between October 1994 and April 1999, with free product detected through the summer and early winter of 1999. There was no free product detected/recorded after December 1999.**
- Sample analysis were carried out initially by the RPC laboratory and it appears after April 1993 that the IOL laboratory conducted almost all of the analysis.
- Legal counsel for IOL indicated in a letter dated November 13, 2001 that “we have not seen anything which would support your client’s contention that the Eastpre Feeds’ property has been contaminated by our client.” However, **it is indicated in a letter response from Service NB to Eric Smith dated June 1, 1999 that “ The responsibility for the clean-up belongs to Irving Oil Ltd.” See Affidavit FN A-923 in Appendix 124.**
- An assessment of Harbour Contamination carried out on behalf of Eastpre Feeds Ltd. (TDG, July, 2001), showed the estimated extent of the hydrocarbon plume in the soil and groundwater as shown in Figures 1-3 and 1-4 (in Figures 3 and 5 in A-281 a in Appendix 4 respectively). Eastpre Feeds Ltd. submitted a proposal in January 2002, **at the request of IOL**, to further assess contamination associated with the IOL bulk station and adjacent properties but IOL twice refused to permit the program to be implemented.
- Movement of contamination from the IOL property appear to be subject to influences from possible movement of contaminates through the remediation piping trenches during either storm high tide water level or non-pumping events or combination of these events.



LEGEND

- ACER BHs/MWs IN GREEN TEXT FOR MW21 TO MW42 FOR JUNE, 2010, 11MW8 TO 11MW17 APRIL 2011, MW30 TO MW42 JULY 2011, 12MW1 TO 12MW92 IN 2012 AND 13MW93 IN 2013, 16MW1 TO 16MW35 2016, 18MW120 TO 18MW162 AND 19MW150 IN BLUE TEXT.
- WMS/ARC BHs/MWs IN LIGHT GREEN TEXT BEGINNING 1989 RELATED TO IOL BULK PLANT
- JWEL BHs/MWs IN BLUE TEXT THREE D GEOCONSULT. IN BROWN EASTPRE FEEDS 1996
- BHs/MWs BY OTHERS UNKNOWN IN BLACK TEXT
- EXISTING RECOVERY WELL (RW) LOCATION (ASPEN, MARCH 2000)
- FN PECHERIES WATER SUPPLY (WS) WELL
- TEST PIT LOCATION IN BLUE TEXT BY JWEL 1995 DFO/DNR PROPERTY
- WMS/ARC TEST PITS IN LIGHT GREEN TEXT BEGINNING IN 1989 RELATED TO IOL BULK PLANT
- TEST PIT LOCATIONS IN GREEN TEXT BY ACER, SEPT, 2010
- 3.2 TPH CONCENTRATION CONTOUR

PROBABLE GROUNDWATER FLOW DIRECTION FOR SHALLOW AQUIFER

TRACE OVERLAY OF IRVING OIL LIMITED SITE PLAN FOR AS BUILT REMEDIATION SYTEM AND FORMER RAIL LOADING RACK SHOWN IN IN BLUE. REFERENCE: CAMPBELL, OCTOBER 30, 1992, INTER-OFFICE MEMO.

Some BHs/MWs and Feature locations approximate.BH/MW locations extrapolated from ASPEN, MARCH 2000, AMEC, 2001 and ARC documents, and railway siding features from Cambell, 1992.

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ACER
Environmental Services (2015) Ltd.

PHASE II & III ENVIRONMENTAL SITE ASSESSMENT
MEL, FN, EFL SHIPPAGAN, NB

FIGURE 1-5

GROUNDWATER FLOW TOWARD 14TH STRET WITH FRENCH DRAIN EFFECT INDICATED BY IOL CONSULTANT

FILE NAME: Fig 1-5 ARC GW Flo	JOB NO.: CBT 60-1	MADE: GP	CHKD: GP	DATE: Jan 29, 2020

- **The groundwater flow direction, site conditions, and relative concentrations for contaminate parameters support that the IOL property represents the apparent source of contaminates detected on the Eastpre Feeds Ltd. Property.**
- Conditions at the IOL and Eastpre Feeds Ltd. properties and adjacent residential, commercial and federally owned properties as well as the proximity of the marine environment are such that the TIER I criteria used to assess the contaminate plumes for remedial considerations are not adequate.
- It is likely that the extent of contamination for petroleum **hydrocarbons will extend further with the establishment of potable water based guidelines**, SSTLs, and application of the Canadian Council of the Ministers of Environment (CCME) criteria for the Marine Environment, and human health guidelines.
- Petroleum sheens, that were described as thicker than usual, were reported to occur at the wharf location for the IOL petroleum transmission line. In addition, municipal underground services are present that represent preferential pathways that would provide for faster transport of contaminated groundwater. See Photo from page 11 (A-1871j) of FN A-1871 a,b,c,d,e,f,g,h,I,j,k, in Appendix 18 as Photo 1-1 in this report.
- There are private water supply wells located on adjacent commercial properties that are used for food grade processing purposes that were not considered in establishing assessment and remediation criteria for the IOL related spills. The wells are at risk of being impacted by contamination on adjacent properties including, but not necessarily limited to, the IOL property and Eastpre Feeds Ltd. property.
- The soil remediation system was not installed until the fall of 1994 and only involved vapour extraction at two monitoring well locations and would be considered very inadequate in treating “site impacted soils” and there was no apparent sampling carried out to confirm if overburden soils were remediated to acceptable levels.
- It is demonstrated in the documentation that IOL appears to make a number of admissions of liability/fault concerning the source and extent of contamination, as well as issues related to action, or lack of action, taken to address containment and remediation of contaminated soil and groundwater (see Background, Section 1.2 in the ACER, 2012 EFL report) (A-291 in Appendix 7).
- It is demonstrated in the documentation frequently, that IOL did not appear to be diligent in taking/expediting corrective measures to address spill, containment and remediation issues (see Background, Section 1.3 in the ACER, 2012 EFL report) (A-291 in Appendix 7).
- This is reflected in part with a **Ministerial Order having to be issued 3 years after the September 24, 1989 spill incident** with the DOE initially requiring a plan of action for decontamination be submitted to the DOE no later than October 13, 1989. Further to this, it appears from the background review that IOL has not been diligent and/or compliant in carrying out remediation, based on a letter from the DOE that required action be taken within the year, to address remediation issues for 80 historical sites that DOE prioritized based on the DOE Guideline for the Management of Contaminated Sites established in 1999 and updated in 2003.
- It is demonstrated in the documentation that IOL appears to make a number of misleading statements concerning the extent of contamination, containment of the groundwater plume and remediation efforts for the soil and groundwater and is detailed further in Section 1.4 (also see Background, Sections 1.2 and 1.3 in the ACER, 2012 EFL report, A-291 in Appendix 7 for additional information/details).

The following comments primarily relate to the contamination and remedial measures associated with the IOL underground gasoline transfer line pipeline involving DFO/DNR. Petroleum product delivery to the site included off-loading of ship tankers and transferred to the bulk plant by pumping, under pressure (likely greater than 40 psi), via separate underground diesel oil and gasoline pipelines. The diesel oil and gasoline lines are reported to be over 600 and 500 metres in length, respectively, that also

A-1871 j

Photo 1-1 Photo showing petroleum sheening in manhole demonstrating that underground services are providing a preferential pathway for movement of contaminated groundwater (from page 11 (A-1871j) of FN A-1871 a,b,c,d,e,f,g,h,I,j, also provided in Appendix 18)

includes sections approximately 65 metres in length that are above ground. The IOL bulk storage, boat unloading facility and the two associated interconnecting gasoline pipelines were established in approximately 1938 (Affidavit document IOL A-8 in Appendix 13). A third pipeline was reportedly installed by IOL in 1953 as well as two additional petroleum storage tanks (Affidavit document IOL A-1 in Appendix 15).

Pressure testing was carried out by IOL on September 13, 1996 (JWEL, November 13, 1996B, A-81 a in Appendix 19)

> "to evaluate their integrity to make recommendations regarding future use." It was indicated that "There are two welded steel pipeline owned by Irving Oil Limited (IOL) that were formerly used to transfer petroleum products from marine tankers to the IOL Shippagan bulk storage facility. The pipelines, 150 mm (6" Ø) and 200 mm (8" Ø), are located on both DFO and private property (see Figure 1). These pipelines were reportedly out of service for 15 years. A fish processing plant owned by EMS Limited requested to use the abandoned pipelines to discharge fish waste products from their plant to the Shippagan harbour."
>
> JWEL supervised the inspection and pressure testing of the pipelines by IOL personnel to ensure they would be suitable to be used by EMS for their proposed purpose.
>
> It was indicated that "On September 12, 1996, the aboveground piping was first visually inspected. Both lines were badly corroded and perforations were evident in the 150 mm diesel line on that section of piping exposed in the cribbing. IOL personnel purged both pipelines prior to pressure testing. Sea water was pumped into the lines at one end and removed with a vacuum truck from the other end. It was uncertain if any product was recovered from the lines from this process.".

In a Tom Gallagher letter to Claude burry of DFO dated November 13, 1996, A-81 a (Appendix 19) it is indicated on page 2 "Both lines were badly corroded and perforations were evident in the 150 mm diesel line on that section of piping exposed in the cribbing. ACER note: It is incorrectly indicated in this quotation that it is a 150 mm diesel line, and should have read 150 mm gas line. It was also indicated that "…. the gasoline line was tested from the exposed section near the cribwork back to the bulk plant, since there were noticeable perforations in the exposed section of pipe over the cribwork. The line was tested at 640 KPa, however, the pressure was quickly lost. A visual inspection at both ends of the pipeline revealed that water was bubbling up through the ground on the bulk plant side of the intermediate valve box . The water bubbling to the surface indicated a breach in one of the l00 mm lines in this area.

Further to the above, it is indicated in a letter dated March 25, 1997 from Tom Gallagher of Jacques Whitford Environmental Limited to Claude Burry of DFO (A-83, Appendix 20) that

"The testing revealed that these 2 abandoned pipeline did not pass testing and were suspected of having been leaking during their operating life." and further indicated that "JWEL recommends that the extent of the contamination (both on and off DFO property) be established prior to DFO initiating any remedial action. DFO clean-up activities should be part of a joint effort which should include all impacted property owners. Premature clean-up may result in recontamination of DFO property" (bold underline added by ACER).

Therefore, intrusive investigations of the DFO property, located down gradient of the IOL bulk plant, were undertaken (JWEL March 25, 1997A, A-83 (Contained in Appendix 20) The gasoline pipeline is located between FN Pecheries Ltd. and Marine Extract Ltd., within the ROW of the former CN rail line and extends across the DFO property, with approximately 300 m located within several metres of and parallel to the waterline/shoreline. Preliminary investigations were undertaken on December 4, 1996 at the request of DFO. It was indicated that "The pipelines were encountered at – 1.5m from grade and groundwater at -2.5m. Hydrocarbon odours were very strong near the property line and gradually weakened as the trench progressed towards the wharf." It was also

indicted that "All soil samples taken from the trench (SS1, SS2, SS4) exhibited total Petroleum Hydrocarbon (TPH) concentrations over the maximum allowable limits." Concentrations for TPH ranged from 120 ppm to 4,800 ppm. It was noted that the NBDOE Level I and II criteria were used for assessment purposes, and TPH concentrations exceeded Level I and II. It was indicated that "The preliminary investigation revealed significant hydrocarbon impacts to DFO property, with the greatest impacts being closest to the DNRE property. The adjacent DNRE property has been confirmed as being contaminated by hydrocarbons (gasoline)." Groundwater sampling was not included as part of the intrusive investigations.

JWEL recommends that a copy of this report be sent to the DNRE to inform them of their obligation to address a known contamination problem in accordance with the New Brunswick Clean Environment Act (NB Regulation 87-97). JWEL also recommends that a copy of this report be sent to IOL. Although preliminary investigations has not confirmed the IOL pipelines have contributed to the gasoline contamination, they are presently the most probable source.".

There was no discussion regarding the BTEX parameters and the NBDOE guidelines and there was no mention of guidelines applicable for Federally owned properties being considered. The reported values for Benzene at SS1 and SS2 were between the detection limit value of 0.1 and <1 mg/kg and the Provincial criteria and as such, it is not possible to establish if concentrations exceeded the criteria at that time for those locations. The concentration of 40 mg/kg for Ethylbenzene at sample location SS1 exceeded NBDOE Level I Criteria of 5 mg/kg, and the concentration of 66 mg/kg at sample location SS1 for Xylene exceeded Level I criteria of 5 mg/kg for potable water and Level II criteria of 50 mg/kg for a non-sensitive site. **Being a Federal property, the CCME 2004 guidelines would be applicable for BTEX parameters. BTEX concentrations exceeded the CCME 2004 guidelines for all locations including locations with concentrations higher than the detection limits. ACER notes that the CCME 2004 TPH criteria for F2 range PHCs is 260 mg/kg values for comparison with the values of 4,800 and 300 mg/kg reported by JWEL but do not provide for protection of groundwater in consideration of the historical on site water supply or protection of aquatic life for the groundwater to surface water pathway.**

Similarly, there was no discussion regarding Naphthalene, with concentrations of 27 ppm being detected in the soil that exceeded the CCME 1991 Assessment Criteria of 1 ppm, representing approximate background levels, but was less than the Interim Remedial Criteria of 50 ppm. However, this exceeded the CCME 1997 Soil Quality Guideline value of 22 ppm for a commercial site. Furthermore, **soils being located within the Mean High Water Tide elevation,** the CCME 1998 Interim Sediment Quality Guideline (ISQG) value of 0.0346 ppm and Probable Effect Level (PEL) of 0.391 ppm are considered to be applicable and were both exceeded. The CCME 2010 Soil Quality Guideline value of 0.013 ppm for Environmental Health for a commercial site is exceeded. The CCME 2010 value is similar to the guideline for protection of freshwater life where potential impacts to nearby surface waters are a concern. If impact to surface water is not a concern, it is recommended to revert to the CCME 1997 value for naphthalene.

With respect to contamination in this area, ACER notes that the marine receiving waters are located within about 60 metres of most areas of concern, being in the order of ten metres for some sample locations with respect to petroleum hydrocarbons. It is also critical to recognize that the property boundary for the SCH property is defined by the 1966 Mean High Water Level (MHWL) as shown in the drawing for proposed land based sampling locations provided in Figure 3-1 (also in Appendix 70). Therefore contamination that occurs on the SCH property in areas that are located between the property line and the current edge of the marine receiving waters, defined by the edge of the wharf structures, is actually occurring within the

boundaries of the Mean High Water Level for the marine receiving waters. Not withstanding this and that contamination has been historically identified within 150 metres of receiving waters and therefore requires appropriate considerations in any assessment, but there are also multiple underground services including water supply, storm water, waste water and water supply lines that provide preferential pathways for migration of contaminants to the marine receiving environment.

The FN Fisheries building encroaches on the Mean High Water Level with the MEL property being approximately 10 m from this boundary. Therefore, direct application of the CCME marine guidelines to the assessment of groundwater in consideration of the groundwater to surface water pathway and risks to the marine environment is considered an appropriate screening approach for the FN, MEL, EFL and SCH properties.

This was not done for the assessment and remedial measures carried out by IOL for the DFO property and given that the CCME guidelines were exceeded at the site over several years, this would be considered a long term contributing source of contamination to the marine environment which has been shown to be contaminated with several contaminates including petroleum hydrocarbons and PAHs. In addition, deeper groundwater contamination, below the perched water table was not assessed or considered.

As indicated in Section 1.1 of this report, federal CCME guidelines are established to assess the potential impacts to the environment for a wide range of contaminates. As indicated in the above and in subsequent discussions in this section of the report, the CCME guidelines were not applied for previous assessments by the IOL consultant or the DFO consultant MGI for several investigations carried out prior to 2011 for land based contamination and consideration of the groundwater to surface water pathway and risks to the marine environment. The groundwater to surface water pathway did not appear to be more directly recognized.

As discussed in further detail in Section 2.0 of this report, it is indicated in the CCME guidelines that the guideline for the protection of marine life in a surface water body includes areas within 10 metres of the Ordinary High Water Mark. Further to this, the Sediment Quality Guidelines are to be applied for sediments in the groundwater surface water transition zone. It is also critical to note that a limitation in the use of the numerical guidelines include "Other scenarios resulting in a high groundwater velocity (e.g. tidal influences close to a marine water body) may also enhance contaminate transport…"…"and a site-specific adjustment of the guidelines will likely be necessary."

As discussed in Section 3.3.1 the intrusive sampling program carried out by ACER in 2016 showed that the bedrock has extensive vertical and horizontal fracturing with large fractures evident. Therefore, direct application of the CCME marine guidelines to the assessment of groundwater in consideration of the groundwater to surface water pathway and risks to the marine environment is considered an appropriate screening approach. It is also indicated in the CCME 2008 Federal guidelines that for "Fractured bedrock or fractured silt/clay" that:

"The transport models used to develop the numerical guidelines assume that contaminant transport occurs through unconsolidated soils. If transport between the contaminant source and receptor (e.g. surface water body) is through fractures instead of unconsolidated soils, either a transport distance of zero should be assumed (i.e. the Canadian Water Quality Guidelines for the Protection of Aquatic Life should be applied to groundwater), or a site-specific risk assessment should be conducted." This would also apply to preferential pathways.

It is indicated in RBCA 2012 that for "identification of potential transport mechanisms and exposure pathways" that "Conduits such as service trenches can provide preferential and high velocity pathways. Pathways must be assessed for immediate and long term human and ecological exposure.", and Is it reasonable to conclude that site petroleum hydrocarbon contamination could impact aquatic receptors or aquatic habitat in surface water bodies via

….preferential subsurface flow pathways (e.g. culvert, trench, sewer line, pipelines, swales) … such that aqueous media concentrations would potentially exceed surface water and/or sediment quality screening levels (Table 3a and Table 4)?

If the answer to any of questions 1 to 4 in Part III is "YES", then further action is required."

For this project, a "YES" answer applies and further action is required, consisting of additional detailed assessment of the ecological environment (aquatic life and environment in particular), likelihood that Tier III criteria be developed rather than using Tier I or Tier II screening levels."

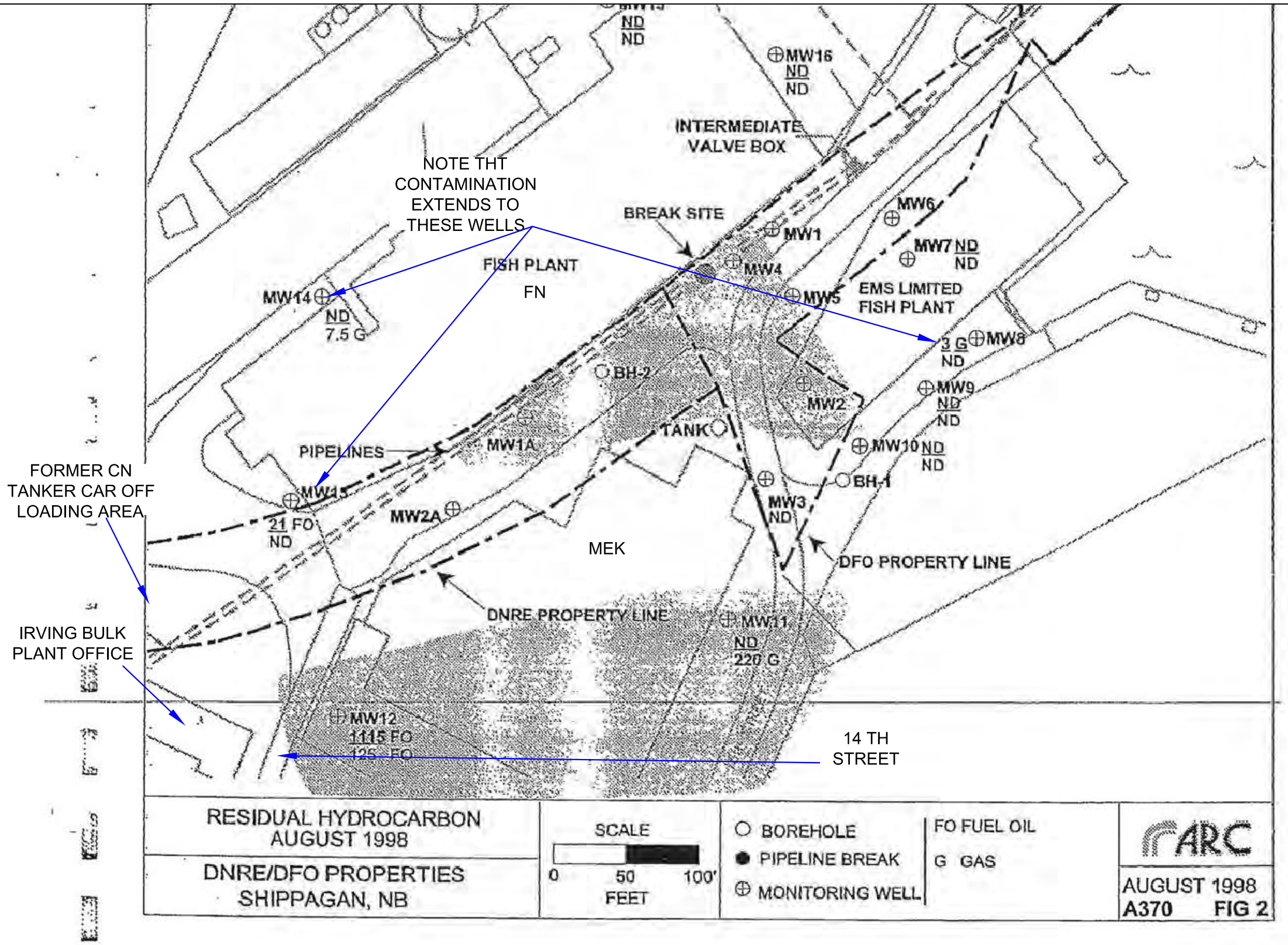
In a letter from Ray Morin of the NBDOE to Johnny Grant of IOL dated June 5, 1997 (A-89 in Appendix 21) it was indicated "Further to our discussions at the meeting of June 3, 1997, this will confirm that we are requesting that you have an intrusive site investigation conducted along the abandoned pipeline. The scope of your investigation should be to determine the extent of gasoline contamination in the soil and in the groundwater which exceeds current Level II guidelines."

Acting at the request of IOL, ARC Associates Ltd. (ARC) carried out soil and groundwater sampling along the underground petroleum pipeline that extends between the IOL bulk plant and wharf, that was located adjacent to the FN Pecheries Ltd. building (ARC, 1997A and 1998 as A-592 a,b and A-332 with AG-438 having better figures all included in Appendix 21, Appendix 22, Appendix 23 respectively). The estimated extent of the hydrocarbon impacts in the soil and groundwater included a significant portion of the footprint for the FN Pecheries Ltd. building. See ACER Figures 1-6 and 1-7 that are also provided in Appendix 24.

Groundwater flow conditions assessed by the IOL consultant on behalf of IOL are an apparent contributing factor to the displacement of contamination to adjacent areas and spreading of contamination throughout this area. Reference is made to the figure identified as "shallow groundwater flow May 2, 1998" that indicates groundwater flow to occur in an east to west direction, as well as west to east and north-south in some areas (Affidavit A-116 in Appendix 25). Figure 3 contained in the ARC Phase II investigation report, A-332 in Appendix 22, (AG-438 better figures, Appendix 23) included additional monitoring wells and also showed components of groundwater flow for July, 1998 to be in an east to west direction landward (rather than towards the shoreline), from the SCH property towards the area between the FN and MEL building. The ARC figure is provided below as ACER Figure 1-8 (also included in Appendix 24.).

A strong component of groundwater flow is evident under the footprint of the FN building that was from north to south from areas of contamination identified on the DFO/SCH property. Groundwater flow under the MEL building was south to east towards the area between the two buildings, that indicates that the roadway and granular fills used to construct the former CN ROW between the buildings provides a "French Drain" effect similar to 14th St. and provides for preferential flow. With specific reference to the ACER Figure 1-8 identified as "shallow groundwater flow May 2, 1998", groundwater flow was reported to occur in an east to west direction, as well as west to east and north-south in some areas (in Affidavit A-116 also in Appendix 25).

The ARC monitoring report, A-321 (Appendix 26) that also included the additional monitoring wells showed flow directions (see ACER Figure 1-9 also provided in Appendix 24) to be almost the opposite of that reported for the July 1998 investigations, prior to any remedial measures. It was noted by ACER that it was indicated in the report that "the treatment system was not operating. The electric panel was checked and all switches were noted to be in the off position." Therefore, it is reasonable to make a comparison of the flow conditions given there would be no pumping influences. It is apparent from the figures that conditions exist that can cause contamination occurring on



AGC DISCLSOURE

AGC0438_0009

LEGEND

- ACER BHs/MWs IN GREEN TEXT FOR MW21 TO MW42 FOR JUNE, 2010, 11MW8 TO 11MW17 APRIL 2011, MW30 TO MW42 JULY 2011, 12MW1 TO 12MW92 IN 2012 AND 13MW93 IN 2013, 16MW1 TO 16MW35 2016, 18MW120 TO 18MW162 AND 19MW150 IN BLUE TEXT.
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- TEST PIT LOCATION IN BLUE TEXT BY JWEL 1995 DFO/DNR PROPERTY
- WMS/ARC TEST PITS IN LIGHT GREEN TEXT BEGINNING IN 1989 RELATED TO IOL BULK PLANT
- TEST PIT LOCATIONS IN GREEN TEXT BY ACER, SEPT, 2010
- 3.2 TPH CONCENTRATION CONTOUR
- PROBABLE GROUNDWATER FLOW DIRECTION FOR SHALLOW AQUIFER

TRACE OVERLAY OF IRVING OIL LIMITED SITE PLAN FOR AS BUILT REMEDIATION SYTEM AND FORMER RAIL LOADING RACK SHOWN IN IN BLUE. REFERENCE: CAMPBELL, OCTOBER 30, 1992, INTER-OFFICE MEMO.

Some BHs/MWs and Feature locations approximate.BH/MW locations extrapolated from ASPEN, MARCH 2000, AMEC, 2001 and ARC documents, and railway siding features from Cambell, 1992.

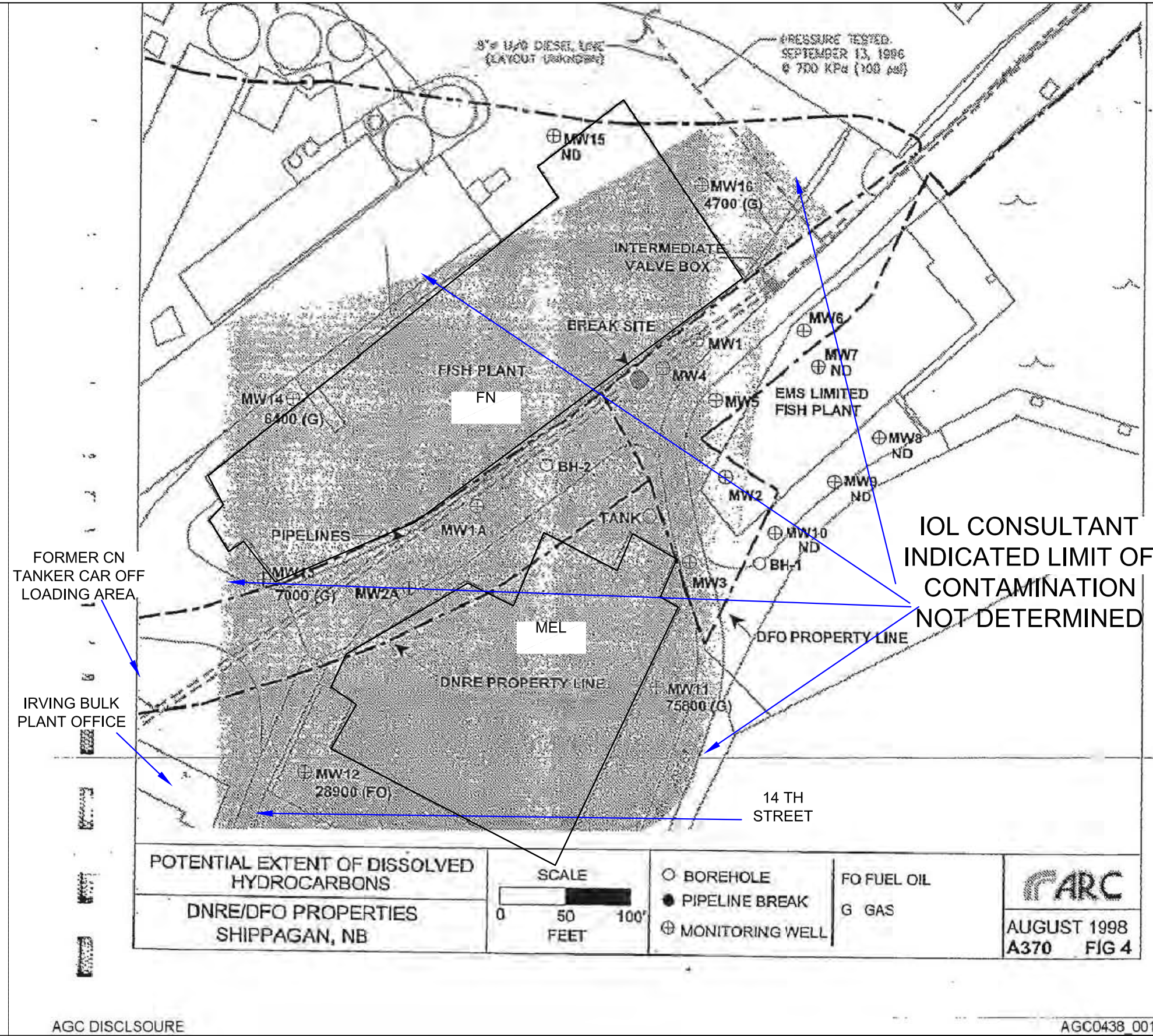
ACER Environmental Services (2015) Ltd.

PHASE II & III ENVIRONMENTAL SITE ASSESSMENT
MEL, FN, EFL SHIPPAGAN, NB

FILE NAME: H13 Fig 1-6 ARC 98 So Ft Prt A-332	JOB NO.: CBT 60-1	MADE: GP	CHKD: GP	DATE: Jan 29, 2020

FIGURE 1-6

FOOTPRINT OF PETROLEUM HYDROCARBON CONTAMINATION IN SOIL FOR IOL UNDERGROUND GASOLINE TRANSFER PIPELINE INCLUDING FN AND MEL BY IOL CONSULTANT ARC 1998 A-332



AGC DISCLSOURE

AGC0438_0012

LEGEND

- ACER BHs/MWs IN GREEN TEXT FOR MW21 TO MW42 FOR JUNE, 2010, 11MW8 TO 11MW17 APRIL 2011, MW30 TO MW42 JULY 2011, 12MW1 TO 12MW92 IN 2012 AND 13MW93 IN 2013, 16MW1 TO 16MW35 2016, 18MW120 TO 18MW162 AND 19MW150 IN BLUE TEXT.
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- TEST PIT LOCATIONS IN GREEN TEXT BY ACER, SEPT, 2010
- 3.2 TPH CONCENTRATION CONTOUR
- PROBABLE GROUNDWATER FLOW DIRECTION FOR SHALLOW AQUIFER

TRACE OVERLAY OF IRVING OIL LIMITED SITE PLAN FOR AS BUILT REMEDIATION SYTEM AND FORMER RAIL LOADING RACK SHOWN IN IN BLUE. REFERENCE: CAMPBELL, OCTOBER 30, 1992, INTER-OFFICE MEMO.

Some BHs/MWs and Feature locations approximate.BH/MW locations extrapolated from ASPEN, MARCH 2000, AMEC, 2001 and ARC documents, and railway siding features from Cambell, 1992.

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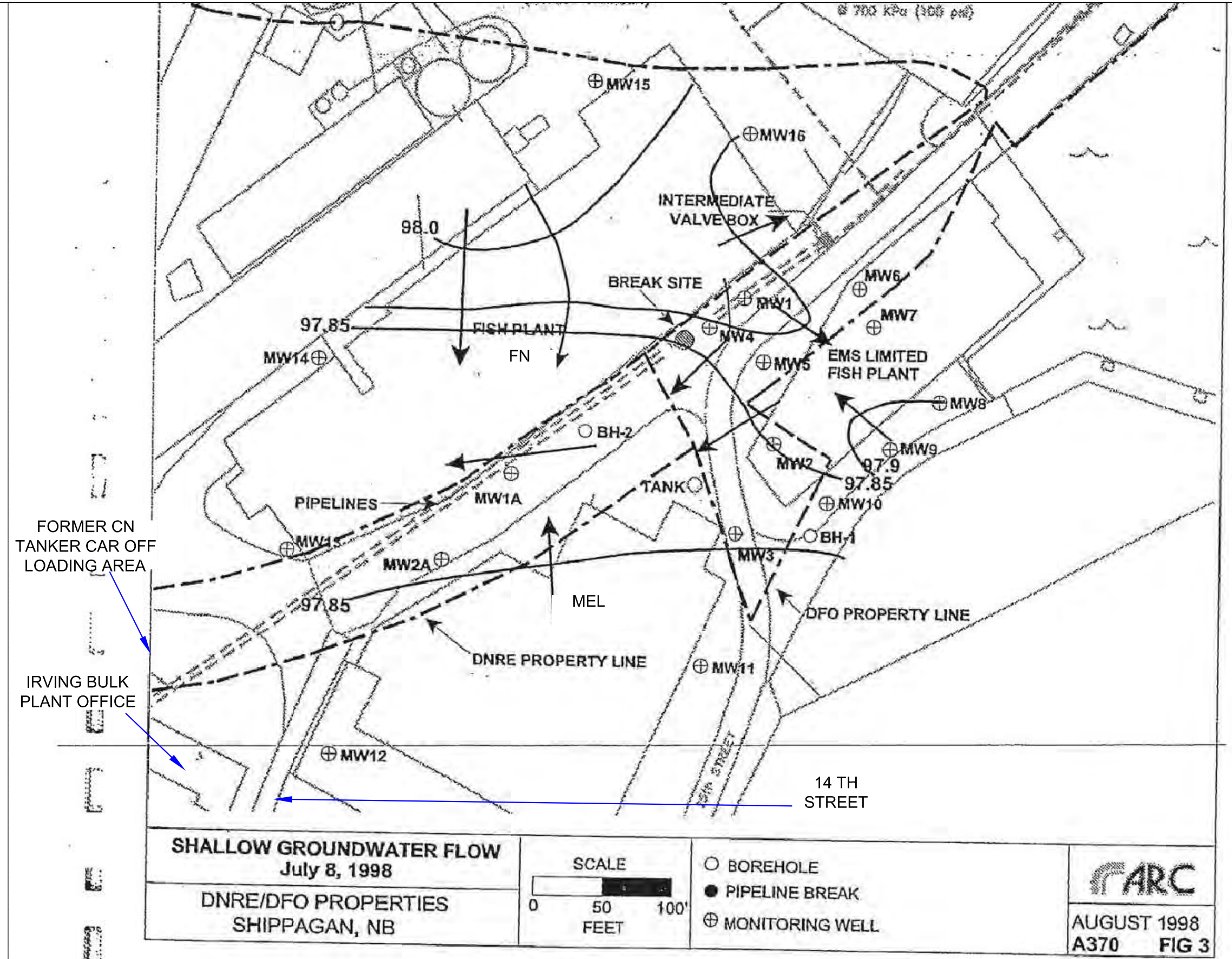
PHASE II & III ENVIRONMENTAL SITE ASSESSMENT
MEL, FN, EFL SHIPPAGAN, NB

FILE NAME: H13 Fig 1-7 ARC 98 GW Ft Prt A-332	JOB NO.: CBT 60-1	MADE: GP	CHKD: GP	DATE: Nov 11, 2019

FIGURE 1-7

FOOTPRINT OF PETROLEUM HYDROCARBON CONTAMINATION IN GROUNDWATER FOR IOL UNDERGOUND GASOLINE TRANSFER PIPELINE INCLUDING FN AND MEL BY IOL CONSULTANT ARC 1998 A-332



LEGEND

- ACER BHs/MWs IN GREEN TEXT FOR MW21 TO MW42 FOR JUNE, 2010, 11MW8 TO 11MW17 APRIL 2011, MW30 TO MW42 JULY 2011, 12MW1 TO 12MW92 IN 2012 AND 13MW93 IN 2013, 16MW1 TO 16MW35 2016, 18MW120 TO 18MW162 AND 19MW150 IN BLUE TEXT.
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- TEST PIT LOCATIONS IN GREEN TEXT BY ACER, SEPT, 2010
- 3.2 TPH CONCENTRATION CONTOUR
- PROBABLE GROUNDWATER FLOW DIRECTION FOR SHALLOW AQUIFER

TRACE OVERLAY OF IRVING OIL LIMITED SITE PLAN FOR AS BUILT REMEDIATION SYTEM AND FORMER RAIL LOADING RACK SHOWN IN IN BLUE. REFERENCE: CAMPBELL, OCTOBER 30, 1992, INTER-OFFICE MEMO.

Some BHs/MWs and Feature locations approximate.BH/MW locations extrapolated from ASPEN, MARCH 2000, AMEC, 2001 and ARC documents, and railway siding features from Cambell, 1992.

ACER
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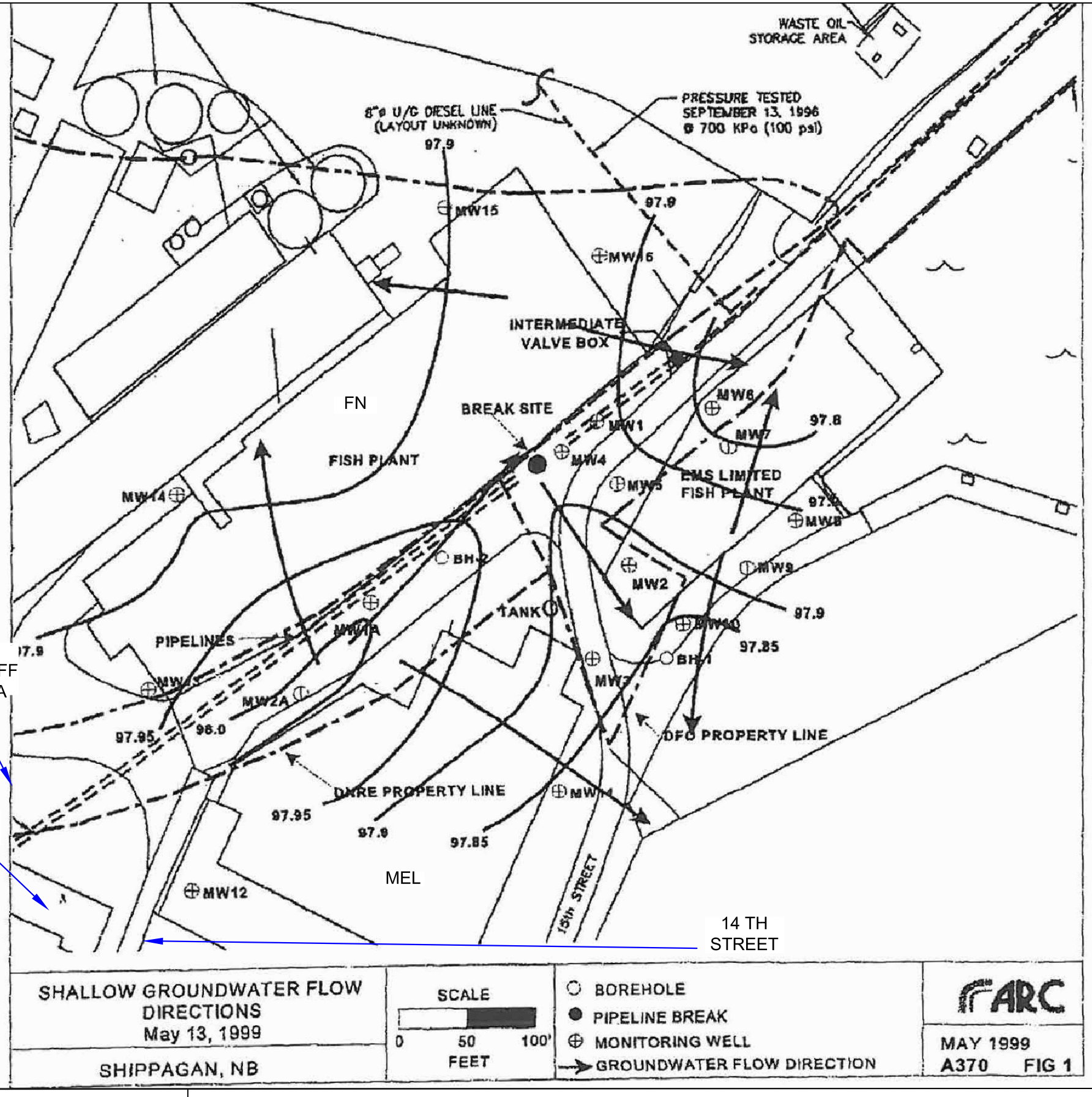
PHASE II & III ENVIRONMENTAL SITE ASSESSMENT
MEL, FN, EFL SHIPPAGAN, NB

FILE NAME: H13 Fig 1-8 ARC 98 GW Flo A-332	JOB NO.: CBT 60-1	MADE: GP	CHKD: GP	DATE: Nov 11, 2019

FIGURE 1-8

GROUNDWATER FLOW JULY 1998 INVESTIGATIONS IOL UNDERGOUND GASOLINE TRANSFER PIPELINE INCLUDING FN AND MEL BY IOL CONSULTANT ARC 1998 A-332



LEGEND

- ACER BHs/MWs IN GREEN TEXT FOR MW21 TO MW42 FOR JUNE, 2010, 11MW8 TO 11MW17 APRIL 2011, MW30 TO MW42 JULY 2011, 12MW1 TO 12MW92 IN 2012 AND 13MW93 IN 2013, 16MW1 TO 16MW35 2016, 18MW120 TO 18MW162 AND 19MW150 IN BLUE TEXT.
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- TEST PIT LOCATIONS IN GREEN TEXT BY ACER, SEPT, 2010
- 3.2 TPH CONCENTRATION CONTOUR
- PROBABLE GROUNDWATER FLOW DIRECTION FOR SHALLOW AQUIFER

TRACE OVERLAY OF IRVING OIL LIMITED SITE PLAN FOR AS BUILT REMEDIATION SYTEM AND FORMER RAIL LOADING RACK SHOWN IN IN BLUE. REFERENCE: CAMPBELL, OCTOBER 30, 1992, INTER-OFFICE MEMO.

Some BHs/MWs and Feature locations approximate.BH/MW locations extrapolated from ASPEN, MARCH 2000, AMEC, 2001 and ARC documents, and railway siding features from Cambell, 1992.

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PHASE II & III ENVIRONMENTAL SITE ASSESSMENT
FN PECHERIES LTD, SHIPPAGAN, NB.

FIGURE 1-9

GROUNDWATER FLOW MAY 1999 INVESTIGATIONS IOL UNDERGOUND GASOLINE TRANSFER PIPELINE INCLUDING FN AND MEL BY IOL CONSULTANT ARC 1999 A-321

FILE NAME: Fig 1-9 ARC 98 GW Flo A-321	JOB NO.: CBT 60-1	MADE: GP	CHKD: GP	DATE: Nov 11, 2019

the DFO property to migrate onto the FN and MEL properties, and result in widespread contamination including the area of the building footprints, other adjacent properties and into the marine environment.

ARC indicated that for the flow conditions shown in Figure 1 that “This groundwater configuration is due to a number of reasons. The main groundwater high is centred in an area of disturbed soil (due to recent excavation) and previously present more permeable soils (due to the installation of pipeline and railway tracks). Consequently, infiltration in this area will be higher than the adjacent areas, thus causing local and temporary rising of the water table. The small area of groundwater low is likely due to natural discharge at the shoreline during a period of low tidal stage. During high tide it is expected that the groundwater elevation will rise due to blockage of discharge to the sea. The rise in tidal water head will cause a subsequent rise in groundwater head and local changes in groundwater flow directions.”

It should be noted that groundwater flow conditions are likely to have remained relatively unchanged or unaffected during the operation phase of the remedial system. Based on a review of monitoring reports in FN A-1804 (Appendix 27) available for the 56 months that the remedial system operated, July 7, 1999 to March 16, 2004, the system was non-operational at least 50 times (personal communication: Eric Smith, May 14, 2017). Given the system was non-operational at this frequency this provided opportunity for contamination to continue to migrate onto the adjacent FN and MEL properties including the area of the building footprints, other adjacent properties and into the marine environment.

The ARC, April 1998, report, A-117 (Appendix 28), for investigations carried out on the DNRE property indicated:

“The dissolved hydrocarbons occur more widely, as would be expected due to groundwater movement and tidal fluctuation effects. Dissolved hydrocarbons occur in highest concentrations in the same zone as defined for the residual hydrocarbons. The groundwater flow indicates a gradient of 0.0015 is operative to the west, (0.0015 between MW2 and MW1). This groundwater flow direction may be influenced by the pumping of remedial wells on the IOL Bulk Plant site or alternatively, through the pumping of any local wells, which extract fresh or saltwater for processing.

The groundwater flow across the site must be considered as having potential to change due to the small differences between the water elevations in the wells. With such small elevation differences, tidal loading could easily cause localized flow to change direction. The orientation and occurrence of both the dissolved and residual plumes appear to indicate that changes in the direction of groundwater flow have taken place. These changes mayoccur due to high tides and/or high recharge events (spring and fall) or local well pumping. If these changes only occur at specific times of the year, and are only in force for short time spaces, then the spreading of the plume would be limited and may to some degree reverse itself at other times of the year.”

A similar statement was made for the ARC, April 1998, report, A-332 (in Appendix 22), for investigations carried out on the DFO property.An assessment of the zone of drawdown influence under existing Department of Environment approved pumping rates was carried out by Craig Hydrogeologic Inc., April, 2011, for the MEL and FN properties, (Affidavit document A-662, Appendix 30). As can be seen in Figures 2, 3, 5, and 6 of the report, the groundwater capture areas for the Marine Extract and FN Fisheries pumping wells reflected by a pumping rate of 250 GPM for FN operations (operational range from 200 to 350 GPM) includes the adjacent DFO and DNRE properties. Craig indicates that “Any properties which are located within the groundwater capture areas of the pumping wells and which have sources of groundwater pollution/contamination pose a risk to the pumping wells.”

Since 1950 or earlier, FN utilized the brackish/saltwater *supply aquifer* in the area of the FN and MEL properties to satisfy a requirement to continuously supply approximately 200 gal/min of water for food grade fish processing purposes. TDG carried out an assessment for groundwater supplies for Marine Extract Ltd. and FN Pecheries

Ltd., **and substantial petroleum hydrocarbon contamination was reported for the shallow and deeper groundwater flow systems** (Letter report from Three-D GeoConsultants Ltd. to EMS Engineering dated November 1, 1993, Affidavit document A-155, in Appendix 31 . Three-D GeoConsultants Ltd. September 1, 1993, A-165 (Appendix 31), during drilling for MEL water supply wells four levels of petroleum contamination were encountered (14 to 16 feet, 20.5 to 21.5 ft., 38 plus/minus, to 44 plus/minus ft.) to 44 ft. depth.

A downhole video was taken in 2000 for the water supply well servicing the FN property and it is reported that oil like globules were evident in the water column (A-57, Appendix 32 is provided as a digital video included as a separate digital file that can be opened using the open source video program "VLC media player") A still photo at time frame 14h18m17s247 from the aforementioned video and a photo of a water sample collected during purging of the well is provided in Appendix 99. **The FN water supply well was affected by petroleum contamination with concentrations of petroleum hydrocarbons (BTEX and TPH) exceeding the RBCA commercial land use with potable and non-potable water criteria, and could no longer be used for food grade seafood operations, ACER, Affidavit document A-292 (Appendix 8).**

The concentrations for Benzene, Toluene, Ethylbenzene, Xylene (BTEX) and Total Petroleum Hydrocarbons (TPH) were reported at 18 mg/L, 43 mg/L, 4.7 mg/L, 24 mg/L and 65 mg/L, respectively, for sampling carried out in April 2011 (see Tables C10 and C8 in Document A-292 in Appendix 8). For comparison, the TIER I potable criteria for BTEX were 0.005 mg/L, 0.024 mg/L, 0.0024 mg/L, 0.3 mg/L respectively, for a residential and commercial site with TPH criteria of 4.4 mg/L and 19 mg/L for a residential and commercial site, respectively.

Analysis results for sample TP5 obtained by ARC, December 1997, A-97 (Appendix 33) in the same general location showed TPH to be non-detectable for the single sample obtained at the 1.8 to 2.1 m zone. Analysis results for the soil sample at TP1 obtained by ARC, December 1997, A-97 (Appendix 33) further west of TP5 showed a TPH concentration of 950 mg/L **as fuel oil** for the single sample obtained at a depth of 2.1 m (fuel oil at other soil sampling locations for this sample program). Water samples were not collected for the DFO or DNRE properties.

Water sample analysis by ARC, April, 1998, A-344 (Appendix 34) showed a maximum TPH concentration of 69 mg/L as gasoline (gasoline also reported at other groundwater sample locations for this sample program) at MW4-98. The current RBCA TPH guideline for gasoline in groundwater is 4.4 and 20 mg/L for potable and non-potable water conditions. Analysis results for the soil samples at MW4-98S3 and MW4-98S6 obtained by ARC, April, 1998, A-344 (Appendix 34) showed TPH values of 420 and 8.1 mg/kg as gasoline at depths of 1.25 to 1.75m (0.25 m above water table) and 3.6 to 4.2 m, respectively (gasoline also reported at other soil sample locations for this sample program).

In an email from Tom Gallagher to DFO dated June 11, 1998, AG-86 (Appendix 35) regarding "Proposed Remediation Plan-IOL Shippagan" it is indicated "We have reviewed the proposed Irving Oil Limited (IOL) plan for clean-up of the gasoline contamination at the reference site. Unfortunately we cannot assess the effectiveness of this plan without more information than was presented in the IOL report." It was further indicated that "without more conclusive information and in order to protect DFO interests we recommend that the following steps be taken:

- Remove all soil on DFO property contaminated above NBDOE Level 2 guidelines.
- Provide recovery well(s) upstream of DFO property capable of retracting contaminated groundwater on DFO property while preventing incoming contaminated water from continuing downstream."

August 26, 1998 A-126 in Appendix 36, IOL requested approval to remove and treat 600 Metric Tonne of contaminated soil. MGI, 2001, A-298 (Appendix 37), **reported that "hydrocarbon impacted soil was removed from the area between FN Fisheries Ltd. and Marine Extract Ltd. fish plants** (also shown in Figure 2 in

Appendix 38, from A-308 provided in Appendix 39). The work was completed by Jacques Whitford Environmental Limited on behalf of Irving Oil Ltd but the volume of contaminated soil removed from the site was not known.". **The area of excavation** shown in Figure 2 of the MGI, 2001, A-298 report (Appendix 37), **was limited to only a portion of the contaminated area** shown for soils **between the FN and MEL buildings** as shown in Figure 2 of the ARC, August 1998 report (AG-438 in Appendix 23).

With respect to the remaining impacted soil between the FN and MEL buildings, on the DFO and DNRE properties only, the DFO consultant MGI (Maritime Groundwater Inc. subsequently acquired by Conestoga Rovers & Associates) July, 2003, A-308 (Appendix 39) indicates on Page 405 "the volume of hydrocarbon impacted soil in this area is estimated to be 2400 cubic metres" in the vicinity of the area between FN and MEL building, contaminated site 4. This estimate represents the remaining portion of contaminated soil between the MEL and FN buildings. ACER notes that this ignores previous investigations that identified contamination to extend under the FN and MEL buildings including ARC, August 1998, A-332 in Appendix 22, (AG-438 better figures, Appendix 23, investigations in July 1998 and also sampling inside the MEL building, A-121 in Appendix 40, June 18, 1998. ACER investigations in 2011 for FN in A-292 (in Appendix 8) and in 2012 for the MEL building footprint in FN A-942 (in Appendix 30) showed petroleum hydrocarbon contamination in the soil to occur under the building footprint for the FN and MEL buildings.

MGI did not consider naphthalene contamination in this area although concentrations were identified in the historical documentation contained in their assessment report. It is indicated in the report that "No soil samples were submitted for PAH analysis from the Additional Phase III ESA work. No PAHs were detected during previous assessment work.". ACER noted in ARC, April 1998, A-344 (Appendix 34) that soil samples at MW2-98 and MW4-98 showed naphthalene concentrations of 42 and 32mg/kg compared with the CCME 2010 provisional guideline of 22 mg/kg for environmental health, but a value of 0.013 mg/kg to be applied if there is concern for potential impact to water bodies. ACER A-292 (Appendix 8), ACER 291 (Appendix 7), and ACER 944 (Appendix 9) all show concentrations of naphthalene in the groundwater to be present that exceed the marine guideline value in consideration of the groundwater to surface water pathway.

In a memo dated November 20, 2000 (A-318 in Appendix 41) regarding "IOL July 2000 Site Monitoring Report, Shippagan, NB" Tom Gallagher of JWEL indicates "It should be clear that the existing remedial approach appears to be geared toward containment and treatment of impacted groundwater, ·rather than remediation of soil. Soil contamination can act as a persistent ·source of groundwater contamination, and as such, groundwater remediation may be required over an extended time frame (greater than 5 years)." It was further indicated that

"The monitoring data presented in the report is from such a limited time period that it is not possible to meaningfully evaluate trends or progress. If additional monitoring data is available for prior sampling events (i.e. from site assessments) it would be useful to include these data.

Interpretation of groundwater elevation data in the form of groundwater contour maps should be considered and opinions provided on the effectiveness of the pumping system and overall progress toward achieving the management objectives. There did not seem to be sufficient information presented in the July report for Aspen's opinion that the dissolved groundwater plume is currently in a stable phase. We recommend that clarification be obtained on the basis for their opinion.

The existing monitoring report indicates that several wells could not be located or were inaccessible. As several of these wells appear to be located hydraulically down-gradient of the hydrocarbon source areas, consideration should be given to refurbishing or replacement of some of these wells. Monitoring of these wells will be necessary to delineate the dissolved hydrocarbon plume and to demonstrate hydraulic containment (i.e. no hydrocarbon discharge to the bay)."

With specific reference to the SCH and DNRE properties that border the eastern portion of the FN and MEL properties and the 2010 to 2013 investigations, the findings of investigations by ACER on the FN and MEL properties near the DNRE and SCH properties. Locations 12MW37D, 12MW43, 12MW75, 12MW78, 12MW46, 12MW47, 12MW53, 12MW58, 12MW74, 12MW75S and 12MW57, 12MW88, showed concentrations for petroleum hydrocarbons and PAHs that exceeded environmental guidelines/criteria. On the Wharf side of MEL, TPH concentrations of up to 6,500 mg/kg were detected in the soil. On the Wharf side of FN, TPH concentrations of 1,800 mg/kg were obtained in the soil. Concentrations of PAHs obtained in consideration of the groundwater to surface water pathway exceeded Federal guidelines at all sample locations analysed with the exception of one location."

A sediment sample (split spoon sample obtained in the highly weathered sandstone) obtained off the edge of the wharf showed a TPH concentration in the lube oil range of 550 mg/kg (location 12SS1).

Access to information request to DFO and DFO defence affidavit documents obtained in August 2012 (ACER receipt date) uncovered several sources of petroleum contamination on DFO land that appears to have never been remediated or otherwise addressed (Maritime Groundwater Inc. – MGI – February 2002 as A-307 in Appendix 42). Supplemental sampling was also carried out in June 2013 to assess other possible contamination sources including the SCH property. Based on reports prepared by Maritime Groundwater Inc. (MGI) on behalf of the DFO, petroleum hydrocarbon contamination was identified on the SCH property in several areas adjacent to and/or neighbouring the FN and MEL properties.

With respect to previous comments regarding locations 12MW37D, 12MW43, 12MW75, 12MW78, 12MW46, 12MW47, 12MW53, 12MW58, 12MW74, 12MW75S and 12MW57, 12MW88, showing concentrations for petroleum hydrocarbons and PAHs that exceeded environmental guidelines/criteria on the FN and MEL properties near the DNRE and SCH properties. It was noted in the report by MGI, dated February 2002, Affidavit Reference A-307 in Appendix 42, page 308, that it is indicated that the highest concentrations of TPHs of the 12 samples obtained in November 2001 were found in samples SED-1, SED-2 and SED-3. These locations are closest to the middle wharf. The highest TPH concentration was for SED-1, 3700 mg/kg (ppm), located closest to the FN and MEL properties (see sample location Drawings on page 292, and page 309 for tabulated values).

May 2, 1997, A-87, (Appendix 43) NBDELG occurrence report on wharf oil spill indicates there may be pipeline contamination reaching the harbour. DFO Affidavit for MEL CA-357 May 27, 2003, (Appendix 44) is a picture of repairs to the old north wharf showing contamination in crib work. DFO affidavit for MEL CA-359 May 29, 2003, (Appendix 45) is a picture showing trucks hauling away contaminated soil. August 20, 2014 AG-611 (Appendix 46) is an email from Rita Mroz to Maria Dober of Environment Canada, regarding historical reference to the Bulk plant, Rita Mroz, Environment Canada, indicates that in a previous email dated November 13, 2002 she indicated that "From the 1950s until the 1980s, Irving has a pipeline that ran from the water over DFO's property, to the bulk storage tanks. DFO's property, near the fuel tanks, is now very contaminated, likely caused by the pipeline leak (they did a stress test using seawater a few years ago and the pipe was "like swiss cheese")".

In the Tom Gallagher letter to Claude Burry of DFO dated November 13, 1996 A-81 a, (Appendix 19) it is indicated on page 2 "Both lines were badly corroded and perforations were evident in the 150 mm diesel line on that section of piping exposed in the cribbing.". ACER note: It is incorrectly indicated in this quotation that it is a 150 mm diesel line, and should have read 150 mm gas line.

MGI report, May, 2001, A-298, (Appendix 37), sediment samples collected from Shippagan Harbour between January 1976 and December 1983 by OceanChem Group had 1,374 mg/kg of oil and grease and exceeded the guidelines for ocean disposal of 10 mg/kg, and being most comparable with the RBCA oil/lube range hydrocarbons TPH criteria of 43 mg/kg and management limit of 500 mg/kg, exceeded this criteria. ACER noted in a report

obtained in 2019 that based on sampling by AMEC in 2010 (Affidavit FN 2712 a and FN 2712 b in Appendix 117) the **Total Organic Carbon (TOC) value for sediment samples obtained from a nearby area with non-detectable petroleum hydrocarbon concentrations** would require t**he RBCA criteria to be adjusted from 25 to 5 mg/kg. Indicating risks to be even more significant to the marine environment.**

March 16, 2011, A-304, (Appendix 47) e-mails from Garth Holder, Public Works, to Raymond Losier, DFO, re removal and disposal of fuel supply lines and soil disposal. Clean-up and disposal of petroleum pipelines and surrounding soils on Shippagan old north wharf during 2002-2003 renovations have no record of contamination testing, even though consultant reports showing petroleum contamination were shown to the wharf committee manager and excavating crew workers noted strong petroleum odours. Roland of Comeau Savoie (wharf contractor) states “What I can remember of that project, the whole area of the old north wharf has been excavated to elevation +1.2 in order to install the new tie rods. The old existing fuel supply pipes were remove and disposed of into the abandoned town sewage lagoon. I do not remember if there was any soil testing done at that time.” In an email from Garth Holder to Raymond Losier dated March 17, 2011, AG-199, (Appendix 48) it is indicated that “When we did the Old North Wharf, we did hit some underground contamination in front of the FN Fisheries, approximately 3 trucks load. This was when we were putting underground services.” No soil testing was carried out on the middle wharf where the IOL pipelines extend along the length of the wharf to the ocean end of the wharf, even though the information discussed above demonstrates that there were issues of concern.

In the summer of 1998 a secondary FN fish plant and fish meal plant waste water treatment system was installed at the eastern end of the FN property. Petroleum contamination was encountered and construction was halted. Photos and a drawing with locations are provided in A-33 a b c (Appendix 49). Given that the IOL underground petroleum pipeline was identified as a source of petroleum contamination on the adjacent DFO property with Irving Oil Limited having been identified as the responsible party, it was concluded that the pipeline was the apparent source of contamination and therefore, IOL was contacted regarding clean up. The impact area was referred to as the “pollution pit”. An invoice dated October 8, 1998, A-37 (Appendix 50) shows that approximately 500 ton of contaminated soils were excavated from the “pollution pit” and transported to Belledune for treatment. In a fax to Sealand Construction Ltd. from Eric Smith dated July 31, 1998, A-36 (Appendix 51) it was indicated that since no one was on site qualified to evaluate the soils that a soil sample be collected in a 5 gal bucket. In a fax from Mike Sauerteig of IOL to Eric Smith dated August 21, 1998, A-38 (Appendix 52) Sauerteig indicates that “We have been informed through conversation with Sealand Constr. that approx. 500 tonnes soil was delivered to Envirem in Belledune, with instructions to send the bill to Irving Oil Limited. Please be advised that we cannot accept responsibility for any costs associated with this work until such time that we have had the opportunity to inspect the soils and have the sample analyzed.”

Irving inspected the site and took samples (5 gallon bucket) to their lab for analysis and the construction of the FN pollution pit was completed. About 3 times the required excavated soil had to be removed due to the sides caving in while we waited for the Irving inspection due to the high water level, continuous pumping to keep the pit dry and sandy soil. There was no sampling carried out to confirm that all contaminated soils had been excavated. Billing, A-39 (Appendix 53) shows IOL having paid the invoice associated with the transport of contaminated soils to Belledune, reflecting an admission that IOL was responsible for the contamination.

As previously noted, a number of petroleum spills have occurred on the DFO Small Craft Harbours property. Sediment samples from the harbour obtained between 1977 and 1980, in A-298 in Appendix 37, showed concentrations for oil and grease (reflecting TPHs) ranging from 56 to 5086 mg/kg. For sampling in 2012, a concentration of 34,000 mg/kg for TPH was obtained by CRA, 2013 (FN A-931, in Appendix 54). Petroleum and naphthalene contamination in soils and groundwater, have been noted in the area of the wharf. The land based

spill sources represent a potentially significant source of petroleum hydrocarbons and naphthalene by means of transport of contaminates via the groundwater to surface water pathway, associated with leaching in soils and migration in the groundwater.

It continues to be recognized that conditions and several of the default criteria for application of RBCA and CCME are not met for historical investigations, but for consistency, the RBCA Tier I criteria and CCME guidelines are used for comparison given that these criteria have been applied historically for remedial purposes by others on behalf of the owners in this area.

As indicated in **CCME, March, 1991**, it is critical to recognize that when assessing risks to the environment that the assessment should also recognize the **combined or synergistic effects of contaminates**. It is indicated in RBCA 2015 that "This protocol is applicable only to sites with petroleum hydrocarbon impacts. It should not be used for sites where other potential contaminants of concern (e.g., PCBs, PAHs, dioxins/furans, metals/ metalloids, nutrients, pesticides, etc.) have been identified, as screening levels for such potential contaminants of concern have not been provided." It is further indicated in RBCA that "If multiple non-petroleum contaminants are included in the risk assessment at Tier II or III (assuming approval from the regulatory agency having jurisdiction), it may be necessary to consider the cumulative effects in the derivation of SSTLs. Different compounds may act on different body organs, thereby affecting the compounds that need to be considered as having cumulative effects." This is reflected in previous versions of RBCA.

Further to this, as indicated previously by ACER, the default criteria of greater than 3 m depth to groundwater does not satisfy requirements for application of the RBCA 2012 RBCA for soil and groundwater and it is also probable, but unconfirmed if contamination is in contact with the foundation wall that may exceed the guideline criteria. The Draft remedial plan (no plan identified as Final was located at the time of preparation of this letter) for the DFO and DNRE properties prepared by ARC and provided to Ray Morin of DOE from Mike Sauerteig of IOL on June 8, 1998 as A-114 in Appendix 55 indicated the design was based on the water table to be 2.0 to 3.0 metres below ground surface. However, it was noted by ACER that the design drawings for the groundwater collection galleries showed the depth of groundwater to be 1.5 to 2.0 metres. Section 3.1.3 of the Phase II report by ARC as A-332 in Appendix 22, (AG-438 better figures, Appendix 23)**,** for the depth to groundwater it was indicated "Groundwater was normally encountered within 2.0 to 2.5 of ground surface" but in the borehole logs the depth to groundwater was reported to range from 1.4 to 2.3 metres with five MWs showing less than 2 m depth (1.4m (MW9) to 1.65 m (MW7, MW8, MW10) to 1.9 (MW13), 2.1 (MW11) to 2.2 (MW12, MW14, MW15) to 2.3 (MW16). Although conditions and several of the default criteria for application of RBCA and CCME were not met, for consistency, the Tier I are used for comparison given that the TIER I criteria have been applied historically for remedial purposes by others on behalf of the owners in this area.

Provincial RBCA and federal CCME criteria are provided for potable water conditions. In some instances, concentrations obtained using RBCA analysis methods have been used to estimate values for comparison with federal guidelines. It is noted for RBCA 2007 that direct comparison of laboratory data from the Atlantic RBCA method and the CCME Canada Wide Standards-Petroleum Hydrocarbons (CWS-PHC) method is not recommended due to differences in the methodologies. However, changes were made to the Atlantic RBCA 2012 Method to enable more direct comparison of data generated by the two methods. The result is the Atlantic RBCA results are now directly comparable to either the PIRI guidelines or the CCME CWS Guidelines. Although changes have been made to harmonize the data generated by the two methods, differences between the methods remain." ACER utilised the CCME 2010 guidelines for groundwater for initial assessments completed on or before July, 2012. The groundwater guidelines were unchanged for the CCME update in November 2012.

Findings indicated that petroleum product was present in the soils and groundwater adjacent to the pipeline, with the piping installation providing a preferential flow path for contaminates. The pipeline extends to the shoreline. Remediation of contamination was reportedly undertaken by IOL in an area adjacent to the pipeline, on the east end of the FN Pecheries Ltd. plant.

It was indicated in a Phase I Environmental Site Assessment carried out by MGI on page 21, paragraph 2, sentence 1 that "hydrocarbon impacted soil and groundwater is known to exist as a result of leaks in the Irving Oil Ltd. underground pipes located on-site, and (page 13, paragraph 6) **under the NBDOE Remediation Sites Management Records that "an ongoing assessment of the DFO wharf and Irving Oil Ltd. pipeline is being conducted by ARC Associates Ltd. on behalf of Irving Oil Ltd.** (MGI, May 2001 is A-298 in Appendix 37). It was indicated on page 21, paragraph 2, sentence 2 that "Groundwater monitoring in this area is currently being conducted by Irving Oil Ltd."

It was also indicated on Page 21, paragraph 3 that "Surface spills associated with the aboveground storage tank located on the eastern wharf were noted in Section 4.1.9. However, due to the location of the storage tank and the lack of surface soil, it is expected that product spilled during refuelling would drain directly in to Shippagan harbour, potentially impacting marine sediments." The storage tank was reported to be operated by Irving Oil Ltd., with a storage capacity of 10,000 litres, and used for diesel. It was also indicated on page 18, paragraph 3, sentence 2 that "The existing product and storage distribution system was upgraded following a 1997 JWEL report noting that the system did not meet all federal codes and regulations." It was indicated in the JWEL 1997 letter report (A-355 in Appendix 37) that:

- the tank area required a spill containment device, and overfill prevention device on the tank, and the existing dike drain valve replaced with a lockable steel indicating type valve;
- the dispensing unit required a hose retraction device;
- the piping required an existing valve on the pipeline to be replaced with steel indicating type valve;
- the system requires traffic protection and a remote emergency shutoff switch.

It was further indicated on Page 24, paragraph 2, that "Other liabilities may include soil that has been impacted by the historical use of fuel oil and bunker C oil on the subject sites….In addition, **there are potential soil impacts below the boat storage area** that relate to the use of paints, solvents, and **petroleum products** for boat maintenance. …… In addition, it was noted during the site visit that the wharf is constructed of creosote and pressure treated lumber. Therefore, marine sediments in the vicinity of the wharf may be locally impacted with metals and PAHs, in addition to hydrocarbons (oil and grease) as identified in the OceanChem report. Concentrations for oil and grease was reported to range from 56 to 5,086 mg/kg compared with the applicable 1991 Guidelines for Ocean Disposal Atlantic Region value of 10 mg/kg. Cadmium ranged from 0.5 to 2.5 mg/kg compared with the guideline value of 0.6 mg/kg."

MGI (MGI, May 2001 is A-298 in Appendix 37) carried out an evaluation of the SCH property using the CCME National Classification System (NCS) for contaminated sites (CCME 1992). The evaluation yielded a score of 66.4, indicating a medium risk potential with action likely required. The CCME 1992 document indicates that for a score between 50 to 69.9, identified as a Class 2 site, that "there is high potential for adverse off-site impacts..." It was recommended (MGI proposal dated October 24, 2000) that soil samples be collected and six monitoring wells installed on the subject properties (Small Craft Harbour –SCH- property) as outlined in MGI's proposal dated October 24, 2000, and marine sediment samples collected from the SCH area (as per ODCA) to determine if PAHs, DDT, metals and TPHs are present in the sediments.

A Phase II/III ESA was carried out by MGI (A-307, Appendix 42) as a follow up to MGI, 2001 Phase I ESA (A-298 in Appendix 37) findings and recommendations. It was reported on Page 11, paragraph 2 that "Following DFO SCH file review and conversations with Mr. Rosaire Rioux (Port Authority Manager) it was noted that hydrocarbon impacted soil was removed from the area between FN Fisheries Ltd. And Marine Extract Ltd. Fish plants (Figure 2). The work was completed by JWEL on behalf of Irving oil Ltd. But the volume of contaminated soil removed from the site was not known." **It was noted for this assessment that there was no indication of soil sampling and analysis to confirm that the concentrations of petroleum hydrocarbons in the soil were below applicable criteria at the limits of the excavation, and therefore there is no verification that the extent of impacted soils were satisfactorily remediated.**

MGI, 2002, (A-307, Appendix 42) indicated that a report prepared by Aspen Environmental Inc. (AEI) dated August 31, 2000 (A-635 in Appendix 123) for monitoring carried out on behalf of IOL in association with the former IOL bulk plant operations, was reviewed and reported on page 12, paragraph 1, sentences 3 and 4 that "The report also presents analytical data from a July 2000 monitoring program in which water samples were collected from accessible monitoring wells. Hydrocarbon concentrations in the water samples collected ranged from non-detectable to 15,300 ug/L and were within applicable NBDELG Tier I criteria (commercial, non-potable, sand soil)." This document indicated by MGI February, 2002 to be dated August 31, 2000 could not be located as part of this assessment. However, it was noted by ACER, March 2012, (A-292 in Appendix 8), Page 1-40 paragraph 2 that for the Irving Bulk Plant property that "Sampling carried out on April 19, 2000 (Hydrocarbon Analysis report with report date May 24, 2001), showed a TPH concentration at BH6M, located adjacent to BH5M, BH7m and former BH8M, at 412.2 mg/L as fuel oil with MW5S having a TPH value of 115,1 mg/L, compared with the Tier I criteria for a residential site with potable water and coarse grain soil was 1.8 mg/L for gasoline and 1.1 mg/L for diesel fuel in 1999, 4.4 mg/L for gasoline and 2.2 mg/L for fuel oil in 2003, and 4.4 mg/L for gasoline and 3.2 mg/L for fuel oil in 2012 and 2015. Values also exceeded RBCA criteria for receiving waters and CCME criteria in consideration of the groundwater to surface water pathway.

ACER noted that on November 20, 2000, JWEL indicates "Soil contamination can act as a persistent source of groundwater contamination, and as such, groundwater remediation may be required over an extended time frame (greater than 5 years)." "The monitoring data presented in the report is from such a limited period that it is not possible to meaningfully evaluate trends or progress." "There did not seem to be sufficient information presented in the July report for Aspen's opinion that the dissolved groundwater plume is currently in a stable phase." "Wells that appear to be located hydraulically down-gradient of the hydrocarbon source areas should be refurnished or replaced. Monitoring of these wells will be necessary to delineate the dissolved hydrocarbon plume and to demonstrate hydraulic containment. "

The MGI May 31, 2001, A-298 in Appendix 37, indicated that "hydrocarbon impacted soil was removed from the area between FN Fisheries Ltd. and Marine Extract Ltd. fish plants." with the area of excavation shown in Figure 2. The excavation is shown in the area between the northern half of the Pecheries FN Fisheries Ltd. and full length of the Marine Extract Ltd. buildings (within the former CN Right of Way purchased by the Department of Natural Resources & Energy and then purchased by the Town of Shippagan who remain the current owner), and in the conclusions section indicated that "It is concluded that the Shippagan Small Craft Harbour property may have environmental liability resulting from the current or past activities on the site. The liabilities include hydrocarbon impacted soil in the vicinity of the Irving Oil Ltd. underground pipelines."".

There was no excavation of contaminated soils on the DFO property below the pipelines or from beneath the footprint of the FN and MEL buildings.

February 2002, Phase II/III ESA by MGI for DFO property, A-307 in Appendix 42, indicated in the "Conclusions" section of the report that "Residual hydrocarbon impact was previously identified along the property boundary in the area between the FN Fisheries Ltd. fish plant and the Marine Extract Ltd. building. Soil samples collected from monitor wells (01MW-1, 01MW-2 and 01MW-6) drilled in this area as part of the Phase II/III ESA were within applicable NBDELG (1999) and CCME guidelines."

Groundwater sampling conducted at three locations in November 2001 indicated concentrations to be within the NBDELG (1999) criteria applied for the assessment. It was further noted that analytical data from a July 2000 monitoring event by ASPEN Environmental associated with remediation of petroleum impacts on the DFO and DNRE properties showed concentrations to be within the NBDELG (1999) criteria. MGI applied non-potable conditions for the selection of NBDELG criteria, although FN and MEL and other users in the area were using potable water wells for food grade operations.

Although the Phase II/III ESA by MGI, Affidavit A-307 in Appendix 42, conducted in November 2001, indicated concentrations for petroleum hydrocarbons in the soil and groundwater samples collected for those investigations to be within the NBDELG (1999) criteria for the area along the property boundary in the area between the FN Fisheries Ltd. fish plant and the Marine Extract Ltd. building, results for the additional sampling locations installed as part of the "Additional Phase III Environmental Site Assessment" conducted in February 2003 by MGI, Affidavit A-308, in Appendix 39 showed concentrations in soil at two of the three additional locations, 03MW-4 and 03MW-5, exceeded NBDELG (1999) and federal CCME criteria.

However, for the "Additional Phase III Environmental Site Assessment" conducted in February 2003 by MGI, Affidavit A-308 in Appendix 39, it was noted that the soil samples submitted for locations 03MW-4 and 03MW-5 for Contaminated Site 4 that showed exceedences, were at depths between 0.61 and 1.83 metres. For the third location 03MW-6, analysis were for soil samples collected at depths between 2.44 and 5.49 metres that showed concentrations to be within the commercial criteria they applied for the assessment. Concentrations at depths between 2.44 and 5.49 m for 03MW-4 and 03MW-5 were also within NBDELG 1999 criteria.

On page 424 MGI, July 2003, A-308 in Appendix 39, it is indicated that "headspace vapour concentrations in soil samples collected during the Additional Phase III ESA ranged from 0 ppm to 85% LEL, with the highest concentrations occurring at 3MW-6." Based on vapour readings for samples, analysis of a sample between 0.6 to 1.83 metres at 03MW-6 would have been appropriate to confirm if concentrations were similar to those obtained at similar depths at 03MW-4 and 03MW-5 that exceeded NBDELG criteria.

ACER notes that for the Phase II/III ESA by MGI conducted in November 2001, Affidavit A-307 in Appendix 42, that with the exception of one sample, that analysis of samples on the SCH/DFO property for Contaminated Site 4 were for sampling depths between 2.4 and 6.0 metres. Similar to the results for the "Additional Phase III Environmental Site Assessment" conducted in February 2003 by MGI, Affidavit A-308 in Appendix 39, for samples analysed at similar depths, concentrations were within the NBDELG (1999) criteria. It appears that exceedences of the NBDELG (1999) criteria for soil is most prevalent at depths ranging from 0.6 to 1.83 m and the extent of contamination (laterally and vertically) in this area was not established in accordance with NDBELG or federal requirements. There was no excavation of impacted soils associated with this area on the SCH/DFO property.

With respect to concentrations of hydrocarbons in groundwater for Contaminated Site 4 for the MGI Phase II/III and Additional Phase III ESAs, it is indicated in the ACER letter to SCH/DFO dated April 17, 2016, FN A-1291 in Appendix 62, that the previous sampling for 01MW-6 was on November 28, 2001 when the monitoring well was initially installed. The concentrations for BTEX components as well as the TPH range hydrocarbons, with the exception of petroleum hydrocarbons in the C6-C10 TPH range, were below quantification limits for the November 28, 2001 sampling event.

It was further noted by ACER that concentrations were higher for select BTEX and TPH components for the other monitoring well 01MW-1 located in the same general area for the same sampling event was higher. It was also noted that concentrations for monitoring wells 03MW-4 and 03MW-5 installed in 2003 (A-308 in Appendix 39) in the same area of concern showed select BTEX and TPH components to be relatively higher compared to the 2001 sampling event. Petroleum hydrocarbons at 03MW-4 exceeded the NBDELG 2003, 2012 and 2015 criteria for non-potable and potable water conditions.

ACER noted that there are concentrations of petroleum hydrocarbons (including naphthalene) on the MEL and FN properties that represent a risk to the marine environment due to the transport of petroleum hydrocarbons to the marine environment via the groundwater to surface water pathway. Contamination as well as remedial activities associated with the DFO property related to the IOL pipeline assessment are considered to be contributing sources/factors to the contamination issues on the FN and MEL properties.

There was no assessment of risks to the marine environment due to the transport of petroleum hydrocarbons (including naphthalene) to the marine environment via the groundwater to surface water pathway and remediation was only carried out to reduce concentrations to levels that satisfied the NBDELG human health criteria and did not include any assessment of risks to the marine receiving environment.

Due to a number of naturally occurring and physically imposed factors it is reasonable to expect that contamination present on the SCH property represents a source of contamination to the FN and MEL properties, and in turn to the marine environment. Meaning that contaminated groundwater associated with the IOL pipeline assessment has migrated from the SCH property onto the FN and MEL properties, and in turn, represents a source of liability and contamination risk to human health as well as the marine environment via the groundwater to surface water pathway.

For the purpose of further defining the area associated with Contaminated Site 4, refer to Figure 5 in A-308 in Appendix 39. The area of petroleum hydrocarbon impacts associated with Contaminated Site 4 as presented in the MGI 2003 report is indicated to extend from the DFO property to the western end of the FN and MEL building footprints. With respect to Contaminated Site 4 it is indicated that concentrations of TPH in soil of 4,800 mg/kg were reported in the vicinity of the pipeline. Hydrocarbon contaminated soil was reportedly removed and the area is shown in Figure 5 of the report. Contaminated soil below and adjacent to the pipe was not excavated to avoid any further damage to the pipe.

A-308 in Appendix 39, July 2003, Additional Phase III ESA by MGI, it is indicated in the report that “Residual hydrocarbon impacts were identified along the property boundary in the area between the FN Fisheries Ltd. fish plant and the Marine Extract Ltd. building. Benzene, toluene and/or xylene concentrations in excess of the applicable CCME or NBDELG Tier I guidelines (for a commercial site with non-potable water and sand soil) were identified in surface and subsurface soil samples.” Sample locations 03MW-4 and 03MW-5 are located on DFO property. It was further indicated in the report that “The aerial extent of hydrocarbon impacted soil in this area is estimated to be 650 square metres with a volume of 2400 cubic metres.” and “The source of hydrocarbon impact in this area is assumed to be related to the abandoned underground fuel lines….”.

ACER notes that with respect to the remaining impacted soil between the FN and MEL buildings, on the DFO and DNRE properties only, the DFO consultant indicates on Page 405 the volume of hydrocarbon impacted soil in this area is estimated to be 2400 cubic metres ”in the vicinity of the area between FN and MEL building, contaminated site 4.”

ACER also notes that this estimate represents the remaining portion of contaminated soil between the MEL and FN buildings. This ignores previous investigations that identified contamination to extend under a large portion of the FN and MEL building footprints including ARC, August 1998, A-332 in Appendix 22, (AG-438 better figures,

Appendix 23), investigations in July 1998 and also sampling inside MEL building , A-121 in Appendix 40, June 18, 1998. ACER, FN A-944 in Appendix 9, for sampling between 2011 and 2013 showed petroleum hydrocarbon contamination in the soil to occur under the building footprint for the FN and MEL buildings.

It is further noted that in DFO correspondence AGC-147 (Appendix 56) between Marcia Johannesen of Public Works and Government Services Canada (PWGSC) and Raymond Losier of DFO dated March 20, 2013 that it was indicated that "Groundwater sampled from Monitoring Well 01MW-6 (down gradient of the former hydrocarbon impacts on the adjacent property) is within acceptable hydrocarbon guidelines and no further assessment is recommended."

ACER also noted that in an email dated April 11, 2013 from Mario Theriault of Conestoga Rovers & Associates (CRA) to Marcia Johannesen (AGC-213, Appendix 57) the following was indicated:

"Hi Marcia, see attached site plan. A monitor well was located immediately north of 01MW-6 as shown on the plan. The monitor wells immediately south and northeast of 01MW-6 could not be located. However, we did notice other monitor wells which appeared to have recently been drilled (silica sand visible on asphalt around flush mount) in the vicinity of the FN Fisheries LTD Fish Plant (at least three monitor wells as shown in orange on the plan; approximate locations). I doubt very much that all other monitor wells (01MW-2, 01MW-3, 01MW- 4, 01MW-5 and 03-MW-1, 03-MW-2 and 03-MW-3 identified in green) are still in place as this area has been paved over the years. Sorry, no photos showing other monitor wells."

It appears from the above that even though there was some interest in the collection of additional information, that it was determined that "no further assessment is recommended" based on concentrations of a single sample and no apparent regard for historical observations of groundwater flow conditions, underground services that provide for preferential flow pathways for movement of contamination.

It was further noted by ACER that the previous sampling for 01MW-6 was on November 28, 2001 when the monitoring well was initially installed (A-307, Appendix 42). The concentrations for BTEX components as well as the TPH range hydrocarbons, with the exception of petroleum hydrocarbons in the C6-C10 TPH range, were below quantification limits for the November 28, 2001 sampling event. It was further noted that concentrations were higher for select BTEX and TPH components for the other monitoring well 01MW-1 located in the same general area for the same sampling event was higher. It was also noted that concentrations for monitoring wells 03MW4 and 03MW5 installed in 2003 (A-308, Appendix 39) in the same area of concern showed select BTEX and TPH components to be relatively higher compared to the 2001 sampling event.

ACER further notes that concentrations for 01MW-6 were for the most part below the quantification limits and results for 01MW-5 were comparatively higher, as well as other locations in the area of interest installed in 2003 that showed even higher concentrations for select BTEX and TPH range petroleum hydrocarbons than the original two monitoring wells.

ACER also noted that given that 01MW-6 showed concentrations for BTEX and select TPH range petroleum hydrocarbons that were below the quantification limits and several other monitoring wells showed comparatively higher values, the decision that "no further assessment is recommended" would not be considered to be a good technically based assessment.

ACER further noted that it is also indicated in the DFO request for property-based environmental information dated October 29, 2013 from the DOE regarding the site with respect to contamination and remedial work etc., it is indicated that "Our records indicate that there has been contamination found at 1. Shippagan, DFO Wharf and Irving Pipeline (PID# 20704584)." as well as several other nearby properties (AGC-228, Appendix 58). This would indicate that there were still issues related to contamination on the DFO property (and presumably the DNRE property), contrary to the position of PWGSC (AGC-147, Appendix 56)."

Further to the above, it is indicated in a letter dated March 25, 1997 from Tom Gallagher of Jacques Whitford Environmental Limited to Claude Burry of DFO (A-83, Appendix 20) that

"The testing revealed that these 2 abandoned pipeline did not pass testing and were suspected of having been leaking during their operating life." And further indicated that "DFO clean-up activities should be part of a joint effort which should include all impacted property owners."

In addition, in correspondence dated August 7, 1997 (AGC-468, Appendix 59) Tom Gallagher, Jacques Whitford, states " Mike Sauerteig from Irving Oil called me today about the Shippagan clean-up. He said that he is awaiting a proposal from his consultant (Vic Nowicki-Arc Associates) which he expects to have in about a week. He said the IOL approach will be to dig test pits starting at the edge of IOL property, and progressing down the pipeline towards the wharf. IOL is going to go right across the DNRE property since they have the "go ahead". He also expects to go right into DFO property. I told him that shouldn't be a problem, and he would need to do that anyways to get the full picture."."

There was no information located in the documentation that indicates this was done.

Sample location 01MW-4 installed by MGI, February 2002 (A-307 in Appendix 42) showed petroleum hydrocarbon contamination in this area. On Page 53 it was indicated that "The source of hydrocarbon impact in this area may be related to past use of hydrocarbon storage in the bulk storage tanks currently being used for fish waste." An 8 inch diesel pipeline is located near the high water mark on DFO property behind FN as shown in A-308 in Appendix 39, is located near sample location 01MW-4.

It was indicated by Eric Smith that the storage tanks have only been used for storage of fish materials and were built in 1966 when the current fish factory was built. Alfonse Finn, indicated that he was the Director-General of FN Fisheries from 1966 to 1998, FN A-984 a in Appendix 113. Alfonse Finn also indicated that while he was the general manager of the factory, it had tanks for fish oil storage and a fuel oil tank. The fuel stored and used by the plant was like "Bunker C". At no time when he was the general manager of the factory were the tanks for the storage of fish oil used for any fuel storage

ACER noted that an environmental screening was commissioned by Public Works with Dillon Consulting Ltd. carrying out sampling of the above ground fish waste storage tanks at Shippagan Harbour in August 2005, A-299 in Appendix 60. Samples of sludge materials were obtained from the bottom of the tanks. On page 8 of the report provided as Appendix D of the document it is indicated that "Based on field observations and the analytical results, the contents inside the tanks are likely sourced from the decomposition of fish."

Therefore the fish tanks are not a source of hydrocarbon impacts as suggested by MGI, February 2002 (A-307 in Appendix 42). As such, the tanks would not represent a source with regards to petroleum contamination in soils, marine sediments or groundwater. In addition, the fish storage tanks were reported to contain sludge and liquids, and would therefore be considered as being liquid tight and as such would not represent a discharge source regardless of contents.

ACER noted that on Page 320 of MGI, February 2002, A-307, in Section 4.2 identified as "NCS Site Classification" the following is indicated. "Site 3 (Fish Waste Storage Tanks)-Score of 70.6 of which 12.6 was estimated resulting in a site classification of class 1 indicating that there is a high risk potential and action is required. This report was prepared in February 2002, with recommended sampling carried out in 2003 (MGI report dated July 2003, A-308 Appendix 39)."

Also on Page 436 of the MGI report dated July 2003, A-308 in Appendix 39 in the Section identified as "Contaminated Site 3 - Fish Waste Storage Tanks" The area of contamination and volume are identified as 315 m2 and 1100 m3, respectively. However, it is noted that sampling was not carried out in the direction of or on the FN

property to the south of 01MW-4, where the highest concentrations were reported. Additional sampling would have been appropriate to determine if concentrations were higher or lower. If higher than that obtained at 01MW-4 then the footprint of contamination and volume would be expected to be higher than the values recorded at that time. ACER noted that on Page 436 of the MGI report dated July 2003, A-308 in the Section identified as "Contaminated Site 3 - Fish Waste Storage Tanks", the area of contamination and volume are identified as 315 m2 and 1100 m3, respectively. However, it is noted that sampling was not carried out in the direction of or on the FN property to the south of 01MW-4, where the highest concentrations were reported. Therefore, the extent of contamination would not be considered to be fully delineated, and it appears that no action has been taken to date to remediate or otherwise address this issue, although "a site classification of class 1 indicating that there is a high risk potential and action is required." was determined.

ACER noted that in reviewing the NCS site classification for "Contaminated Site 3", it appears that groundwater to surface water pathway was ignored as well as the presence of known contamination including petroleum hydrocarbons, Polycyclic Aromatic Hydrocarbons (PAHs), heavy metals, PCBs and pesticides in the sediments of the marine environment. Several of these parameters have been detected for land based sampling including the SCH property. It is also critical to recognize that when assessing risks to the environment that the assessment should also recognize the combined or synergistic effects of multiple contaminates (CCME, March, 1991). The known presence of multiple contaminates appeared to have been ignored for the original NCS assessment and would have resulted in a higher score for several of the assessment items, in turn resulting in a higher cumulative score and indicating increased risk. It is likely that the same concerns would apply if the more recent NCS site classification system were used. No further action was apparently undertaken for this site.

ACER noted that in the Phase II/III ESA (A-307, in Appendix 42) and the Final Phase II ESA (FN A-931 in Appendix 54), for the DFO property that under Section 1.3.2, "Water Supply/Groundwater Usage" of each of the reports, that the saltwater supply wells associated with food grade operations for FN and MEL were not identified in the two assessments. This would result in a higher score for several aspects of the NCS classifications. Also, there was no consideration of water supply wells located at the end of the wharf that would result in a further increase in the NCS score indicating increased risk.

ACER noted that in DFO correspondence AGC-202 to 205 (Appendix 61) between Marcia Johannesen of Public Works and Government Services Canada (PWGSC) and Raymond Losier of DFO in November 2012 that it appears that for the Final Phase III Environmental Site Assessment completed in 2013 that CRA recommended that three additional monitoring wells be installed in the area of 01MW-4, referred to as "Contaminated Site 3" for the collection of soil and groundwater samples for BTEX/TPH analysis. This was presumably for the purpose of further delineation and identification of an apparent source. However no additional monitoring wells were indicated to have been installed in this area after 2003, based on the sampling plan provided in the final Phase III ESA completed in 2013 by CRA (FN A-931, Appendix 54), or otherwise. It was indicated in MGI (CRA acquired MGI) in 2003 (A-308, Appendix 39) that based on the Phase II/III ESA and Additional Phase III data, this area is one of several areas that is an environmental liability. The objectives of the Additional Phase III ESA were indicated to be as follows:

"1. Complete a detailed intrusive investigation (Phase III ESA) to identify the source and nature of contamination on the property and delineate the horizontal and vertical extent of contamination at the identified potential areas of concern.

2. Provide a concise summary of all contaminated sites on the property based on the results of the intrusive investigation.

3. Develop a Remedial Action Plan for the remediation and/or risk management of known contaminated site(s) on the property, if applicable.

It is noted that the above Item 3 is not addressed in this, but is included in separate letter.

It was noted by ACER that the source and nature of contamination in the area of 01MW-4 "Contaminated Site 3" was not identified in this report or other Affidavits. ACER further noted that there was no documentation located in the Affidavits pertaining to a remedial Action Plan in a separate letter as indicated in the objectives of the MGI (CRA) report (A-308, in Appendix 39). ACER 2013 sampling (FN A-944 in Appendix 9) at the property boundary showed a lower concentration for PHCs compared with 01MW-4 but exceeded RBCA criteria, and there was no apparent evidence of any remedial work. Given that the concentrations were higher on the SCH property compared with the FN property, the SCH property would represent an apparent source of petroleum hydrocarbon impacts to the FN property and possibly the MEL property. In addition, there was no mention of this area of contamination in the Final Phase III by CRA, 2013…." (FN A-931, in Appendix 54).

1.2.4 Harbour Area

As indicated in the ACER letter to James Gunvaldsen-Klaassen, Council, Civil Litigation and Advisory Services Department of Justice, Atlantic Regional Office from ACER dated April 17, 2016, FN A-1291 (Appendix 62) it was noted by ACER that in the assessment report by MGI (CRA) dated February 27, 2013 as affidavit FN A-931 in Appendix 54, that MGI (CRA) chose the Management Limit value for the modified TPH to identify locations that exceeded RBCA criteria. However, it is indicated in the RBCA Guidelines that "It is advised that all sediments be screened using the "typical" screening levels." Except for Max TPH value of 500 mg/kg, the screening levels change proportionally with the foc. The Max TPH value does not change with sediment foc. While the product-specific screening values can vary with foc and could potentially exceed 500 mg/kg, this value represents the maximum screening level for Modified TPH, regardless of sediment foc. However, the value for foc was not established based on sampling "non-petroleum impacted areas of the site" and could be at a value that warrants the application of lower criteria for the protection of the marine environment. From MGI 2002 (A-307, Appendix 42), hydrocarbon fractions were detected in the diesel/fuel oil (FO) and fuel oil/heavy oil (LO) range for all samples, with the TPH carbon fractions reported to resemble diesel/fuel oil (FO) and fuel oil/heavy oil (LO) for samples nearest the middle wharf and fuel oil/heavy oil (LO) at remaining locations. **Given that a sediment foc value was not obtained from a non-petroleum impacted area with certainty, the RBCA screening level for "Typical" sediments for diesel/fuel oil (FO) is 25 mg/kg and 43 mg/kg for (heavy fuel) oil/lube (LO). As such, based on the information collected by CRA (MGI), this indicates that 12 of the 14 sediment samples exceeded the RBCA criteria**. Additional sampling of sediments outside the area of contamination would assist in establishing a more definitive sediment foc value for consideration of RBCA for site assessment purposes. The federal CCME 1991 guidelines for ocean disposal is 10 mg/kg for sediment.

ACER noted in a report obtained in 2019 that based on sampling by AMEC in 2010 (Affidavit FN 2712 a and FN 2712 b in Appendix 117) the **Total Organic Carbon (TOC) value for sediment samples obtained from a nearby area with non-detectable petroleum hydrocarbon concentrations** would **require the RBCA criteria to be adjusted from 25 to 5 mg/kg. Indicating risks to be even more significant to the marine environment.**

Further to this it was noted by ACER that an Eckman Grab Sampler was also used for the sampling carried out in November 2012 by MGI FN A-931 in Appendix 54. As indicated previously, samples would only represent surficial sediments. As such, no representative "depth profiling" was carried out "to fully define this contaminated site." as recommended by MGI, February, 2002, A-307 in Appendix 42, page 317, of ACER letter dated April 17, 2016. **It was also noted on page 320 (report page 55) of the same report that "a Marine and Aquatic Site**

Classification was carried out." for the waterlot. It was indicated that "The procedure indicated a Hazard Ranking Score of 2 which results in a "Medium-high Priority Site" ranking. There was no information located in the affidavits indicating any further action was taken to address this issue and further assessment of the extent of contamination in the harbour sediments was warranted given that higher concentrations of contaminates were identified further afield and sediment sampling was limited to the surface sediments to this point.

Concentrations of petroleum hydrocarbons in the marine environment were typically highest for sediment samples obtained adjacent to the Wharf where the IOL petroleum transfer lines were located, storm drain outfalls that typically provide for preferential flow from inland areas, and is also located immediately down gradient of contaminated areas on the FN, MEL and DFO properties.

ACER noted in the report by MGI, dated February 2002, Affidavit Reference A-307 in Appendix 42, page 308, that it is indicated that the highest concentrations of TPHs of the 12 samples obtained in November 2001 were found in samples SED-1, SED-2 and SED-3. These locations are closest to the middle wharf. The highest TPH concentration was for SED-1, 3700mg/kg (ppm), located closest to the FN and MEL properties (see sample location Drawings on page 292, and page 309 for tabulated values).

It was noted by ACER that for investigations carried out in 2012 by MGI (two sample locations) as follow up to the 2001 investigations for marine sediments by MGI "one location was established near the outer boundary of the waterlot in the general area of SED-9 that previously showed the lowest TPH concentrations (assumed non-detectable for TPH given that values were indicated to be "less than" a specific value). Location 12SED-2 was further afield, over 100 metres from any previous sample location, but showed a significantly higher concentration at 34,000 for TPH." This indicates potential risks to the marine environment are greater than previously assessed.

ACER noted in DFO correspondence AGC-202 to 205 (Appendix 61) between Marcia Johannesen of Public Works and Government Services Canada (PWGSC) and Raymond Losier of DFO in November 2012 that CRA recommended that six sediment samples be collected to "Establish current quality of sediment in Harbour waterlot" for PAHs, metals and BTEX/TPH. It was proposed to "Collect sediment sample near former 2001 samples SED-1, 2, 5, 8, 9 and 10". However, the only evidence of additional sediment sampling is provided in the Final Phase III ESA by CRA, 2013 (FN A-931, Appendix 54) that only showed two locations.

It was also noted by ACER that the two sample locations taken in 2012 for the MGI 2013 report were not located in or near the areas previously sampled in 2001 by MGI, A-307 in Appendix 42 or sample locations established between 1997 and 1983 (in MGI, A-298 in Appendix 37), that showed concentrations exceeded the applicable guidelines. Historical samples were obtained from the inner harbour area whereas the two sample locations recently sampled in 2012 by MGI were located at more distant locations (up to 90 m) beyond the outer boundaries for the wharf structures where previous sampling showed non-detectable concentrations (assumed non-detectable for TPH given that values were indicated to be "less than" a specific value).

As indicated previously, one location was established near the outer boundary of the waterlot in the general area of SED-9 that previously showed the lowest TPH concentrations (assumed non-detectable for TPH given that values were indicated to be "less than" a specific value). Location 12SED-2 was further afield, over 100 metres from any previous sample location, but showed a significantly higher concentration at 34,000 for TPH. Indicating even greater risks to the marine environment than previously assessed for the DFO waterlot.

With respect to the February 27, 2013, FN A-931, Appendix 54, Conestoga-Rovers & Associates (MGI) report, the wording used in outlining the objectives appears to leave information gaps that result in misleading information in that it appears to ignore the extent and significance of contamination for sediments and the groundwater as

presented in previous reports and by comparing only a limited number of samples to guidelines and suggesting concerns are minimal based on the samples obtained for this particular report.

There were other areas of concern identified on the SCH/DFO property in previous reports prepared for SCH/DFO by MGI (Conestoga Rovers & Associates), that were not included in the "Final Phase III Environmental Assessment on Shippagan Wharf, NB" dated February 27, 2013, FN A-931, Appendix 54. As such, being identified as a "Final" Phase III may be considered somewhat misleading, given that it may be assumed by other parties that the other areas of concern previously identified are no longer a concern.

It was indicated by MGI, May 31, 2001, A-298 in Appendix 37, on page 21 that "Surface spills associated with the aboveground storage tank located on the eastern wharf were noted in Section 4.1.9. However, due to the location of the storage tank and the lack of surface soil, it is expected that product spilled during refuelling would drain directly into Shippagan Harbour, potentially impacting marine sediments." It appears that no action has been taken to identify/recognize all potential sources, carry out any remedial work or otherwise address environmental issues even though exceedences of guidelines were identified and the site received a Medium-high Priority Ranking.

As indicated previously the Marine and Aquatic Site Classification for the waterlot site based on 2002 sediment sampling gave a Medium-high Priority Ranking, Appendix 42, Affidavit 307. Given that a TPH concentration was detected further afield from previous sampling points (14), the extent of contamination is actually much greater than previously assessed in 2002, and the 2012 concentration of 34,000 mg/kg is significantly higher than the maximum value of 3,700 mg/kg at SED-1, indicating an increased risk to the marine receptors and that action is required.

From the MGI 2002 report, Appendix 42, A-307, concentrations of Polycyclic Aromatic Hydrocarbons (PAHs), heavy metals, PCBs (values ranging from 1 to 21.4 µg/kg compared with the CCME Interim Sediment Quality Guideline value of 21.5 µg/kg) and DDT (values ranging from 2.6 to 11.8 µg/kg compared with the Interim Sediment Quality Guideline value of 1.19 µg/kg) have also been identified in the sediments with select parameters exceeding CCME guidelines and the 1991 guidelines for Ocean Disposal.

ACER noted that analysis detected five PAH compounds (acenaphthene, fluorene, phenanthrene, anthracene and fluoranthene) in SED #10 exceeding the respective PELs. The remainder of the PAH compounds were either non-detect or between the ISQL and the PEL (Table 13).

ACER further noted that the PEL is a CCME guideline that is indicated to represent a Probable Effect Level and the ISQL is an Interim Sediment Quality Level. The ISQG (ISQL indicated by MGI) "are intended to be used for evaluating the potential for biological effects…., CCME, 1999, updated 2001. The PEL "defines the level above which adverse effects are expected to occur frequently"….."(i.e., more than 50% adverse effects occur above the PEL)." CCME, 1999 updated 2001."

ACER noted that in a letter to Mr. Alain Noel of DFO from Gilles Theriault of the Sustainable Development Committee of Shippagan dated February 24, 2000 (AGC-425, in Appendix 63) it was indicated that results from water sampling collected in the harbour in 1999 demonstrate the presences of certain hydrocarbon components at several sampling stations. It was also indicated that the Centre of Aquarium Research and the Marine Centre of Shippagan draws their saltwater from the same Shippagan harbour. The slightest concentrations of hydrocarbons in the harbour are a constant threat to their work and their research.

With the following also noted "The Sustainable Development Program of Shippagan Harbour intends to conduct in-depth analysis to determine the potential sources of hydrocarbons during the upcoming summer season." and "We therefore ask Fisheries and Oceans, as well as the Port Authority Committee of Shippagan to take immediate necessary measures to reduce the risk of contamination at Shippagan Wharf. In order to evaluate whether this

infrastructure contributes to the contamination of the harbour, we believe a sampling program around this site needs to be controlled (ordered) by your minister, this spring. "

As well there was a hand written note on the May 2, 2000 email with what appears to be the initials CB (likely Claude Burry) indicating "It was latter suggested by A. Noel that we hold off on the sampling program. Therefore, No further work has to be done." with the note dated October 7, 2000 The email was assigned an "Importance" rating of High and a "Sensitivity" rating of Private."

ACER also noted that there was no indication of surface water sampling being carried out within or outside the waterlot boundaries of the SCH property in Shippagan located in any of the MGI or CRA (MGI acquired by CRA) documents, or other DFO Affidavits between 2000 and 2013. However, petroleum hydrocarbons were reported in the groundwater for sampling carried out by MGI and CRA and as reported by other consultants that exceeded the Federal guidelines for marine life in consideration of the groundwater to surface water pathway.

It is reported that when the tide is low and the larger fishing boats use the wharf facilities that there are times when the boat plow through the sediments resulting in the sediments becoming suspended as evidenced by the very cloudy and dirty appearance of the water in the harbour (personal communication Eric Smith and Nazaire Savoie, Chatham Biotec Ltd., 2017). This provides an opportunity for the contaminated sediments to be transported further afield, increasing the extent of impacts and risks to the marine environment.

In 2010 (Affidavit A-2712a in Appendix 117) a marine surface and core sediment sampling program was carried out by AMEC at the Marine Service Centre in Shippagan, located immediately south of the Shippagan wharf area on behalf of DFO (Figure 1 of the report). **A Total Organic Carbon (TOC) value for sediment samples obtained from a nearby area with non-detectable petroleum hydrocarbon concentrations had a value of 2.2 g/kg which is 5 times lower than the TOC value used to establish the RBCA criteria of 25 mg/kg. As such, the RBCA criteria would have to be adjusted from 25 to 5 mg/kg, indicating risks to be even more significant to the marine environment. As indicated previously, this would also apply to the assessment of samples for investigations by others on behalf of DFO/SCH as well as the ACER sampling program. A comparison of the RBCA ecological criteria for marine life with the concentrations for surface samples, ranging from a non-detectable concentrations of 20 mg/kg to 390 mg/kg showed TPH concentrations exceeded the RBCA criteria for five of the seven surface samples.**

TPH concentrations for the four subsurface samples were less than the laboratory detection limit of 20 mg/kg, and would require analysis to lower levels for comparison with the applicable criteria of 5 mg/kg. It should also be noted that homogenization of the subsurface portion of the core samples from 0.6 m to 3.5 m would result in an average concentration that would not provide a true reflection of **peak concentrations** within the sample zone.

In the AMEC report summary it is also indicated that the analytical results of the ten samples analysed showed that the sediment did not meet the Canadian Environmental Protection Act (CEPA) Ocean Disposal Guidelines, CCME Interim Sediment Quality Guidelines (ISQGs) and Probable Effect Levels (PELs) for marine/estuarine environments in consideration of ocean disposal or CCME *Soil Quality Guidelines (SQGs)* for agricultural, residential/parkland, and commercial/industrial applications *in consideration of land based disposal* as follows:

- PAH - Three samples (SH10, SH14, and SH25) exceeded the CCME ISQGs with 7 to 8 individual compounds in consideration of ocean disposal.
- PAH - One sample (SH25) exceeded the CCME PELs for 2 individual compounds in consideration of ocean disposal.
- PAH - Three samples (SH10, SH14, and SH25) exceeded the CCME SQGs for the protection of human health (potable water) for all land use scenarios with 1 to 3 individual compounds *in consideration of land based*

disposal.

- PAH- Three samples (SH10, SH14 and SH29 SURF) exceeded the CCME SQG for the protection of human health (potable water) IACR (Drinking Water Check) *in consideration of land based disposal*.
- PAH- Three samples (SH10, SH14, and SH25) exceeded the CCME SQGs for the protection of environmental health (freshwater life) for all land use scenarios with 1 to 2 individual compounds *in consideration of land based disposal*.

1.3 Petroleum Spills IOL Facilities and Operations

The historical review by ACER showed that the IOL site appears to have been subject to frequent releases of petroleum product (Affidavit document A-291, Appendix 7). Affidavit FN A-1887 b (in Appendix 65) provides a summary of continuous spills and associated volumes. This supports a link between monitoring data for the bulk plant site and underground petroleum transfer lines with respect to the occurrence of free phase product, sheening and increases in concentrations being indicators of additional spillage.

1- Rail tanker unloading discharge filters: FN A-1887 a, items 3.1 to 3.7: 2 filters with 10 litres discharge each approximately 200 tankers per year for 20 years: 2 x 10 litres x 200 tankers x 20 years = 80,000 litres

2- Tank truck unloading rack and tank truck unloading station; FN A-1887 a, items 4.1 to 4.6 and 9.71; quantity of spillage over 50-year operating period unknown estimate 1 litres per truck loading x 50 truckloads per week: 1-litres x 50 trucks/week x 52 weeks/year x 50 years =130,000 litres

3- Two 4-inch gasoline pipelines intermediate valve box on DFO property: FN A-1887 a ,items 2.6 and 5.1 to 5.11 and 7.1 to 7.6: from 1938 to 1975,6 boats per year at 2,000,000 litres discharge per boat at minimum 40PSI pressure estimate 1,000 litres leakage per discharge: 37 years x 6 boats/year x 1,000 litres = 222,000 litres

4- Six inch and 8-inch pipeline in DFO old north wharf crib work: FN A-1887 a, items 2.6 and 6.1 to 6.18: and 7.1 to 7.6: from 1958 to 1975 6 boats per year at 2,000,000 litres discharge per boat at minimum 40PSI pressure estimate 1,000 litres leakage per discharge: 17 years x 6 boats/year x 2,000 litres = 204,000 litres

5- Eight-inch diesel pipeline near DFO 01 MW 4: FN A-1887 a items 2.6 and 8.1 to 8.9: operating from 1960 to 1975 with 6 boats per year estimate 1,000 litres leakage per discharge 10 years x 6 boats /year x 1,000 litres =60,000 litres

Total continuous spills 696,000 litres

Spills by Date:

6- Bulk storage tank leak 1970: FN A-1887 a, items 9.1 180,000 gallons or 818,280 litres

7- Bulk storage tank leak late 1970s: FN A-1887 a, items 9.2 to 9.25; 400,000 gallons or 1,818,400 litres

8- Bulk storage tank leak January 16, 1980: FN A-1887 a, items 9.3, estimate 30,000 litres

9- Bulk storage tank leak 1979: FN A-1887 a, item 9.4, 7,000 gallons or 31,822 litres

10- Bulk storage tank leak May 30, 1984; FN A-1887 a, items 9.5-9.6: 10,980 litres

11. Bulk storage tank leak December 12, 1997, FN A-1887 a, item 9.5a, 654,624 litres

12- Bulk storage tanks end of 1980s: FN A-1887 a, items 9.72 to 9.73 and 9.75, estimate 400,000 litres

13- Bulk storage tank leak: FN A-1887 a, item 9.74, 1,200 gallons or 54,552 litres

14- Bulk storage tank September 1989: FN A-1887 a, item 9.8: 20,000 gallons or 90,920 litres

15- Bulk storage tanks September 24, 1998: FN A-1887 a, item 9.9, 3,200 litres

16- Bulk storage tank June 1993: FN A-1887 a, item 9.10: 1,000 litres

17- Bulk storage tank June 1994: FN A-1887 a, item 9.11, 1,000 litres

18- Bulk Storage tank October 6, FN 1989: A-1887 a, item 9.12, 3200 litres

19- Bulk storage tank April 6, 1998: FN A-1887 a, item 9.13, 1,800 litres

20- Bulk storage tank April 8, 1998: FN A-1887 a, item 9.14, 500 litres

21- Bulk storage tanks October 11, 2001: FN A-1887 a, items 9.15 and 9.16 estimate 1,000 litres

22- Truck unloading facility July 22, 2003: FN A-1887 a, item 9.17, 60 litres

23- Bulk storage area drums April 11, 2013: FN A-1887 a, item 9.18, 38 litres

Total spills by date 3,21,406 litres

Total spills 4,617,406 litres

The total estimated volume of petroleum products handled at the IOL Shippagan bulk facility can be estimated by: June 17, 1982, AG-501 invoice for IOL petroleum vessel unloading April 11, 1982 and May 3, 1982. Each of these would be approximately 3,000,000 liter of petroleum products. August 21, 1939-October 29, 1963 AG -616 log of yearly shipping activity at Shippagan wharf IOL vessels start delivering fuel on 1950 up to 7 boats per year. Pipeline were used from 1938 to 1993 so the total volume handled by pipeline would be (1993-1938) x 7 boats/year x 3,000,000 litres/boat = 1,155,000,000 litres. Rail tanker unloading and tanker truck unloading could increase this by 20% so the total estimate is 1,386,000,000 litres. The total estimated spillage represents .333% of the total volume which would go unnoticed as IOL does not even keep the blue books for the Shippagan facility which records shipping and receiving.

1.3.1 Other Indicators of Potential Spills

Other indicators of potential spills having occurred include significant increases in concentrations particularly if it is evidenced from several monitoring wells across a site and even more so if there is free product shows up in the wells or product sheening. This is evidenced further if concentrations or free product levels occur for an extended period(s). A change in the type of the product is another indicator. The following was noted during the historical review.

Petroleum Hydrocarbon Concentrations (PHC) concentrations in the soil for the ACER 2016 investigations are orders of magnitude higher compared to the IOL 1989 and values for similar areas, and 1992 values for locations other than BH5 through BH8. This would be indicative of a significant amount of petroleum product having migrated and spread through the site and groundwater, as compared with the reported spill of September 1989 that indicated 2,600 litres was lost in the ground. The following reflects indications of additional releases on the site, while acknowledging that other spills are reported by others to have occurred prior to 1987 before it was mandated to be reported by the DELG.

It is also important to point out that IOL employees were directed to remove free product from the wells weekly using bailers, with the expectation that levels would become negligible to non-existent over a relatively short time

period for a spill into the ground of 2,600 litres (A-528 a in Appendix 66) . Given that monthly monitoring reports indicated a continued presence of free product of thicknesses typically reported to be greater than 20 cm between May 1993 and August 1996 and up to 4 cm between 1997 and 1999 and up to 1 cm for another 7 years would be most likely be indicative of on-going releases and as such an indication of similar occurrences historically.

Sampling in November 1989 showed concentrations of BTEX and Total Petroleum Hydrocarbons (TPH), in the gasoline range, at all locations that exceeded the applicable guidelines at the time at several locations for the soil and groundwater. The second sampling event conducted in July 1990 showed BTEX and TPH concentrations in the fuel oil range, and concentrations exceeded guidelines in the area of BH7M near the former loading rack. For the third sampling event conducted in December 1990, BTEX and TPH, in the gasoline and fuel oil range, were detected and concentrations exceeded guidelines at select locations. Gasoline hydrocarbons were detected in the area of the former railway line and fuel oil was detected in the area of BH7M located south of the former loading rack. It was noted that that gasoline range petroleum hydrocarbons were reported in the groundwater samples initially collected in March 1992 from monitoring wells MW4 and MW6 located on the Eastpre Feeds Ltd. property, based on RPC laboratory analysis (ARC, 1992). Approximately two years earlier, initial sampling on the IOL property showed gasoline at all sample locations, immediately after the gasoline spill of September 1989, changing to fuel oil and then to fuel oil or gasoline over a 12 month period at these locations. The significant fuel oil presence reported initially being noteworthy as well. This would suggest that there was a release of fuel oil product, but there was no evidence identified confirming a reported spill.

ACER noted that there were increases in hydrocarbon concentrations observed at a number of monitoring wells in 1994, 1995, 1996, 1997, 1998 and 2000 that appear to reflect “EVENTS” or an “EVENT” associated with the IOL property, also recognizing that fuel oil, gasoline and Naphthalene were detected at significant concentrations on the IOL and Eastpre Feeds Ltd. property, with increases observed for 1998, 1999 and 2000 being primarily limited to the IOL property.

It was noted from the historical review that it was indicated in the formal report (ARC, 1993D, A-493 a in Appendix 67) that MW5D was not accessible for the June 23, 1993 sampling event as it was covered by (a) large abandoned fuel storage tank. However, it was not mentioned in the main report that gasoline was spilled in the area of MW5S and MW5D, as recorded in the Project Monitoring Checklist appended to the report.

Affidavit document A-291, Appendix 7, page 1-55) it is indicated that:

““In a monitoring report dated January 15, 1993 (ARC, 1993J) the following was indicated concerning groundwater “Groundwater elevation data collected during the monitoring visit, December 22, 1992, indicates the remedial wells are only partially affecting local groundwater flows to control the migration of dissolved hydrocarbons.” In a letter from ARC to I Mosher dated Jan 20, 1993 it was indicated that “it is apparent that we need to effect a greater influence on the dissolved hydrocarbon plume at the site, we would suggest the installation of an additional remedial well located in the area of BH8M (Figure 1) and to increase the pumpage from RW1 and RW2”.””

Given that it was indicated that pumpage needed to be increased at RW1 and RW2 in combination with installation of an additional RW would indicate that adequate containment was not being provided in the area of BH5 to BH8 frequently reported to show in the order of 30cm free product. But it is also possible that this could indicate that there was another spill incident given that free product measuring 30 cm thickness was being detected and baling of free product was to have been continuing. Additional free product would be available to move off site via 14th St.

ARC, 1994, A-513 in Appendix 68, reported on the installation of RW3, installed in November 1993, located in the area of BH8M where free phase product continued to be detected with thicknesses in the order of 30cm for BH5M

and BH6M. Free product thickness in the RW was 30 mm. ACER noted that the thickness at BH5M in November was 10cm. Location BH8M is located at the IOL southern property boundary where free phase product was first reported over 3 years ago in December 1990. As indicated, IOL employees were directed to remove free product from the wells weekly, the continued presence of free product is likely indicative of probable on-going releases and as such an indication of similar occurrences historically.

In ACER, 2012, A-291, Appendix 7, ACER notes that

""a letter was provided from ARC to Chris Clinton of IOL that is dated September 12, 1994 (ARC, A-531) concerning the detection of **free phase product including fuel oil at MW5D and MW5S.** Monitoring Well MW5D was installed in March, 1993 as a deeper MW in the bedrock to further assess groundwater conditions**. Monitoring well MW5D established as a deep well in the bedrock (5 to 6.5 m into the bedrock) showed free phase product during sampling in May, 1994. It was indicated that "This well is screened approximately 5.0 m below the water table depending on the time of groundwater table measurement. This means for product to enter the well, it had to be present at some depth of below the water table." It was also indicated that "The change in hydrocarbons from gasoline or combined gasoline/fuel oil to fuel oil is also of concern.". (bold added by ACER**) The depth of the groundwater pumping wells ranged from about 5.8 to 7.62 metres into the bedrock.

A letter from ARC to Chris Clinton of IOL dated September 13, 1994 (ARC, 1994D), was provided as follow up to the September 12, 1994 (ARC, 1994E) letter concerning the detection of free phase product including fuel oil at MW5D and MW5S. ARC 1994D commented that contamination at these locations could be due to a couple of possibilities:

"(1) Was there a small spill this winter to allow penetration to the deeper part of the aquifer as well as the shallow portion?...(2) Is this a result of previously unknown deep contamination from beneath the adjacent tank enclosure moving under the influence of spring groundwater gradients, or remedial well pumpage?. In the September 13, 1994 letter to IOL, ARC advised that " MW2 and MW11 must be monitored at each monitoring visit as they provide data indicating off site dissolved hydrocarbon concentrations".. ... "a monitoring well should be installed within the containment dike (Figure 1) such that dissolved hydrocarbon concentrations may be monitored in this area "……." MW1 should be replaced as dissolved hydrocarbons are moving off site and I believe it is in IOL's best interest to monitor this.""

ACER 2012, A-291, Appendix 7 noted

""**that hydrocarbon concentrations at MW4 became elevated in April 1993 at the time when free phase product was detected at BH5M, BH7M and BH8M, and showed further increases into September 1993 and peaking at 73 mg/L in August 1993, as fuel oil. Values then decreased with a TPH value of 17.6 mg/L for March 29, 1994. Sampling was discontinued, presumably due to the low concentrations, until November 1994. A TPH value of 180 mg/L as fuel oil was reported for sampling carried out on November 4, 1994, for MW4 that exceeded the TIER I guideline value of 20 mg/L.** Free phase product with a thickness of 2 cm was reported for July 1994 at MW4, and was still detected at a thickness of 2 cm for the October, 1994 sampling event. **It is our opinion that this would indicate the likely movement of a concentrated zone of petroleum hydrocarbons in the area.""**

ACER 2012, A-291, Appendix 7 also noted

""From the historical review it was noted that there was a gasoline spill due to gasket failure on a tank recorded for July 13, 1994, with an unknown amount of product spilled (DOE Occurrence Report No. 94-BA-0177, Dated 13/07/94). It is critical to note that there was no quantity identified and IOL has not provided any blue

books that would confirm how much leaked from the tank. It is ACERs opinion that this was a likely contributor or source associated with the detection of gasoline in various monitoring wells as well as the increase in petroleum hydrocarbon concentrations at MW5D, MW5S and MW4 for the next 4 months. It is also critical to note that the failure was indicated to be a gasket failure, and it is likely that product was being released for a number of months or possibly years before the "failure" was detected. ACER notes that until July 1990 analysis showed gasoline at all locations consistent with the reported spill in September 1989. In July 1990, the second sample event, only fuel oil was reported at all locations sampled. ACER notes that it would be unusual for a change in resemblance across a site. The next sample event in December 1990 showed fuel oil and gasoline and free product was reported as sheen in a number of wells. Of key importance is that free product was reported as sheen initially and was measured for the first time in May 1993 with 37 cm being reported, with gasoline being dominant in the area of BH5M to BH8M until November 1994. Based on the above information the gasoline leak would be an obvious contributor, and for product thicknesses to increase from a thin sheen to 37 cm for several months would indicate a significant amount of product was released.

But also of note concerning the above is that MW5D did not show any detectable levels prior to May 1994, and ARC indicated not only is free product being detected in this area, but fuel oil was now being detected at MW5D and MW5S. The presence of fuel oil in the two wells, previously reported to be gasoline only, would indicate a release of fuel oil had occurred.

It is equally critical to note that as indicated previously, concentrations of TPH fuel oil range petroleum hydrocarbons reported by RPC for December 1990 were significant (only fuel oil) at BH5M, BH7M and BH8M, located in the primary area of impact (near former loading rack area), at values of 4,460 mg/L, 2,600 mg/L and 0.4 mg/L, respectively (WMS, 1991A). It was further indicated in the report that free phase product was now observed at BH5M and BH7M, and as previously indicated it was noted in this assessment that between April 1993 and November 1994, samples were not collected at BH5M, BH7M or BH6M as free product was present (ACER, A-291 in Appendix 7). Free product was also recorded intermittently for BH8M during this period and represents a potential contributing source by way of general groundwater flow and also preferential flow through piping trenches. This would indicate that a significant spill of fuel oil had occurred, although nothing was located in the documentation to indicate there was a reported spill.

It is important to note that between December 1995 when JWEL (1996) carried out investigations and November 1997 when ARC (1997B) conducted investigations, that order of magnitude increases in petroleum hydrocarbon concentrations possibly due to an "Event(s)" and significant issues with providing containment of the contaminate plume on the IOL property occurred as discussed below.""

ACER 2012, A-291, Appendix 7 further noted:

""**Monitoring for 1996 generally showed concentrations to be increasing throughout the year with significant values being reported for November 28, 1996, showing TPH ranges of 130 mg/L as fuel oil at MW4, 7.5 mg/L at MW6 as gasoline and 200 mg/L at MW15 as fuel oil and gasoline for the Eastpre Feeds Ltd property and 0.23 mg/L at BH1as fuel oil to 310 mg/L at BH7M as fuel oil and gasoline for the IOL property (ARC, 1997A in A-592 a,b in Appendix 21). Free phase product was recorded for the IOL property only, with 0.25 litres of free phase product being removed from BH6M and BH7M. It was odd to observe that a monitoring event was also conducted on November 25, 1996 (ARC, 1997A in A-592 a,b in Appendix 21), with results in the area of BH7M and BH8M on the IOL property showing a very low TPH concentration of 1.2 mg/L as fuel oil and gasoline at BH8M, compared with a value of 310 mg/L fuel oil and gasoline at BH7M on November 28. It was similarly observed that for the Eastpre Feeds Ltd. property, the**

concentration at MW4 also increased from a value of non-detect on the November 25 sample date, compared with a TPH value of 130 mg/L as fuel oil for the November 28 sample date.

It was further noted from the historical review that according to the sampling checklist dated November 25, 1996 that none of the three recovery wells were operating. It was also noted from the review that RW2 that has an influence in the area of MW4, and RW3 that has an influence in the area of BH7M and BH8M were not pumping (ARC, 1997A in A-592 a,b in Appendix 21). It was also noted from the review that MW5D appeared to have been decommissioned circa January 1997. The figure shows groundwater contamination extending across a large portion of the IOL site and onto the Eastpre Feeds Ltd. property as well as the former railway line, FN Fisheries, and a property to the south (ARC, 1997A in A-592 a,b in Appendix 21).""

ACER 2012, A-291, Appendix 7 noted:

""Monitoring results for August and September 1996 showed that petroleum hydrocarbon concentrations on the IOL and Eastpre Feeds Ltd. properties may experience an order of magnitude increase. However, it was also noted from the review that RW2 that has an influence in the area of MW4, MW6 and MW15, and RW3 that has an influence in the area of BH7M and BH8M were not pumping (ARC, 1997A in A-592 a,b in Appendix 21). It was also indicated that "It should be noted that a 0.01 m layer of undissolved petroleum product was measured in monitoring well BH6." And that "Consequently, groundwater flow beneath the remainder of the site moves from west to east/northeast under natural groundwater conditions.", being in the direction of the FN/MEL, SCH properties and marine receiving waters. In a letter from ARC to Mr. Mike Sauerteig dated October 10, 1996, ARC indicated that "MW3 has shown a steadily increasing level of dissolved hydrocarbons (e.g., 2,300 ppb in April 1996 to 6,100 ppb in August 1996). This well is located approximately 3.0 metres beyond the IOL property boundary. These concentrations would indicate the plume is moving off-site in a northerly direction…." ."

ACER, 2012, A-291 in Appendix 7 further notes:

""that two back to back accidental spills were reported at IOL in April, 1998 involving diesel oil and stove oil**. On April 6, 1998 a spill of diesel fuel was reported for the bulk plant due to overflow.** The liquid was contained within the dike. Quick dry material was spread to absorb the spilled material (DOE Occurrence Report 98BA-0023 and dated 98/04/06). It is believed that soils were excavated to a depth of about 30cm, based on documentation provided in DOE Occurrence Report No. 98BA-0026 dated 98/04/08**. A spill of stove oil was reported on April 8, 1998 due to a leaking manhole on another tank (Occurrence Report No. 98BA-0026 dated 98/04/08).** It was estimated that 500L was released and the product and water was collected by pumping. It was indicated that "most of the contaminated soil was removed". The report indicated that soil was excavated to a depth of approximately 30 cm, and was terminated because of the frozen ground. It was further noted that "Its all contained within the diking system, there was just a sheen on the water, they'll pump it to their shop tank."."

Fifteen tanks were on site with a combined storage of approximately 5.5 million litres (1.2 million imperial gallons).

It is also noted that there was an incident in December 1997 that required a lift station located on 16th St, one street over from 14th st for the IOL bulk plant, to be shut down **due to gasoline infiltration into the sewer lines** between 12th St and 15th St (FN A-1887 a in Appendix 64). Gaskets on the sewer line were reported to breakdown due to gasoline in the soils and groundwater in the area of 12th St to 15th St, with IOL bulk plant and underground petroleum transfer lines being located between these streets. Environment NB measured the gasoline content in the manhole at 67 percent. Product was removed from a manhole with pumping carried out over a 25 day period using a pump with a pump rate of 400 gallons per minute that was operated 24 hours a day until the gasoline level diminished below the explosion level. The remaining product was allowed to move through the system to the Town lagoon although the system was not equipped to provide treatment, with discharge to the ocean.

The volume pumped to achieve non-explosive conditions would be very significant with a significant amount remaining in the lines given the concentration level, indicating a very large volume of product having been released and only a portion likely being drawn into the sewer system. Deterioration of gaskets on the lines was reported to be due to petroleum product in the soils. These lines would provide an opportunity for contaminated groundwater to be "sucked in" to the sewer lines. Storm lines that discharge to the harbour would also be susceptible to deteriorating gaskets and provide an opportunity for contaminated groundwater to be drawn to seepage locations move more easily and faster to the marine receiving waters.

It is evident from the above that spills on site were a regular occurrence but quantities in some cases were simply estimates, with other cases normally indicated to be "unknown quantity" and as indicated previously, it was further noted in a letter dated July 8, 2005 from Mr. J. PA-539aul Harquail provided in response to Undertaking 63 from the Examination of Discovery Court File No. M/C/0793/02, March 2004, pages 368-369 Q.989 (see Appendix 88) concerning records (blue book) of daily inventories for tank contents, that it was indicated "We continue to take this undertaking under advisement to determine issue of relevance and commercial sensitivity, however, we have not located such documents.". This information would provide an indication of the "unknown quantity" released for spills and operations in general as this information is intended to achieve as well. Daily budget provides an indication if leaks are occurring from tanks and piping.

1.4 Possible IOL and DFO Due Diligence Issues

It appears from the documentation for the assessment associated with the two IOL underground gasoline transfer lines that there were delays in carrying out assessment and remedial programs and lack of diligence in maintenance of remedial systems that would have results in increased spreading of contamination including migration to the harbour. These may be considered indicators of liability/fault concerning contamination issues as well as issues related to action, or lack of action taken to address remediation of soil and groundwater. A number of issues were identified with respect to IOL during an initial review of historical documentation and are presented in section 1.2 of the Phase II ESA report by ACER dated July 3, 2012 as Affidavit A-291 in Appendix 7. Of key significance for the IOL bulk plant assessment/remediation was:

- the lack of action to undertake investigations to assess and establish the extent of contamination associated with the IOL bulk plant operations;
- to provide and implement a remedial action plan in a timely manner, noting that a remediation system for the IOL bulk plant was not installed until circa October, 1992, over three years after investigations carried out in 1986;
- recognition of preferential pathways for migration and spreading of contamination and increased risks to human health and the marine environment;
- IOL was not diligent/compliant with DOE requirements regarding timely installation of remediation systems. In a letter to Mr. Scott Stevens of IOL from the DOE dated September 29, 1989 the DOE directed that a consulting firm be hired to assess the magnitude and extent of contamination and based on the findings a plan of action for decontamination be submitted to the DOE no later than October 13, 1989, (Affidavit document A-291, Appendix 7, Page 1-52).
- In a letter to I Mosher of IOL from R Morin dated April 22, 1992 it was indicated "Due to the unusual amount of time which had gone by already (with apparently no remedial work taking place), you are requested to install remedial systems and to start up remediation by 92/05/29", that clarifies that no remediation had taken place.

This demonstrates that IOL was not diligent or compliant in meeting DOE requirements (A-291, Appendix 7, Pages 1-52 to 1-53).

- Due to further delays and non-compliance, a Ministerial Order dated September 20, 1992 was served to IOL on October 2, 1992, (Affidavit document A-291, Appendix 7, Page1-53). On February 15, 2019 another Ministerial Order was signed and to be served on IOL but was withheld after discussions with IOL legal counsel and IOL council inquiring what could be done to avoid the order being served (A-2734 in Appendix 126), and IOL showing "voluntary compliance".
- The soil remediation system was not installed until the fall of 1994 and only involved vapour extraction at two monitoring well locations (ARC, 1995A, Affidavit document A-550 a, in Appendix 69) and would be considered very inadequate in treating "site impacted soils" as further evidenced from the current ACER investigations.
- It is demonstrated in the documentation that IOL appears to make a number of misleading statements concerning the extent of contamination, containment of the groundwater plume and remediation efforts for the soil and groundwater (see Background, Section 1.4 in the ACER, 2012 EFL report, A-291 in Appendix 7). A couple important items follow from Page 1-49, Section 1.4 in the ACER, 2012 EFL report, A-291 in Appendix 7).

  - ""It appears that a letter from ARC to Chris Clinton of IOL that is dated September 13, 1994 (ARC, 1994D), was provided as follow up to the September 12, 1994 (ARC, 1994E) letter concerning the detection of free phase product including fuel oil at MW5D and MW5S. ARC 1994D commented that contamination at these locations could be the result of several possible factors as commented in the letter, "(1) Was there a small spill this winter to allow penetration to the deeper part of the aquifer as well as the shallow portion?...(2) Is this a result of previously unknown deep contamination from beneath the adjacent tank enclosure moving under the influence of spring groundwater gradients, or remedial well pumpage?. In the September 13, 1994 letter to IOL, ARC advised that " MW2 and MW11 must be monitored at each monitoring visit as they provide data indicating off site dissolved hydrocarbon concentrations".. ... "a monitoring well should be installed within the containment dike (Figure 1) such that dissolved hydrocarbon concentrations may be monitored in this area "……." MW1 should be replaced as dissolved hydrocarbons are moving off site and I believe it is in IOL's best interest to monitor this.". There was a noted increase in TPH concentrations for sampling carried out on April 21, 1993 at MW2, that is located to the south of MW1 (ARC, 1993B).

    It would appear from the above that the reason for recommending a MW in the dike area was to determine if fuel oil was present in the up gradient tank farm area and represented a contributing source to MW5S and MW5D. A monitoring well was never established in the tank farm impoundments. This demonstrates an admission of liability/fault related to ensuring containment of the contaminate plume in the groundwater, and not allowing sampling as recommended by the IOL expert in the tank farm impoundments may be an indication that IOL was concerned that there was contamination in the tank farm impoundments from historical spills that would be detected.

  - Records indicated that IOL directed ARC to delete information from a monitoring report dated November 7, 1994 (ARC, 1994C) related to delineation of the petroleum hydrocarbon plume in the groundwater. The original report contained the following information in the section regarding dissolved contaminate plume:

"Ground water sample analysis results from IOL indicate that a dissolved contaminate plume appears to cover the central part of the site. However, the boundaries of this plume cannot be exactly determined due to insufficient data."

IOL directed the consultant to remove the following comment from the original document "However, the boundaries of this plume cannot be exactly determined due to insufficient data." See Appendix A5 for the original and modified pages of the report. Removing this statement suggests that IOL may have been trying to avoid being found at fault concerning the significance and extent of contamination in the groundwater beyond the central part of the site. As indicated previously, a number of MWs including installations on the Eastpre Feeds Ltd. property and other adjacent properties were being sampled by the IOL consultant that provided for what would be considered assessment of the extent of contamination (see Appendices A6 and A7 which reflect MW locations for and prior to November 1994).**""**

The corresponding Affidavit Numbers for the 5 referenced documents identified the last item above are as follows: ARC, 1994C is A-539a that is the report containing the IOL directed correction that was submitted to the DELG; with IOL A-205 showing the document that IOL instructed the consultant to correct/change, and are both provided in Appendix 128.

- IOL was aware of the water supply well located on the FN/MEL property as indicated in the Court Discovery File M/C/1793/02 V1&V2 for Steve Jarvis of IOL, in Appendix 88, see page 74 of the court document).

With respect to assessment and remediation associated with the two IOL underground gasoline transfer lines and a lack of due diligence to contain contamination and protect human health and the environment, the importance of the following aspects are further emphasized given soil and groundwater contamination were identified to extend across the MEL, FN and SCF/DFO:

- inadequate delineation of contamination into the bedrock aquifer(s) in consideration of the FN water supply well/aquifer in consideration of risks to operations;
- no monitoring of several water supply wells to verify there was no contamination and no notification of property owners of potential risks to the water supplies;
- delays in meeting time lines for remediation (over two years to implement groundwater pump and treat);
- ensuring remedial groundwater pump and treat system operating continuously to prevent contaminated groundwater from migrating off site to the marine environment and into the deeper groundwater flow system(s);
- comprehensive monitoring program including adequate monitoring wells to verify contaminated groundwater was not reaching the marine environment.

As indicated in Section 4.1.1, on May 2, 1997 a heavier than usual petroleum sheening was observed in the harbour in the area of the IOL underground petroleum transfer lines formerly used by IOL (A-87, NBDELG occurrence report No. 97-BA-0060, in Appendix 43). With respect to the"Environmental Review, former CN ROW , and KAPAC Property" (A-353 a, December 1997 in Appendix 21) by ARC, it is indicated in a letter dated January 23, 1998 to Claude Burry of DFO from Tom Gallagher of JWEL regarding his review of the report that **"The ARC report does not present the consultants field observations with respect to hydrocarbon odours or staining, or groundwater seepage and makes no conclusions based on the results of the soil samples analyzed, therefore, we can only provide comment on the laboratory results presented."** (A-353 a, December 1997 in Appendix 21). In the conclusions JWEL indicates that

""The investigation presented in this report does not delineate the gasoline impacts encountered on the DFO property beneath the abandoned IOL pipeline, and does not provide any conclusive information regarding the potential for other gasoline impacts beneath the pipeline.

The ARC investigation appears to be directed at shallow impacts in the area of the pipeline. Deeper investigations of the soil and groundwater will be required to determine the extent of the gasoline contamination encountered beneath the abandoned IOL gasoline pipeline on DFO property, or the potential for other gasoline impacts beneath the pipeline.""

In the letter to Mike Sauerteig of IOL from Claude Burry of DFO regarding the review completed by JWEL it is indicated that "**The findings of this review indicate that the ARC report does little to establish any conclusive results pertaining to hydrocarbon contamination of DFO property originating from adjacent Irving Oil operations.** We are quite disheartened to say the least, with the findings of the review. The local community council, harbour authority and SCH have been waiting 7 months since our site meeting of June 3rd. for a commitment and action plan from Irving Oil."

Subsequently on ***April 4, 1998 at a meeting held with all parties involved and IOL had made an assessment, it was indicated that "IOL will try to schedule clean up in July" (1998).*** In a letter from Ray Morin of the NBDELG to Johnny Grant of IOL dated June 5, 1997 (A-89 in Appendix 21) it was indicated "Further to our discussions at the meeting of June 3, 1997, this will confirm that we are requesting that you have an intrusive site investigation conducted along the abandoned pipeline. The scope of your investigation should be to determine the extent of gasoline contamination in the soil and in the groundwater which exceeds current Level II guidelines."

In correspondence dated August 7, 1997 (AGC-468, Appendix 59) Tom Gallagher, Jacques Whitford, states " Mike Sauerteig from Irving Oil called me today about the Shippagan clean-up. He said that he is awaiting a proposal from his consultant (Vic Nowicki-Arc Associates) which he expects to have in about a week. He said the IOL approach will be to dig test pits starting at the edge of IOL property, and progressing down the pipeline towards the wharf. IOL is going to go right across the DNRE property since they have the "go ahead". He also expects to go right into DFO property. I told him that shouldn't be a problem, and he would need to do that anyways to get the full picture.".

There was no information located in the documentation to indicate that this was done.

It was indicated in the JWEL report, November 1996 (A-83 in Appendix 20) that **"The preliminary investigation revealed significant hydrocarbon impacts to DFO property, with the greatest impacts being closest to the DNRE property. The adjacent DNRE property has been confirmed as being contaminated by hydrocarbons (gasoline).", and further indicated that "JWEL recommends that the extent of the contamination (both on and off DFO property) be established prior to DFO initiating any remedial action. DFO clean-up activities should be part of a joint effort which should include all impacted property owners. Premature clean up may result in recontamination of DFO property"**

In an email from Tom Gallagher to DFO dated June 11, 1998, AG-86 (Appendix 35) regarding "Proposed Remediation Plan-IOL Shippagan" it is indicated "We have reviewed the proposed Irving Oil Limited (IOL) plan for clean-up of the gasoline contamination at the reference site. Unfortunately we cannot assess the effectiveness of this plan without more information than was presented in the IOL report." It was further indicated that "without more conclusive information and in order to protect DFO interests we recommend that the following steps be taken:

- Remove all soil on DFO property contaminated above NBDOE Level 2 guidelines.

- Provide recovery well(s) upstream of DFO property capable of retracting contaminated groundwater on DFO property while preventing incoming contaminated water from continuing downstream."

Partial excavation was carried out to remove some contaminated soils and a remedial program was implemented. With respect to contamination identified by ARC in the area of the gasoline pipeline on August 26, 1998 A-126 in Appendix 36, IOL requested approval to remove and treat 600 Metric Tonne of contaminated soil. **The area of excavation** shown in Figure 2 of the MGI, 2001, A-298 report (Appendix 37), **was limited to only a portion of the contaminated area** shown for soils between the FN and MEL buildings as shown in Figure 2 of the ARC, August 1998 report (AG-438 in Appendix 23). Excavation was terminated near the top of the pipes to avoid potentially damaging the pipes and therefore only a fraction of the contaminated soils was removed according to the contractor Sealand Construction Ltee. (Personal communication: Eric Smith, circa 2012).

No one was notified at MEL or FN that there were contamination concerns identified in the area of the two IOL underground gasoline lines.

It appears from the field log/monitoring report that groundwater remediation did not commence until circa July 1999. Therefore the time frame from initial identification of petroleum hydrocarbon contamination on May 2, 1997 to remedial pumping for groundwater in July 1999, represents over two years, and noting that only a small part of the contaminated soils were excavated. Based on a review of monitoring reports in FN A-1804 (Appendix 27) available for the 56 months that the remedial system operated, July 7, 1999 to March 16, 2004, the system was non-operational at least 50 times (personal communication: Eric Smith, May 14, 2017). Given the system was non-operational at this frequency this provided opportunity for contamination to continue to migrate onto the adjacent FN and MEL properties including the area of the building footprints, other adjacent properties and into the marine environment.

In a memo dated November 20, 2000 (A-318 in Appendix 41) regarding "IOL July 2000 Site Monitoring Report, Shippagan, NB" Tom Gallagher of JWEL indicates "It should be clear that the existing remedial approach appears to be geared toward containment and treatment of impacted groundwater, ·rather than remediation of soil. Soil contamination can act as a persistent ·source of groundwater contamination, and as such, groundwater remediation may be required over an extended time frame (greater than 5 years)." It was further indicated that

"The monitoring data presented in the report is from such a limited time period that it is not possible to meaningfully evaluate trends or progress. If additional monitoring data is available for prior sampling events (i.e. from site assessments) it would be useful to include these data. Remediation was discontinued circa March 2004 based on the field log book (FN A-1804 in Appendix 27) less than 5 years after start up of the groundwater pump and treat system, with contamination issues still being evident from the current ACER investigations.

Interpretation of groundwater elevation data in the form of groundwater contour maps should be considered and opinions provided on the effectiveness of the pumping system and overall progress toward achieving the management objectives. There did not seem to be sufficient information presented in the July report for Aspen's opinion that the dissolved groundwater plume is currently in a stable phase. We recommend that clarification be obtained on the basis for their opinion.

It is the position of IOL that the Ministerial Orders only require IOL to assess and remediate contamination identified on the bulk plant property. (Discovery Court File Number M/C/0793/02, March 2004, in Appendix 88). On February 15, 2019 another Ministerial Order was signed and to be served on IOL but was withheld after discussions with IOL legal counsel and IOL council inquiring what could be done to avoid the order being served (A-2734 in Appendix 126). DELG indicated "that the properties associated with the former Shippagan Bulk Plant and Pipeline must be assessed and remediated in accordance with the NB Brunswick Guideline for the

Management of Contaminated Sites." IOL indicated that they had information that they would be willing to submit to the DELG to demonstrate that they have been conducting assessment work on the site. It is indicated that given the voluntary compliance by IOL, it was decided that the Order would not be served. **The ministerial order indicates that Irving Oil Company, Limited "Conduct an Environmental Site Assessment (ESA) in accordance with CSA Standard Z769-00 (R2013) on the source properties, third party properties, and all other contaminated properties identified during the ESA" and "The Remedial Action Plan shall be implemented immediately upon approval by the DELG".** There was no monitoring information provided to the DEGL regarding remedial work associated with the bulk plant property after 2004, although a number of requests had been made.

On December 3, 2012, the DOE requested a meeting with IOL representatives (Affidavit document FN A-906 a,b,c,d in Appendix 10). On May 10, 2013, the DOE wrote to Michelle Paul-Elias of Cobalt Properties Corporation (Cobalt), part of the Irving Group of Companies, and reiterated that there had been no additional environmental information provided since June 2004 and that "The DELG is of the opinion that Petroleum contamination in the immediate area likely originated from historical operations/spills at the former bulk plant or pipeline. Based on available file information, petroleum hydrocarbon contamination appears to have impacted a number of properties including but not limited to, PIDs20371894, 20321311, 20322517, 20373957, 20704854, 20804829, and 20371266." and therefore **requested "that a comprehensive environmental site assessment report be submitted to the Department on or before September 15, 2013."(FN A-898 in Appendix 11). <u>This was not done.</u>**

PIDs 20373957 and 20322517 are the EFL properties and PID 20371266 is the FN property. PIDs 20321311 and 20371894 are the former IOL property.

The DELG sent a reminder e-mail to Cobalt Properties Corporation dated October 28, 2013 to request an updated report on the IOL bulk storage site and pipeline to bring properties into voluntary compliance with the DOE Contaminated Sites Management Process (FN A-896 in Appendix 12). A response from Cobalt was to be provided by the end of January, 2016. Subsequently Eric Smith undertook a motion for a court order to undertake investigations on the IOL bulk plant property in February 2016 given that his property interests were adversely impacted, with the IOL bulk plant operations including the former CN Rail tanker car petroleum offloading facility/area and two IOL underground gasoline transfer lines being the apparent source(s).

Lack of action by IOL in implementing clean-up measures provided an opportunity for contaminants to continue to migrate/move off the bulk plant site and CN ROW/driveway. Documentation shows that the DELG (note that NBDELG, DOE and DELG are the same) has continually had non-compliance issues with IOL for the Shippagan operations, 1989 through to 2020, (and with other NB sites) with DFO also being disconcerted with regards to contamination with IOL indicating a commitment to address environmental issues associated with IOL operations in Shippagan but not following through on them.

With respect to the"Environmental Review, former CN ROW , and KAPAC Property" (A-353 a, December 1997 in Appendix 21) by ARC, it is indicated in a letter dated January 23, 1998 to Claude Burry of DFO from Tom Gallagher of JWEL regarding his review of the report that **"The ARC report does not present the consultants field observations with respect to hydrocarbon odours or staining, or groundwater seepage <u>and makes no conclusions</u> based on the results of the soil samples analyzed, therefore, we can only provide comment on the laboratory results presented."** (A-353 a, December 1997 in Appendix 21). In the conclusions JWEL indicates that

""The investigation presented in this report does not delineate the gasoline impacts encountered on the DFO property beneath the abandoned IOL pipeline, and does not provide any conclusive information regarding the potential for other gasoline impacts beneath the pipeline.

The ARC investigation appears to be directed at shallow impacts in the area of the pipeline. Deeper investigations of the soil and groundwater will be required to determine the extent of the gasoline contamination encountered beneath the abandoned IOL gasoline pipeline on DFO property, or the potential for other gasoline impacts beneath the pipeline.""

In the letter to Mike Sauerteig of IOL from Claude Burry of DFO regarding the review completed by JWEL it is indicated that "**The findings of this review indicate that the ARC report does little to establish any conclusive results pertaining to hydrocarbon contamination of DFO property originating from adjacent Irving Oil operations.** We are quite disheartened to say the least, with the findings of the review. The local community council, harbour authority and SCH have been waiting 7 months since our site meeting of June 3rd. for a commitment and action plan from Irving Oil."

In a fax from Tom Gallagher to Claude Jacques Boudreau of DFO dated March 28, 2003 (A-315 in Appendix 129), regarding "Shippagan – Contaminated Site Meeting – March 27, 2003" the following is indicated:

"1. DFO expressed concern that Irving Oil Limited had not submitted monitoring documentation for well over a year. Records show that to date only two incidents of sampling results have ever been submitted to the DFO. With this lack information there is no way to determine the effectiveness of remedial activities at the site."

and

"4. DFO requested a ministerial order be served on Irving Oil by the NBDELG citing the lack of continual action by IOL to address the contamination issue since it's discovery in September 1996. The NBDELG was reluctant to do so since this lack of action is apparently acceptable (Raymond Morin cited his department had 15 year old projects that were still on-going). DFO expressed concern with this stand taken by the NBDELG. Mr Morin indicated that he would be willing to serve an order if this lack of action continued, however, would not define specifically what would constitute the serving of a ministerial order."

and

"5. The NBDELG also stated that specific clean-up requirements by the DFO would not be included in a ministerial order. The NBDELG is willing to accept proposed approved methods by IOL. If specific requirements are sought by the DFO (ie: soil removal of impacted soils with concentrations exceeding acceptable limits), then the DFO must pursue these independently of the NBDELG."

With respect to assessment and remediation carried out by the SCH/DFO for the SCH/DFO property and contamination issues, including harbour impacts, the following was noted that may be misleading and reflect on due diligence issues. ACER, April 17, 2016, FN A-1291, Appendix 62, noted in DFO correspondence AGC-202 to 205 (Appendix 61) between Marcia Johannesen of Public Works and Government Services Canada (PWGSC) and Raymond Losier of DFO in November 2012 that CRA recommended that six sediment samples be collected to "Establish current quality of sediment in Harbour waterlot" for PAHs, metals and BTEX/TPH. It was proposed to "Collect sediment sample near former 2001 samples SED-1, 2, 5, 8, 9 and 10". However, the only evidence of additional sediment sampling is provided in the Final Phase III ESA by CRA, 2013 (FN A-931, Appendix 54) that only showed two locations."

It was also noted by ACER that "the two sample locations taken in 2012 for the MGI 2013 report were not located in or near the areas previously sampled in 2001 by MGI, A-307 in Appendix 42 or sample locations established

between 1997 and 1983 (in MGI, A-298 in Appendix 37, that showed concentrations exceeded the applicable guidelines. Historical samples were obtained from the inner harbour area whereas the two sample locations recently sampled in 2012 by MGI were located at more distant locations (up to 90 m) beyond the outer boundaries for the wharf structures where previous sampling showed non-detectable concentrations (assumed non-detectable for TPH given that values were indicated to be “less than” a specific value).” Identification of only 2 sample locations in areas well outside previous locations that showed non-detectable concentrations for a report entitled “Final” may give the perception of bias.

However, in this instance ACER, April 17, 2016, FN A-1291, Appendix 62 also noted that “one location established near the outer boundary of the waterlot in the general area of SED-9 that previously showed the lowest TPH concentrations (assumed non-detectable for TPH given that values were indicated to be “less than” a specific value). Location 12SED-2 was further afield, over 100 metres from any previous sample location, but showed a significantly higher concentration at 34,000 for TPH, ”indicating even greater risks to the marine environment than previously assessed for the DFO waterlot. No additional investigations were recommended.

With respect to the February 27, 2013, FN A-931, Appendix 54, Conestoga-Rovers & Associates (MGI) report, the wording used in outlining the objectives appears to leave information gaps that result in misleading information in that it appears to ignore the extent and significance of contamination for sediments and the groundwater as presented in previous reports and by comparing only a limited number of samples to guidelines and suggesting concerns are minimal based on the samples obtained for this particular report.

There were other areas of concern identified on the SCH/DFO property in previous reports prepared for SCH/DFO by MGI (Conestoga Rovers & Associates), that were not included in the “Final Phase III Environmental Assessment on Shippagan Wharf, NB” dated February 27, 2013, FN A-931, Appendix 54. As such, being identified as a “Final” Phase III may be misleading, given that it may be assumed by other parties that the other areas of concern previously identified are no longer a concern.

1.5 Objectives

The objective of this assessment was to carry out intrusive investigations to:

- identify apparent sources of contamination;
- further assess the extent of contamination in the soil, groundwater and marine environment;
- assess groundwater flow in the overburden and highly weathered and fractured bedrock;
- identify remedial considerations; and
- implications on existing and future potential land use including adjacent residential and Federal Government land use.

Sampling was undertaken by ACER between 2009 and 2019, with Three-D GeoConsultants Ltd on site for investigations carried out on the IOL bulk plant property and MEL property in 2016.

2.0 APPROACH AND METHODOLOGY

In general, the approach to the assessment considered the New Brunswick Department of the Environment (DOE) management guidelines for the Implementation of Risk Based Corrective Action (RBCA) for the Management of Petroleum Hydrocarbon Contaminated Sites and Canadian Council of Ministers of the Environment (CCME).

As indicated in ACER 2012 Phase II ESA reports A-291 and A-292, in Appendix 7 and Appendix 8, ACER and previous assessments by others have shown that several areas of the SCH/DFO property have been contaminated that are adjacent to the FN and MEL properties that have exceeded provincial and federal guidelines for human health and the marine environment in consideration of the groundwater to surface water pathway, and contamination also occurs in the sediments of the DFO waterlot that exceed federal guidelines including petroleum hydrocarbons, PAHs, metals (including heavy metals), Polychlorinated Biphenyls (PCBs) and the insecticide Dichlorodiphenyltrichloroethane (DDTs).

Concentrations of petroleum hydrocarbons and PAHs are present in the groundwater on the FN, MEL and EFL and other adjacent properties that exceed federal guidelines for the marine environment and represents a risk to the marine environment in consideration of the groundwater to surface water pathway and discharge to the marine environment.

It is indicated in RBCA that:

“This protocol is applicable only to sites with petroleum hydrocarbon impacts. It should not be used for sites where other potential contaminants of concern (e.g., PCBs, PAHs, dioxins/furans, metals/ metalloids, nutrients, pesticides, etc.) have been identified, as screening levels for such potential contaminants of concern have not been provided. However, it is acknowledged that some elements of the protocol could potentially be applied to sites where the principal contaminants are not petroleum hydrocarbons. Use of this protocol or aspects of this protocol, in such situations should be discussed with the responsible regulatory authority before proceeding.”

The DELG Management Guideline indicates that:

“Non-petroleum impacted sites are to be evaluated by means of an appropriate screening criteria established by the CCME or other provincial jurisdictions in instances where the DELG does not have screening criteria for the particular contaminant.”

However, the Tier I criteria were used for comparison/screening assessment purposes with limitations to the guidelines applied accordingly, that may not have been considered historically for assessment purposes by others on behalf of property owners foradjacent or nearby properties, including Irving Oil Limited (IOL) operations and SCH/DFO lands in consideration of remedial criteria. The CCME guidelines were also utilised for assessment purposes consistent with previous assessments carried out by ACER. **Further discussion is provided below regarding the application of the RBCA and CCME guidelines and limiting factors.**

The Tier I Risk Based Screening Levels (RBSL) for petroleum hydrocarbons are based on the ATLANTIC PIRI Risk Based Corrective Action (RBCA) v2 (ATLANTIC PIRI, October 2003, Updated March 2007) management program. The Tier I look up tables provide remedial criteria for potable and non-potable residential and commercial land uses, for two soil types and several petroleum hydrocarbon compounds.

The Atlantic PIRI Tier I (or “generic”) remedial criteria are derived using conservative default assumptions about site conditions and employ substantial conservatism. The TIER I criteria are used to screen/conduct an initial assessment of a site, provided that subsurface conditions for the site are similar to the default values for the generic site. A number of requirements must be satisfied and site specific decisions must be made before selecting RBSL criteria from the Tier I RBSL Table. Several of the mandatory requirements for the application of the Tier I criteria for a generic site require that:

- the groundwater level be greater than three metres below the ground surface;
- that there be:
  - no visible staining of surface soils;
  - no free product in the soil or groundwater;
  - no objectionable odours or explosive conditions in indoor or outdoor air; and
  - no objectionable taste and odour in potable water; and

It is also noted that other conditions that may preclude the use of the Tier I RBSL criteria include the following building factors:

- single story building;
- floor slab thickness less than 11.25 cm;
- exceedence of default crack fraction;
- dirt floor, sumps with dirt bottoms;
- impacted soil concentration higher than Tier I RBSL is in contact with the foundation wall.

Tables containing the Tier I values that are considered typical of many sites in Atlantic Canada are provided in the RBCA document. However, if the above conditions are not satisfied, then TIER II criteria may be determined to identify Site Specific Target Levels (SSTLs) or Pathway Specific Screening Level (PSSL) values may be considered if/as applicable for assessment purposes.

The site conditions do not satisfy a number of the above conditions and as such the Tier I criteria should be considered accordingly. This is discussed in more detail in Section 3.3. For the general area for the Assessed Properties the depth to groundwater during summer was typically noted to range from 1.66 to 2.56 metres below surface grade with most locations showing about 2.1 metres. Water level were recorded to rise by 0.3 m and up to 1.0 m for episodic rainfall events as well as longer term seasonal conditions (fall and spring conditions). This results in a change of minimum depth of 1.66 m noted above to as little as 0.55 to 1.36 with a number of sample locations showing water levels about 10 cm below surface grade. The FN building is slab on grade construction with the EFL building having a partial basement about 1 metre below grade. Odours were very strong from a most of the borehole/monitoring wells, there is possible contaminated soil in contact with the foundation walls.

Commercial land use with non-potable water site classification, and coarse grained soil was used for this site for assessment considerations for comparison purposes with historical monitoring and assessment by the IOL consultants the SCH/DFO consultant MGI for several investigations carried out prior to 2011 and others. Commercial land use with a potable water site classification and a coarse grained soil was also used for this site in recognition of the FN water supply and water supplies for ice plant operations in the area (see Section 1.2.2). Residential criteria for potable water was also reviewed in consideration of potential future residential land use and existing adjacent residential land use. Criteria was also applied in consideration of the groundwater to surface water pathway and risks to the marine environment.

Federal CCME guidelines are established to assess the potential impacts to receiving waters for a wide range of contaminates. The CCME guidelines were not applied for previous assessments by the IOL consultant or the SCH/DFO consultant MGI for several investigations carried out prior to 2011 for land based contamination and consideration of the groundwater to surface water pathway and risks to the marine environment.

It is indicated in RBCA 2012 that for “identification of potential transport mechanisms and exposure pathways” that “Conduits such as service trenches can provide preferential and high velocity pathways. Pathways must be

assessed for immediate and long term human and ecological exposure.", and Is it reasonable to conclude that site petroleum hydrocarbon contamination could impact aquatic receptors or aquatic habitat in surface water bodies via ….preferential subsurface flow pathways (e.g. culvert, trench, sewer line, pipelines, swales) … such that aqueous media concentrations would potentially exceed surface water and/or sediment quality screening levels (Table 3a and Table 4)?.

If the answer to any of questions 1 to 4 in Part III is "YES", then further action is required."

For this project, a "YES" answer applies and further action is required, consisting of additional detailed assessment of the ecological environment (aquatic life and environment in particular), likelihood that Tier III criteria be developed rather than using Tier I or Tier II screening levels.

Groundwater screening levels can be used for evaluating groundwater quality at locations greater than 10 metres from a freshwater or marine water body. It is recommended that surface water screening levels should be applied directly (or unadjusted) when evaluating groundwater quality at locations within 10 metres of a freshwater or marine surface water body.

Intrusive sampling carried out by ACER showed that the bedrock has extensive vertical and horizontal fracturing with large fractures evident. Therefore, direct application of the CCME marine guidelines to the assessment of groundwater in consideration of the groundwater to surface water pathway and risks to the marine environment is considered an appropriate screening approach.

It is noted that the CCME 2008 Federal guidelines indicate that for "Fractured bedrock or fractured silt/clay…The transport models used to develop the numerical guidelines assume that contaminant transport occurs through unconsolidated soils. If transport between the contaminant source and receptor (e.g. surface water body) is through fractures instead of unconsolidated soils, either a transport distance of zero should be assumed (i.e. the Canadian Water Quality Guidelines for the Protection of Aquatic Life should be applied to groundwater), or a site-specific risk assessment should be conducted." This would also apply to a water supply well used for food grade operations."

It is indicated in the CCME guidelines that limitation in the use of the numerical guidelines include "Other scenarios resulting in a high groundwater velocity (e.g. tidal influences close to a marine water body) may also enhance contaminate transport…"…"and a site-specific adjustment of the guidelines will likely be necessary." This is applicable to the study area.

It is also critical to recognize that when assessing risks to the environment that the assessment should also recognize the combined or synergistic effects of multiple contaminates (CCME, March, 1991).

The RBCA approach and CCME guidelines identified above were applied for these investigations. This approach was not applied for previous assessments by the IOL consultant for the IOL bulk plant property and associated facilities including the former rail car unloading facility, the IOL underground petroleum transfer lines that extended onto the DFO lands, or the DFO consultant MGI for several investigations carried out between 2001 and 2013 on DFO lands. The Final Phase III ESA carried out by MGI for DFO in 2012 only assessed one of several contaminated sites MGI previously identified on the property and in this instance applied CCME criteria.

The CCME Guidelines (internet summary tables) were also applied for the assessment of petroleum hydrocarbons in consideration of neighbouring adjacent Federal land use and potential future use as Federal Land use, as well as for the parameter Naphthalene. Due to the proximity of the site to the "sensitive" marine aquatic environment, the CCME guidelines were also applied in consideration of marine receiving waters and Marine Aquatic Life.

The approach used relied on the Canadian Standards Association (CSA) Standard Z768-01 that provides general guidance for the approach to conducting Phase II ESAs in combination with other guidelines (Environment Canada

Technical Assessment Bulletins and American Society of Testing Materials Standard Practice E 1527-00 etc.) and our experience on similar projects. Sampling protocols were carried out in general accordance with the CCME Subsurface Assessment Handbook for the Assessment of Contaminated Sites, December 1994, and the CCME Technical Assessment Bulletins on Contaminated Sites, Number 1 to 14, Environment Canada Ontario Region, March 1992. The project involved the following activities:

Activity 1: Additional review of historical data

Activity 2: Intrusive Site Investigations

Activity 3: Reporting

The methodologies applicable to tasks associated with these activities are provided in the following sections.

2.1 Activity 1 Additional Review of Historical Data

Additional information associated with environmental conditions in the study area was reviewed to assist with further characterization of conditions for land based areas of interest and the marine environment.

2.2 Activity 2 Intrusive Site Investigations

Supplemental Site Investigations were carried out between 2011 and 2019 to further delineate the extent of contamination and identify apparent sources. Drilling contractors included Lantec Drilling Services Inc, Boart Longyear and Modern Well Drilling 1993 Ltd.

2.2.1 Borehole Soil Sampling

Supplemental Site Investigations were carried out in 2011, 2012 and 2013 to further delineate the extent of contamination and identify apparent sources of contamination, Appendix 9 (Affidavit document FN A-944). Investigations involved the additional ***installation and sampling of over seventy BH/MW and 5 Test Pit (trench) locations*** that included the Pecheries FN Fisheries Ltee, Marine Extract Ltd., former CN Right of Way (now owned by the Town of Shippagan), the former IOL Rail Siding Petroleum Offloading Rack, the property boundary between the IOL bulk plant and 14th Street and the eastern property boundary for the IOL bulk plant. See Figure 3-1 in Appendix 70 for sample location plan.

Twenty seven BH/MW locations were installed on the former IOL bulk plant property and 20 were located on the DFO property.

2.2.2 Bedrock Assessment

A downhole video recording was made for several wells installed into the bedrock including the IOL and FN/MEL properties.

2.2.3 Monitoring Wells for Groundwater Sampling

Seventy one MWs were installed on the Pecheries FN Fisheries Ltee, Marine Extract Ltd., former CN Right of Way (now owned by the Town of Shippagan), the former IOL Rail Siding Petroleum Offloading Rack, the property boundary between the IOL bulk plant and 14th Street and the eastern property boundary for the IOL bulk plant.

Twenty seven MW locations were installed on the former IOL bulk plant property and 20 were located on the DFO property. Monitoring wells were constructed according to standard protocol, using 5.08-cm diameter Schedule 40 PVC pipe. For locations inside buildings the wells and were completed below the concrete floor so that the locations could be “sealed off” using the concrete core and a sealer compound in consideration of the food grade

operations carried out in the building. Flush mounts were used in traffic areas and stand ups were located in non-traffic areas.

The wells were thoroughly developed by purging, to remove sediment laden water produced during the drill process and to enhance the effectiveness of the screen and filter pack. Three times the volume of water present in the well was purged from the well during well development.

The screened pipe was connected to a solid PVC riser that terminated at below the concrete floor, at grade and above grade as appropriate and was capped. The annular space around the PVC screen was backfilled with number 2 silica sand. The annulus from 0.5 metres above the screen to within 0.3m of the ground surface was filled with bentonite. Monitoring well construction details are shown on the BH/MW logs contained in Appendix 71.

2.2.4 Marine Sampling

Marine sampling involved surface grab and core sampling of sediments and the collection of benthic samples. Standard Operating Procedure No. 10 and 15 of the in CCME 2016 guidelines was applied for sediment and benthic sampling, respectively. Surface sediment and benthic sampling was carried out using an Eckman Grab Sampler. Sediment core samples were obtained using a 50 mm diameter core sampler with a drop hammer.

Benthic samples were washed using a 500 micron screen to remove materials and preserved using formalin.

The samples were collected in laboratory provided containers and mason jars (for benthic samples) and shipped in ice-packed coolers along with completed Chain-of-Custody forms.

Twenty seven sample locations were used for characterization of the sediments with leachate testing carried out for some locations:

- Area 1 Inner Harbour: 18SD4, 18SD7, 18SD9.
- Area 2 Channel: 18SD55, 18S57, 18SD37and 8SD38 with 18SD37and 8SD38 also representing wharf area.
- Area 3 Midfield location near the water intake for the science aquarium: 18SD19, 18SD20, 18SD30
- Area 4 Far field : 18SD31, 18SD33, 18SD18SD34, 18SD31B, 18SD35, 18SD36,
- Lobster Harvest Area Near causeway: 18SD55
- Additional sampling near boat unloading facility 19SD1, 19SD2, 19SD3, 19SD4, 19SD6, 19SD7 and 19SD8
- Additional sampling shallow area north of new north wharf: 19SD1

2.3 Laboratory Analysis

Soil, groundwater and sediment samples for selected monitoring wells were submitted to the RPC laboratory in Fredericton, NB, an accredited lab with the Canadian Association for Environmental Analytical Laboratories (CAEAL), for analysis including Petroleum Hydrocarbons and PAH (polycyclic aromatic hydrocarbons including Naphthalene).

2.4 Project Control and QA/QC Control

Quality Assurance/Quality Control measures were incorporated into the program to ensure and monitor that defensible and representative results were obtained during sampling. Strict protocols were followed to prevent the possibility of cross contamination during the borehole/monitoring well installations, including cleaning of equipment with biodegradable soap and distilled water and rinsing of the field sampling equipment using distilled water between each sampling event.

2.5 Activity 3 Reporting

Reporting includes a description of the methodologies used, and findings of the investigations including analytical results and conclusions, and BH/MW logs containing descriptions of the hydrogeological conditions noted during installation of the test holes.

3.0 FINDINGS OF INVESTIGATIONS

Soil overburden, bedrock, groundwater and marine conditions are described as well as laboratory analysis for contaminates of concern in this section. The data was used to establish concentration contours that show the footprint and source(s) of contamination in Section 4.0, and for the evaluation of remedial measures in Section 5.0.

3.1 Site Description

The assessed properties of interest include:

- Pecheries FN Fisheries Ltd (FN), interest of Eric Smith, with Property Identification Number (PID) 20371266 and address at 99, 15th St.;
- Marine Extract Ltd. (MEL), interest of Eric Smith, with PID 20552352 and address at 103, 15th St;
- Eastpre feeds Ltd. (EFL), interest of Eric Smith, consists of Parcel Identification Numbers (PID#s) 20373957 and 20322517, being adjacent to each other and the IOL property. The Eastpre Feeds Ltd. property is located at 108, 12th Street, Shippagan, NB.

The properties are located adjacent to areas with residential and commercial land use designations. Shippagan harbour is located to the east of the properties. The property boundary for the SCH/DFO property is defined by the 1966 Mean High Water Level (MHWL), also referred to as the Ordinary High Water Mark (OHWM), as shown on Figure 3-1 (also included in Appendix 70). The eastern edge of the FN Fisheries building extends across the Mean High Water Level with the MEL property being approximately 10 m from this boundary being separated by 15th St and the EFL property being located about 30 metres from FN.

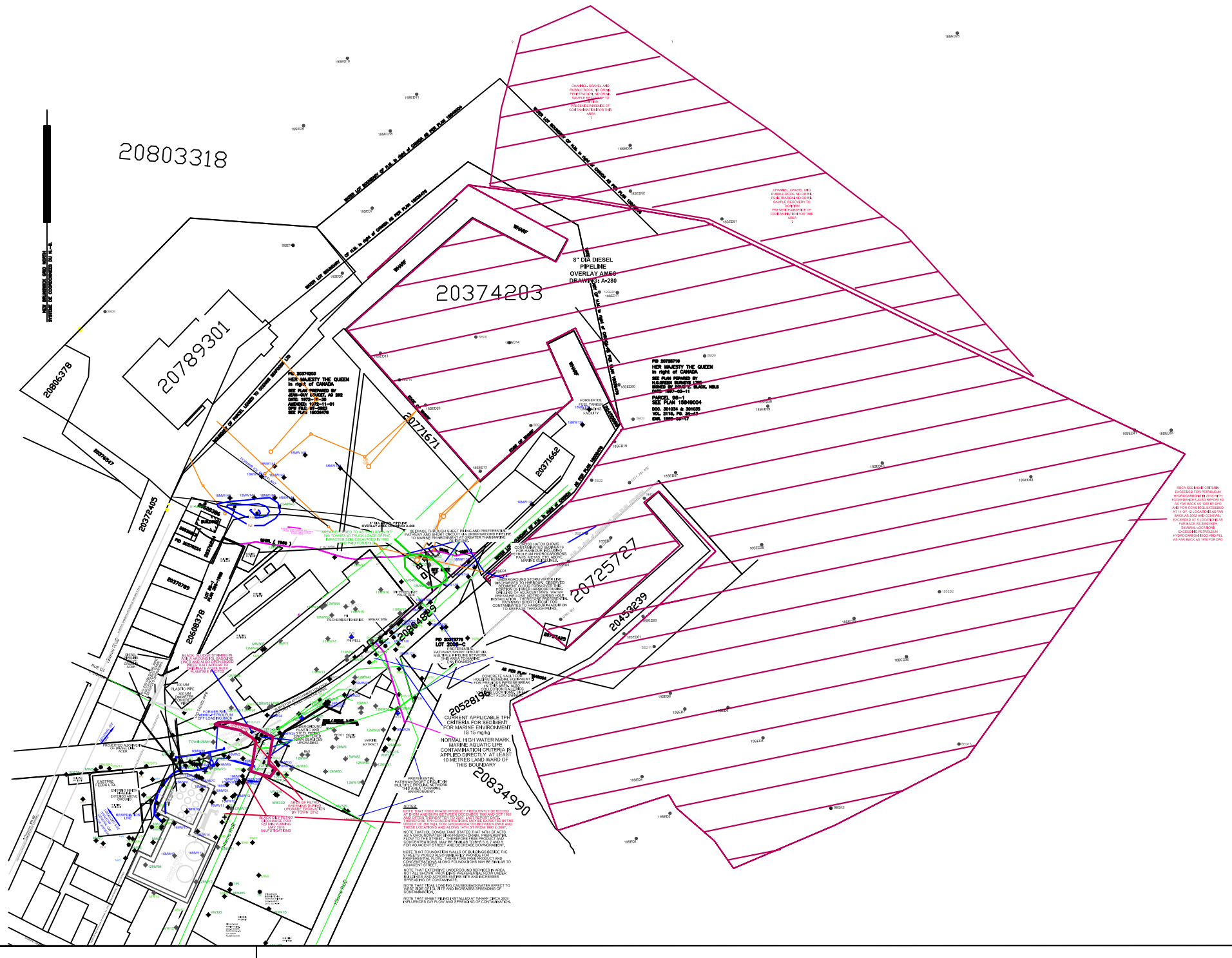
Residential land use and a school are located to the west, properties to the south include a former CNR right of way, a former IOL Bulk Plant, and Eastpre Feeds Ltd., with residential and commercial land use beyond these properties, and Marine Extract Ltd. is located to the east. Water was supplied for FN Pecheries Ltd. operations via a local private water supply/aquifer well used for food grade processing. The water supply must satisfy drinking water quality requirements given the food processing application, with refinement if/as required.

3.2 Site Subsurface and Hydrogeological Conditions

Subsurface conditions are described below and in the attached BH/MW logs in Appendix 71. Sampling locations for this program and historical sampling locations are shown on Figure 3-1 (with a blown up figure in Appendix 70) and the subsurface and hydrogeological conditions are described in the following sections.

3.2.1 Geology

A profile showing the stratigraphy of the site is shown in Figures 3-2 and 3-3 (also provided in Appendix 72), with the transect line extending directly from the IOL bulk plant to the wharf as shown on Figure 3-1. Overburden conditions are described in detail in the borehole logs contained in Appendix 71. Photos taken during rehabilitation of underground services by the Town that show the overburden and bedrock conditions as well as petroleum sheening and staining in the soils, weathered/fractured bedrock and groundwater are provided in Photos 3-1 to 3-14 below (also included in Appendix 72). Several downhole video stills showing the extensive and significant fracturing in the bedrock are provided in Photos 3-15 to 3-18 for 16MW20A that is located on the IOL bulk plant and adjacent to 14th St., and Photos 3-19 to 3-22 for 16MW 22B that is located about 140 metres down gradient of 16MW20A and are also included in Appendix 72. Monitoring well 16MW20B is located adjacent to the MEL building, about several metres from the IOL underground gasoline transfer line and about 18 metres from the FN water supply well that extends into the bedrock to a depth of about 120 feet.



LEGEND

- ACER BHs/MWs IN GREEN TEXT FOR MW21 TO MW42 FOR JUNE, 2010, 11MW8 TO 11MW17 APRIL 2011, MW30 TO MW42 JULY 2011, 12MW1 TO 12MW92 IN 2012 AND 13MW93 IN 2013, 16MW1 TO 16MW35 2016, 18MW120 TO 18MW162 AND 19MW150 IN BLUE TEXT.
- WMS/ARC BHs/MWs IN LIGHT GREEN TEXT BEGINNING 1989 RELATED TO IOL BULK PLANT
- JWEL BHs/MWs IN BLUE TEXT THREE D GEOCONSULT. IN BROWN EASTPRE FEEDS 1996
- BHs/MWs BY OTHERS UNKNOWN IN BLACK TEXT
- EXISTING RECOVERY WELL (RW) LOCATION (ASPEN, MARCH 2000)
- FN PECHERIES WATER SUPPLY (WS) WELL
- TEST PIT LOCATION IN BLUE TEXT BY JWEL 1995 DFO/DNR PROPERTY
- WMS/ARC TEST PITS IN LIGHT GREEN TEXT BEGINNING IN 1989 RELATED TO IOL BULK PLANT
- TEST PIT LOCATIONS IN GREEN TEXT BY ACER, SEPT, 2010
- 18SED1 & 19SED 1 ACER 2018 and 2019 SEDIMENT
- 3.2 TPH CONCENTRATION CONTOUR
- PROBABLE GROUNDWATER FLOW DIRECTION FOR SHALLOW AQUIFER

TRACE OVERLAY OF IRVING OIL LIMITED SITE PLAN FOR AS BUILT REMEDIATION SYTEM AND FORMER RAIL LOADING RACK SHOWN IN IN BLUE. REFERENCE: CAMPBELL, OCTOBER 30, 1992, INTER-OFFICE MEMO.

Some BHs/MWs and Feature locations approximate.BH/MW locations extrapolated from ASPEN, MARCH 2000, AMEC, 2001 and ARC documents, and railway siding features from Cambell, 1992.

ACER
Environmental Services (2015) Ltd.

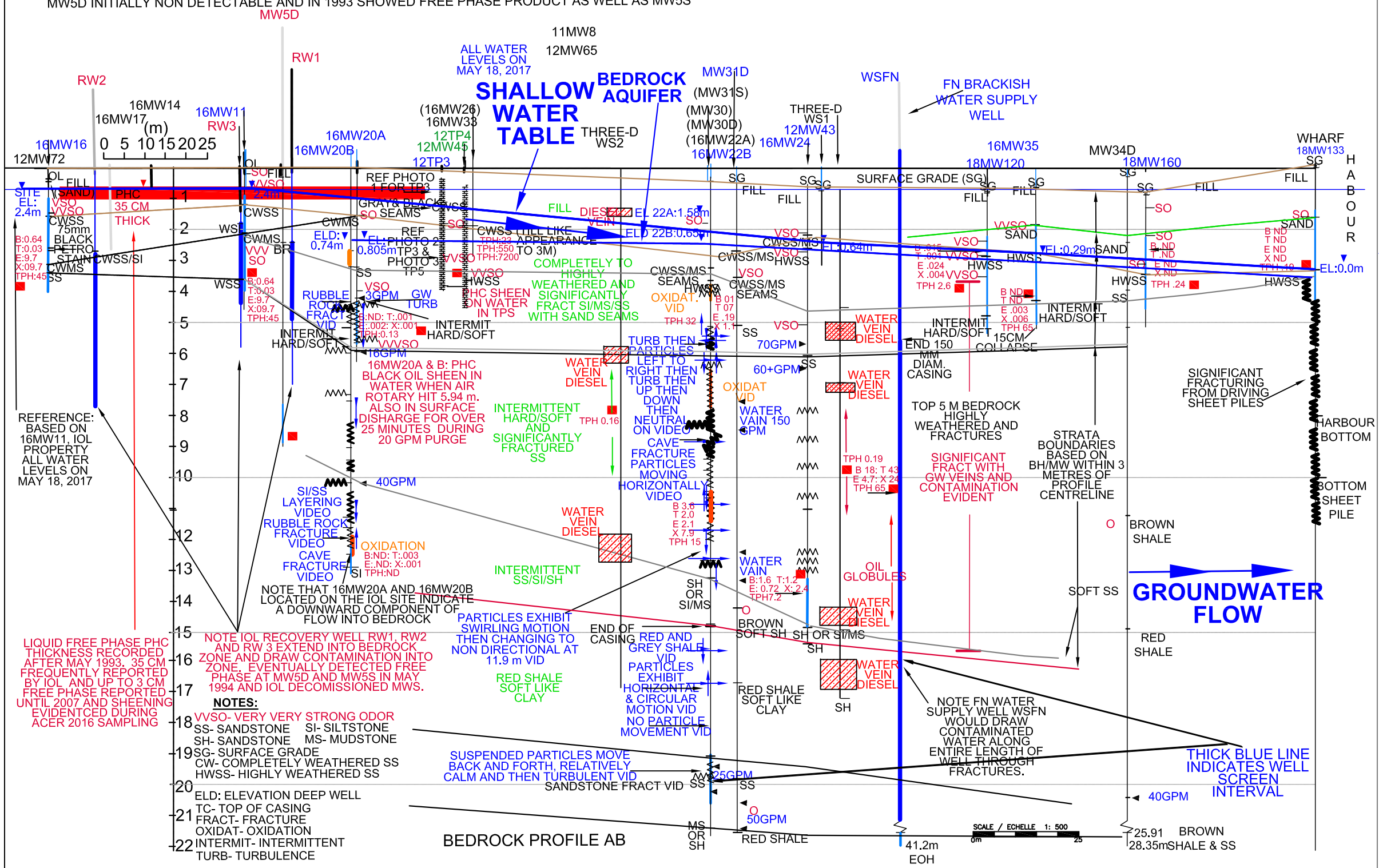
PHASE II & III ENVIRONMENTAL SITE ASSESSMENT
MEL, FN, EFL SHIPPAGAN, NB

FILE NAME: Fig 3-1 Samp Locat Pln	JOB NO.: CBT 60-1	MADE: GP	CHKD: GP	DATE: Jan 29, 2020

FIGURE 3-1

SAMPLE LOCATION PLAN OF STUDY AREA
(BLOW UP DRAWING IN APPENDIX 70)

IOL RECOVERY WELLS RW1 AND RW2 GREATER THAN 25 AND 50 M FROM RW3. RW1 RW2, RW3 AND MW5D FOR IOL SHOWN TO REFLECT DRAW DOWN ZONES FOR CONTAMINATION INTO BEDROCK. MW5D INITIALLY NON DETECTABLE AND IN 1993 SHOWED FREE PHASE PRODUCT AS WELL AS MW5S



LEGEND

PUMPING WELLS SHOWN WITH LIGHT BLUE EXTENSION LINES. IOL REMEDIAL PUMPING WELLS RW1, RW2, RW3. WSFN FOOD GRADE WATER SUPPLY WELL FOR FN. WS1 AND WS2 FOOD GRADE WELLS FOR MEL.

STEEL WELL CASING IN DARK BLUE

WELL SCREEN DASHED BLUE LINE

HORIZONTAL AND VERTICAL FRACTURES. LARGE FRACTURES SHOWN IN BOLD

GROUNDWATER MOVEMENT OBSERVED IN WELL

GROUNDWATER MOVEMENT OBSERVED IN WELL DOMINATE FLOW

GROUNDWATER FLOW DIRECTION

PETROLEUM HYDROCARBON LAYER THICKNESS

PHC	PETROLEUM HYDROCARBON
SG	SURFACE GRADE
SS	SAND STONE
SI	SILTSTONE
SH	SHALE
GW	GROUNDWATER
VVSO	VERY VERY STRONG PETROLEUM HYDROCARBON ODOR
B	BENZENE
T	TOLUENE
E	ETHYLBENZENE
X	XYLENE
TPH	TOTAL PETROLEUM HYDROCARBONS

TRACE OVERLAY OF IRVING OIL LIMITED SITE PLAN FOR AS BUILT REMEDIATION SYTEM AND FORMER RAIL LOADING RACK SHOWN IN IN BLUE. REFERENCE: CAMPBELL, OCTOBER 30, 1992, INTER-OFFICE MEMO.

Some BHs/MWs and Feature locations approximate.BH/MW locations extrapolated from ASPEN, MARCH 2000, AMEC, 2001 and ARC documents, and railway siding features from Cambell, 1992.

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ACER Environmental Services (2015) Ltd.

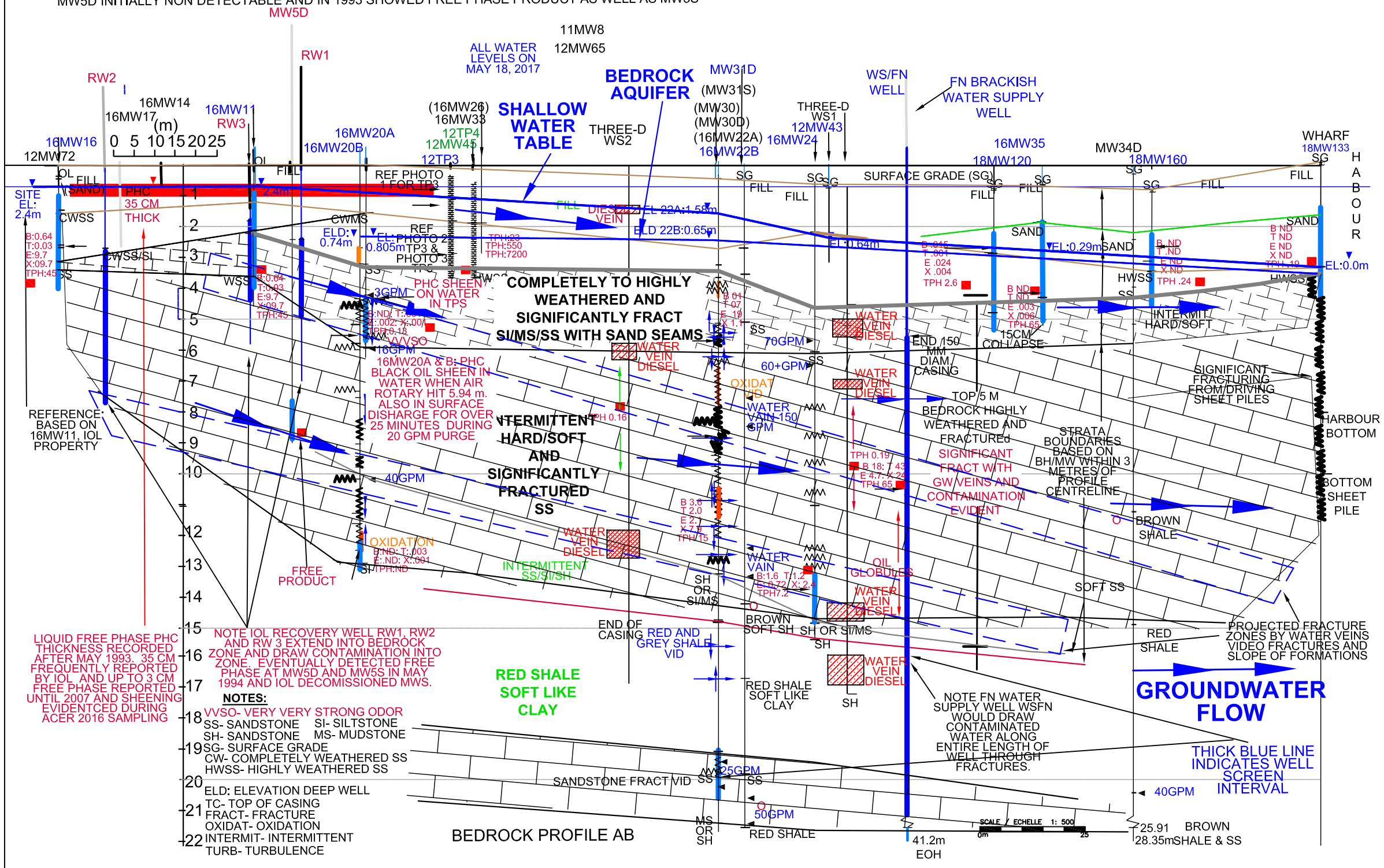
PHASE II & III ENVIRONMENTAL SITE ASSESSMENT
MEL, FN, EFL SHIPPAGAN, NB

FIGURE 3-2

OVERBURDEN AND BEDROCK PROFILE WITH GROUNDWATER LEVELS & FLOW MID TIDE LEVEL AND GROUNDWATER CONTAMINATION

FILE NAME: Fig 3-2 Sol Bed Rck Profile	JOB NO.: CBT 60-1	MADE: GP	CHKD: GP	DATE: Dec 5, 2019

IOL RECOVERY WELLS RW1 AND RW2 GREATER THAN 25 AND 50 M FROM RW3. RW1 RW2, RW3 AND MW5D FOR IOL SHOWN TO REFLECT DRAW DOWN ZONES FOR CONTAMINATION INTO BEDROCK. MW5D INITIALLY NON DETECTABLE AND IN 1993 SHOWED FREE PHASE PRODUCT AS WELL AS MW5S



LEGEND

PUMPING WELLS SHOWN WITH LIGHT BLUE EXTENSION LINES. IOL REMEDIAL PUMPING WELLS RW1, RW2, RW3. WSFN FOOD GRADE WATER SUPPLY WELL FOR FN. WS1 AND WS2 FOOD GRADE WELLS FOR MEL.

STEEL WELL CASING IN DARK BLUE

WELL SCREEN DASHED BLUE LINE

HORIZONTAL AND VERTICAL FRACTURES. LARGE FRACTURES SHOWN IN BOLD

GROUNDWATER MOVEMENT OBSERVED IN WELL

GROUNDWATER MOVEMENT OBSERVED IN WELL DOMINATE FLOW

GROUNDWATER FLOW DIRECTION

PETROLEUM HYDROCARBON LAYER THICKNESS

PHC	PETROLEUM HYDROCARBON
SG	SURFACE GRADE
SS	SAND STONE
SI	SILTSTONE
SH	SHALE
GW	GROUNDWATER
VVSO	VERY VERY STRONG PETROLEUM HYDROCARBON ODOR
B	BENZENE
T	TOLUENE
E	ETHYLBENZENE
X	XYLENE
TPH	TOTAL PETROLEUM HYDROCARBONS

PROBABLE GROUNDWATER FLOW DIRECTION FOR SHALLOW AQUIFER

TRACE OVERLAY OF IRVING OIL LIMITED SITE PLAN FOR AS BUILT REMEDIATION SYTEM AND FORMER RAIL LOADING RACK SHOWN IN IN BLUE. REFERENCE: CAMPBELL, OCTOBER 30, 1992, INTER-OFFICE MEMO.

Some BHs/MWs and Feature locations approximate.BH/MW locations extrapolated from ASPEN, MARCH 2000, AMEC, 2001 and ARC documents, and railway siding features from Cambell, 1992.

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ACER Environmental Services (2015) Ltd.

PHASE II & III ENVIRONMENTAL SITE ASSESSMENT
FN PECHERIES LTD, SHIPPAGAN, NB.

FIGURE 3-3

BEDROCK FRACTURE ZONES AND GROUNDWATER LEVELS & FLOW FOR MID TIDE EVENT AND GROUNDWATER CONTAMINATION

FILE NAME: Fig 3-3 Bed Rck Frac Zons	JOB NO.: CBT 60-1	MADE: GP	CHKD: GP	DATE: Dec 5, 2019

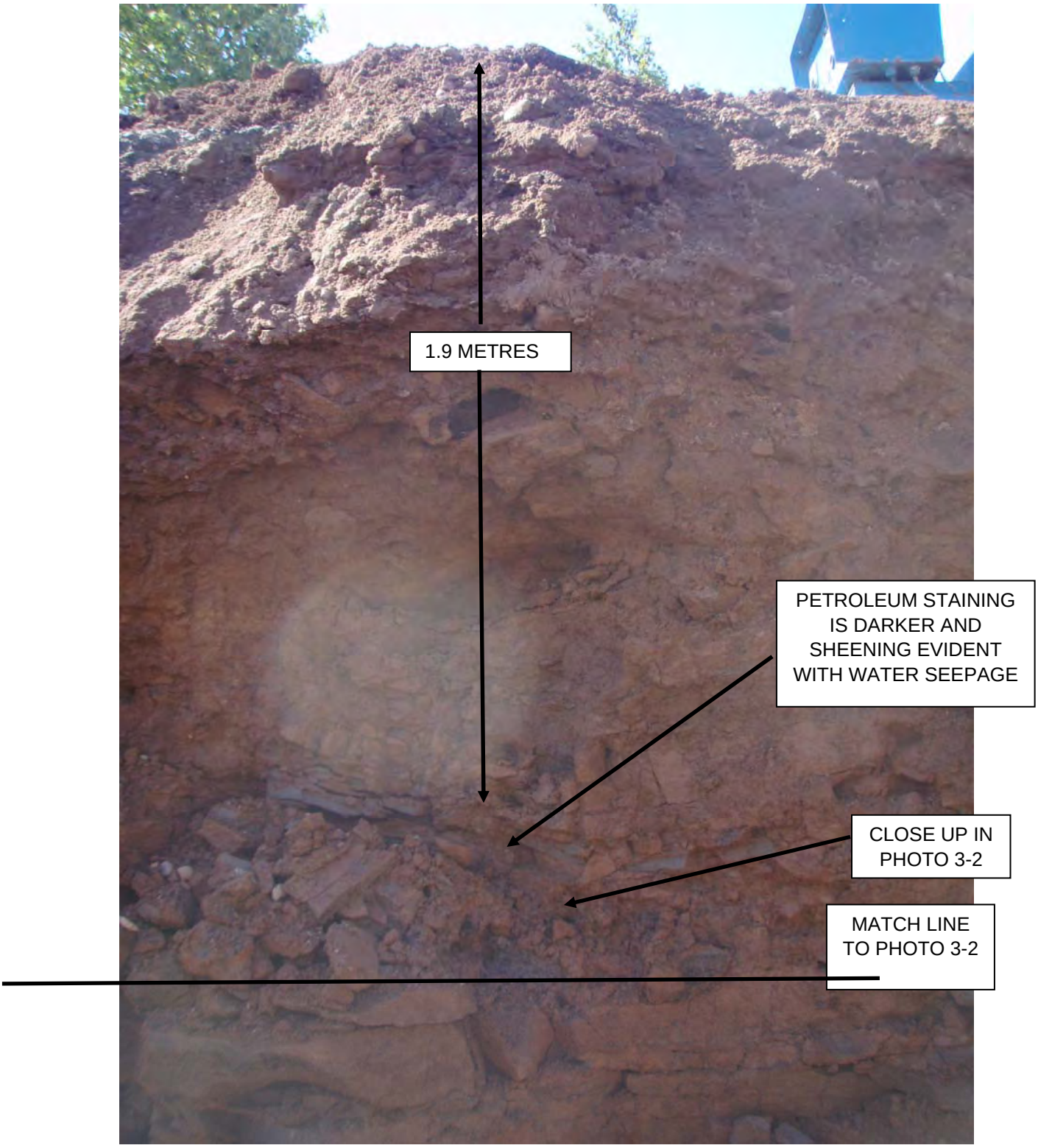


Photo 3-1 at TP3 showing upper 6 feet of test pit profile. See photo 2 for bottom 6 feet with match line.

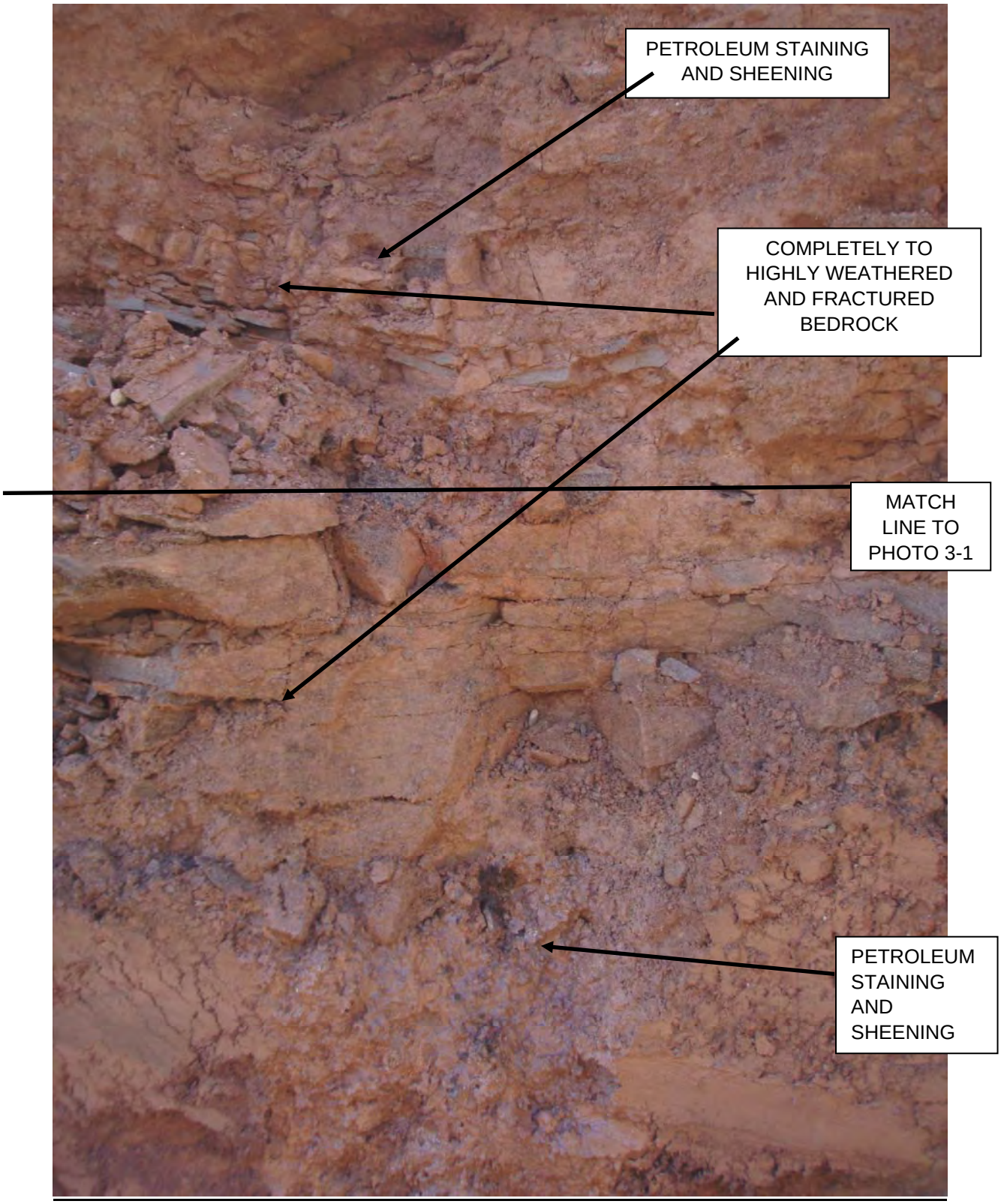


Photo 3-2 at TP 3 at back end of MEL property near 14th St showing bottom 6 feet of profile. Upper zone of bedrock fracturing. Petroleum sheening evident.

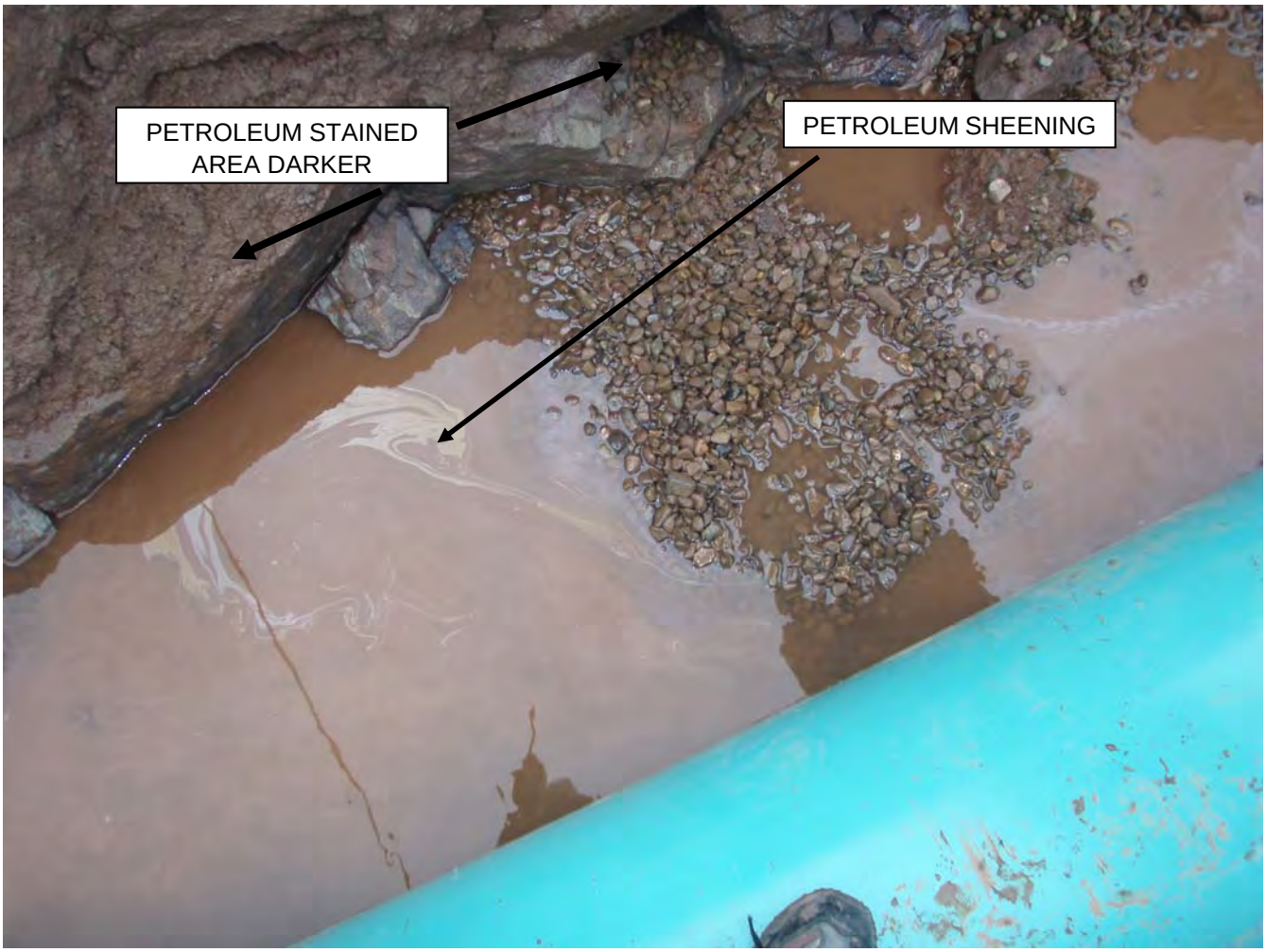


Photo 3-3 showing petroleum sheening in groundwater at TP 3 at back end of MEL property near 14th St where petroleum sheening was evident in seepage on the wall of the excavation (see Photo 3-2).

Photo 3-4 Bedrock with interbedding layers with mudstone/siltstone.

Photo 3-5 Showing highly fractured bedrock.

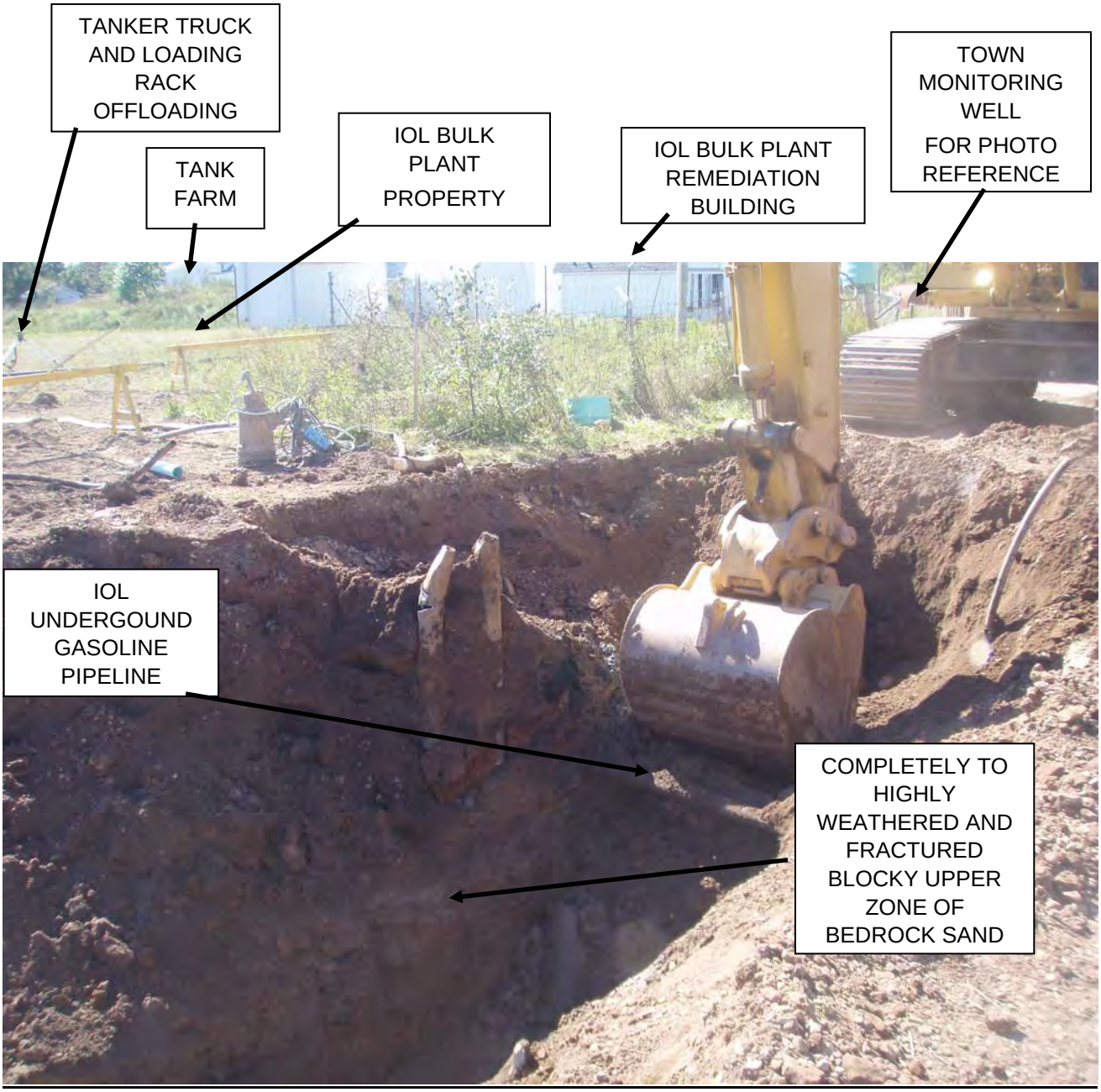


Photo 3-6 Looking towards IOL site from west side of FN/MEL. Bedrock fracturing and horizontal layering shown is typical.

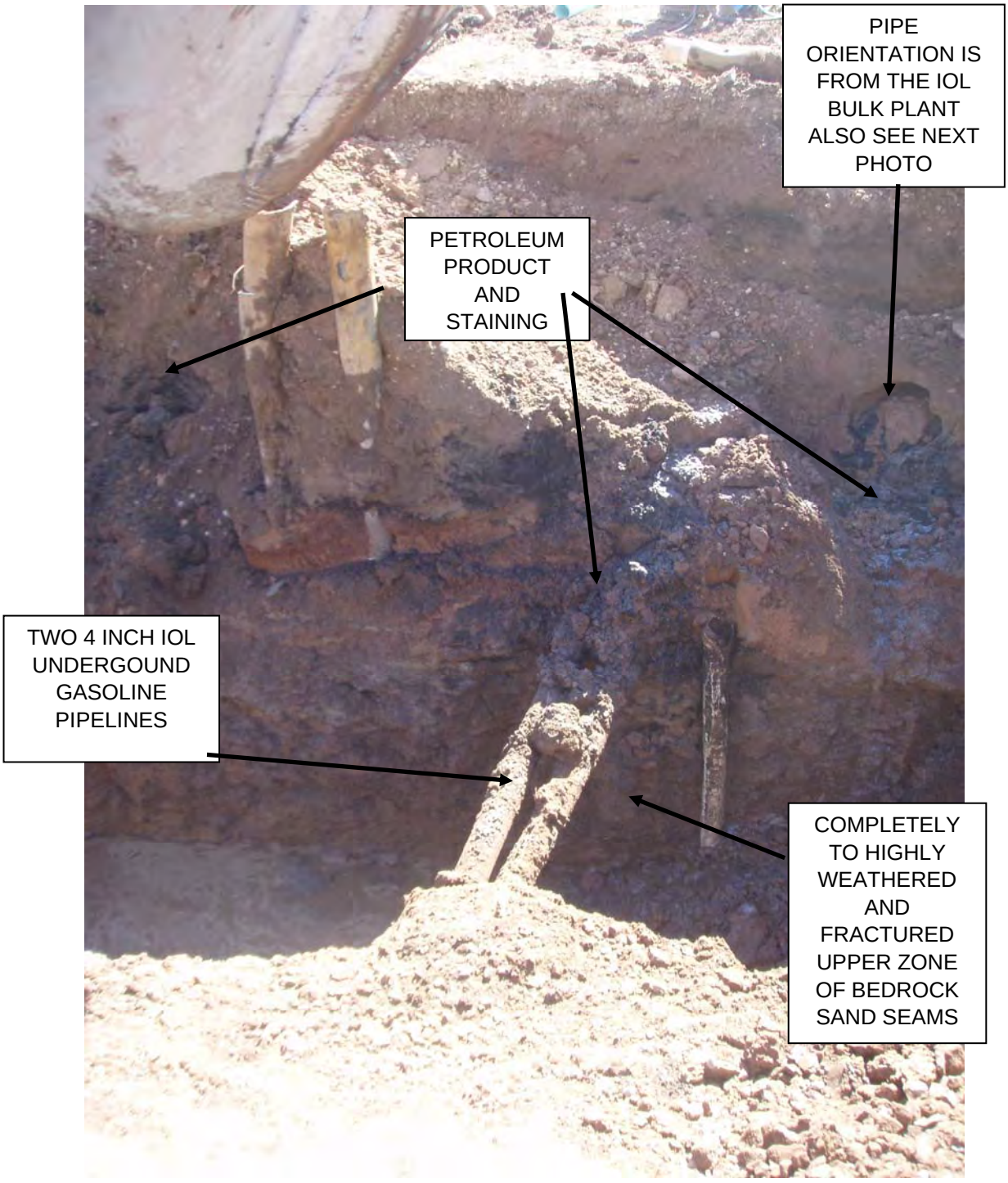


Photo 3-7 Also refer to Photos 3-6 and 3-8. IOL underground gasoline transfer lines. The orientation of the 8 inch pipe with petroleum sludge discharge appears to be from the IOL bulk plant property based on orientation of pipe.

Photo 3-8 Close up shot of petroleum staining for conduit having an orientation that indicates the pipe to be from the IOL bulk plant property. Photos 3-6 and 3-7 shows relative location of pipe with the IOL buildings apparent and Town well noted “for “ reference on photos.

Photo 3-9 This is a photo underneath one of the IOL 4 inch underground gasoline transfer lines showing petroleum product and staining. Location shown in previous photos. Photos 3- 6 and 3-7 shows relative location of pipe with the IOL buildings apparent and Town well noted “for “ reference on photos.

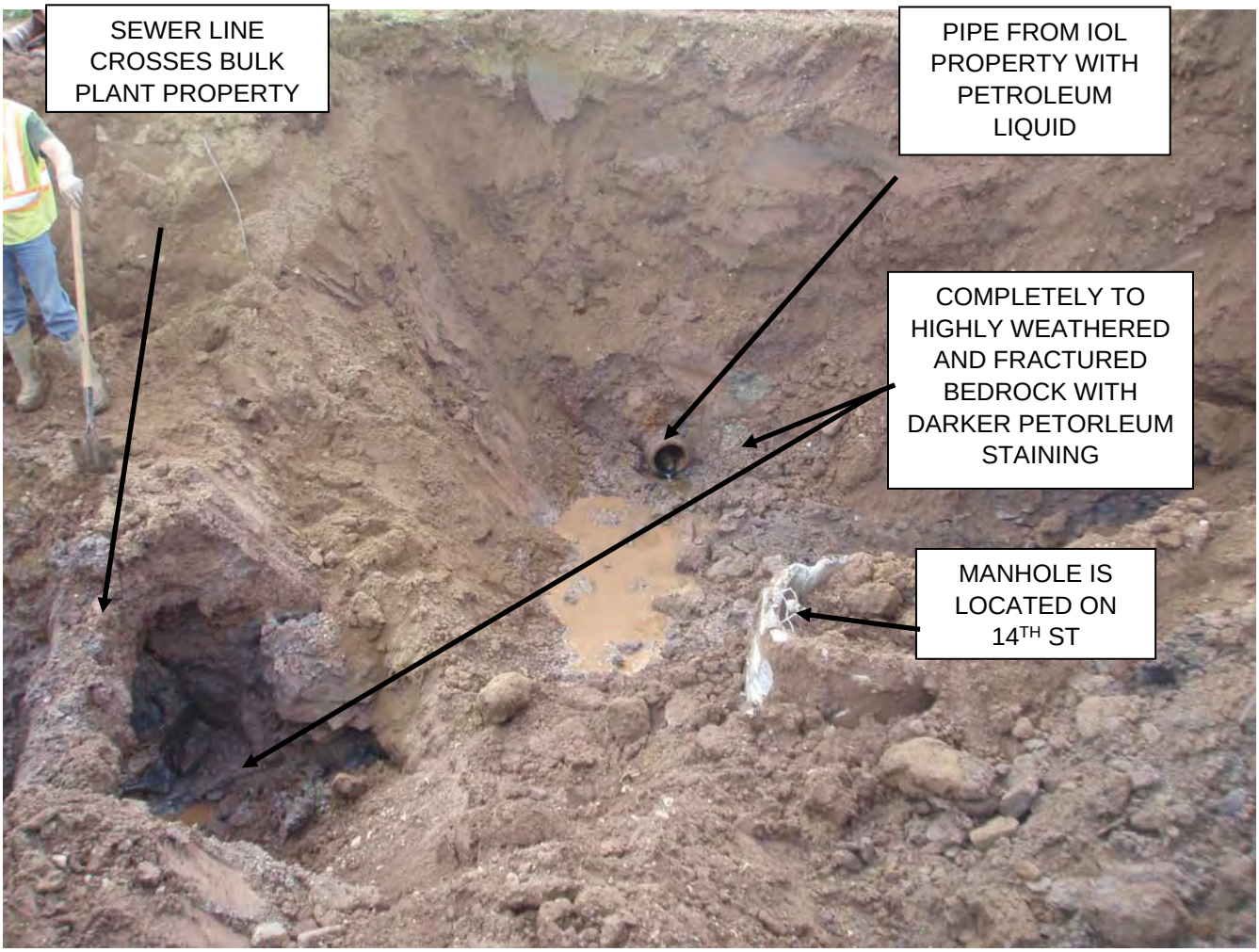


Photo 3-10. Underground sewer line at the boundary of IOL bulk plant and 14th street. Original sewer line located on the bulk plant property and parallel to the east side of the IOL bulk plant. IOL would not allow the line to be upgraded and Town had to do a build around. A four inch pipe was also encountered at the IOL bulk plant property boundary, with petroleum contaminated liquid being emitted.

Photo 3-11. Underground sewer line at the boundary of IOL bulk plant and 14th street. Manhole location upgrades reference location to IOL bulk plant. Also see Photos 3-10, 3-12, 3-13 and 3-14.

Photo 3-12. See Photo 3-12 for reference location. Underground sewer line at the boundary of IOL bulk plant and 14th street with new manhole installed. Grey area at water line showing petroleum staining. Also see Photos 3-10, 3-11, 3-13 and 3-14.

Photo 3-13. Close up of petroleum staining at water line shown in Photo 3-12. See Photos 3-11 and 3-12 for reference location. Underground sewer line at the boundary of IOL bulk plant and 14th street with new manhole installed. Darker grey area at water line showing petroleum staining. Also see Photos 3-10 and 3-14.

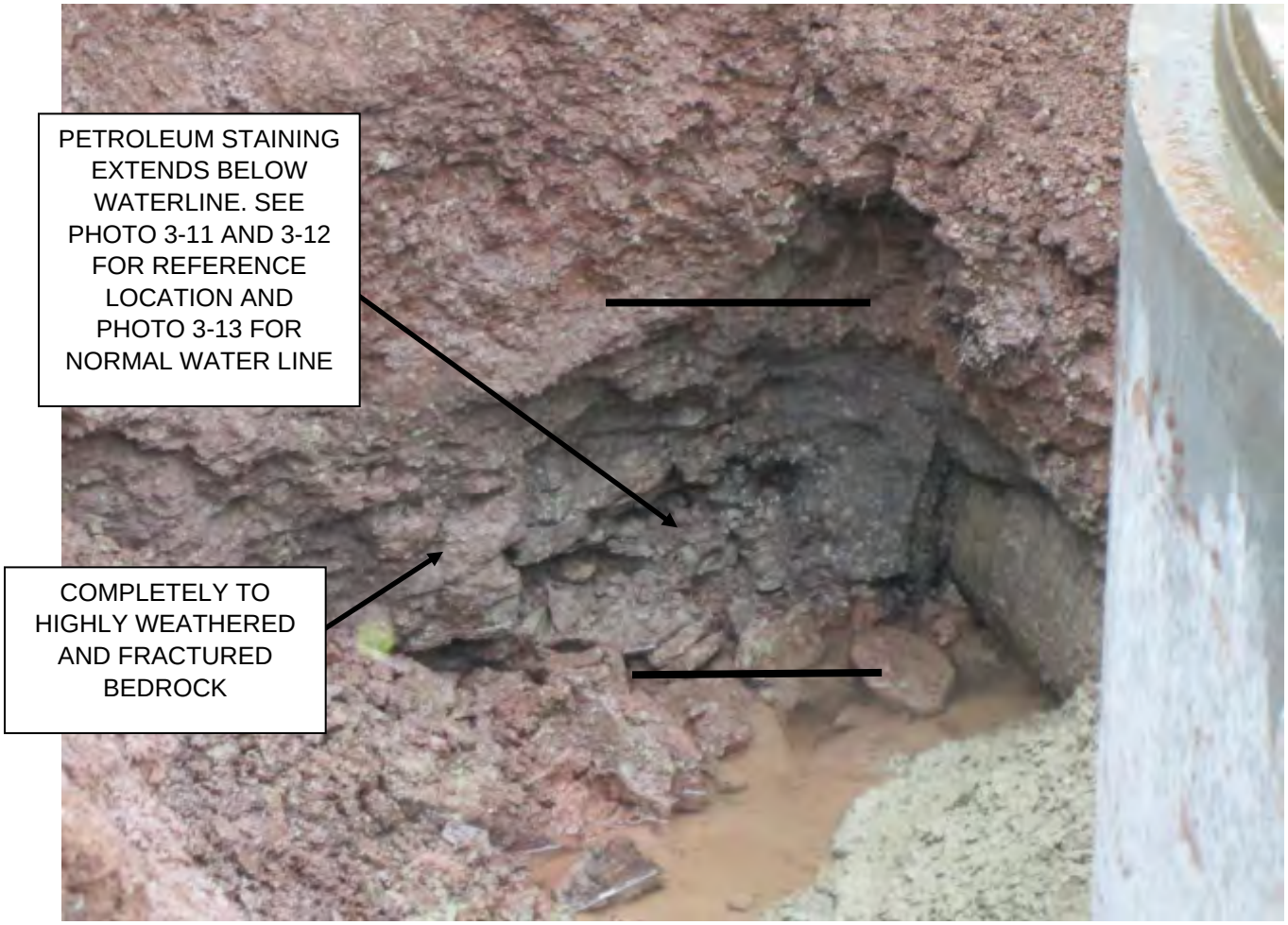


Photo 3-14. Demonstration of preferential flow pathway associated with extensive network of underground services and highly fractured bedrock conditions. Close up of petroleum staining at water line FOR shown in Photo 3-12. See Photos 3-11 and 3-12 for reference location. Underground sewer line at the boundary of IOL bulk plant and 14th street with new manhole installed. Darker grey area at water line showing petroleum staining as a result of contaminate migration associated with groundwater flow along underground services. Also see Photos 3-10 and 3-14.

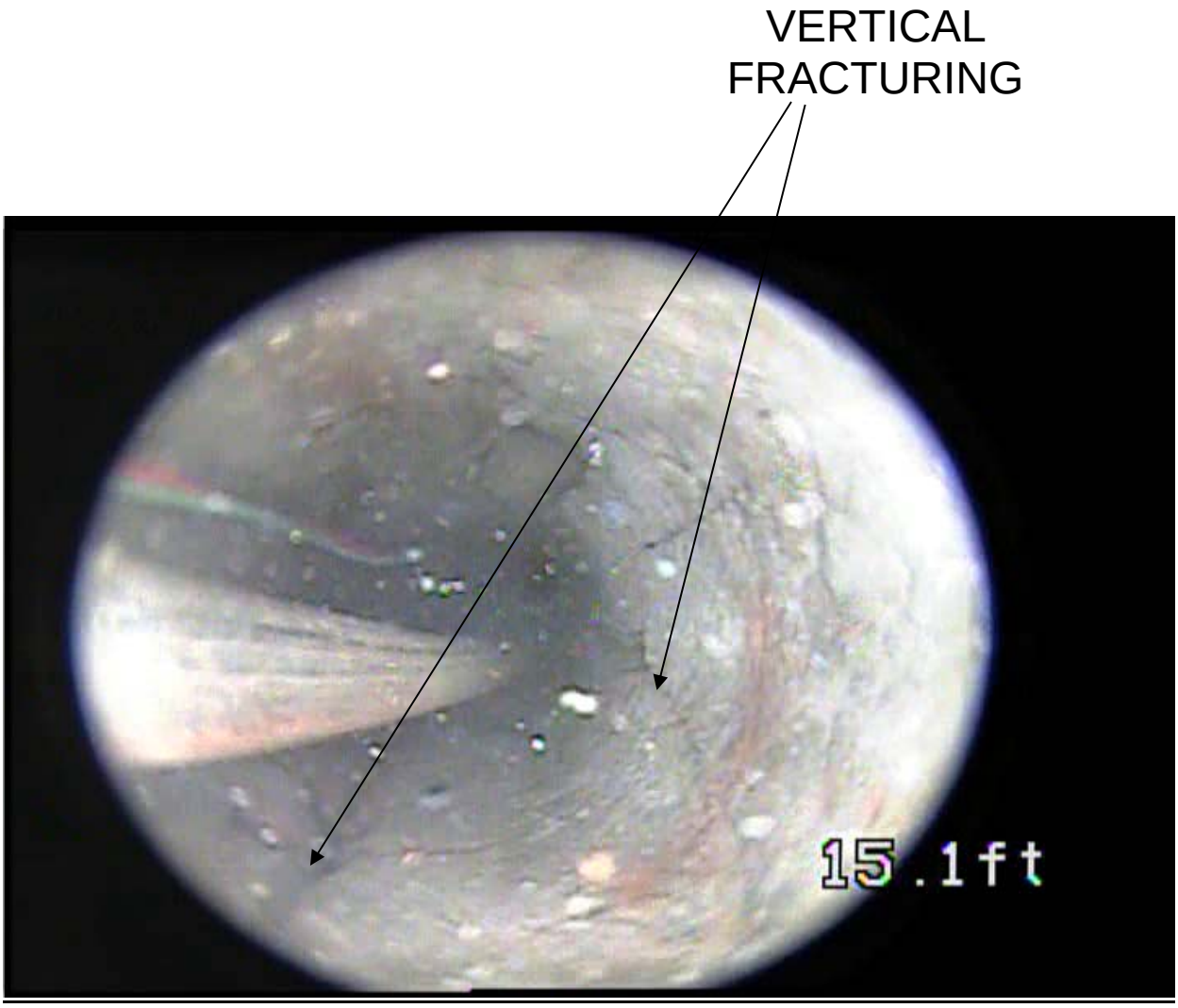


Photo 3-15 Of Photo group 3-15 to 3-18 for Video Snapshots showing major fracturing from 14 ft. to 19 ft. at 16MW20A. Well 16MW20A is located near IOL and 14th St. boundary. Photo also included in Appendix 72

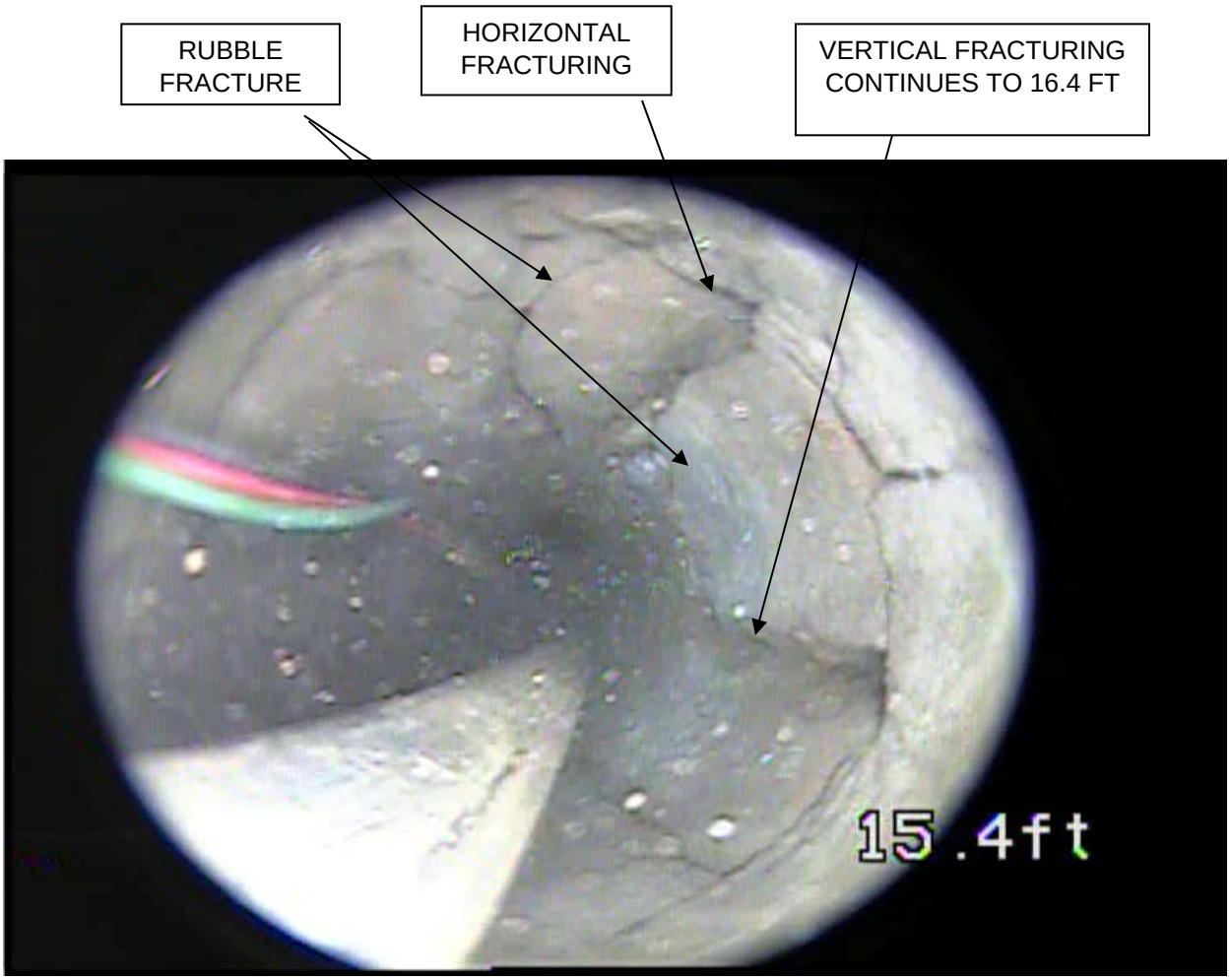


Photo 3-16 Of Photo group 3-15 to 3-18 for Video Snapshots showing major fracturing from 14 ft. to 19 ft. at 16MW20A. Well 16MW20A is located near IOL and 14th St. boundary. Photo also included in Appendix 72.

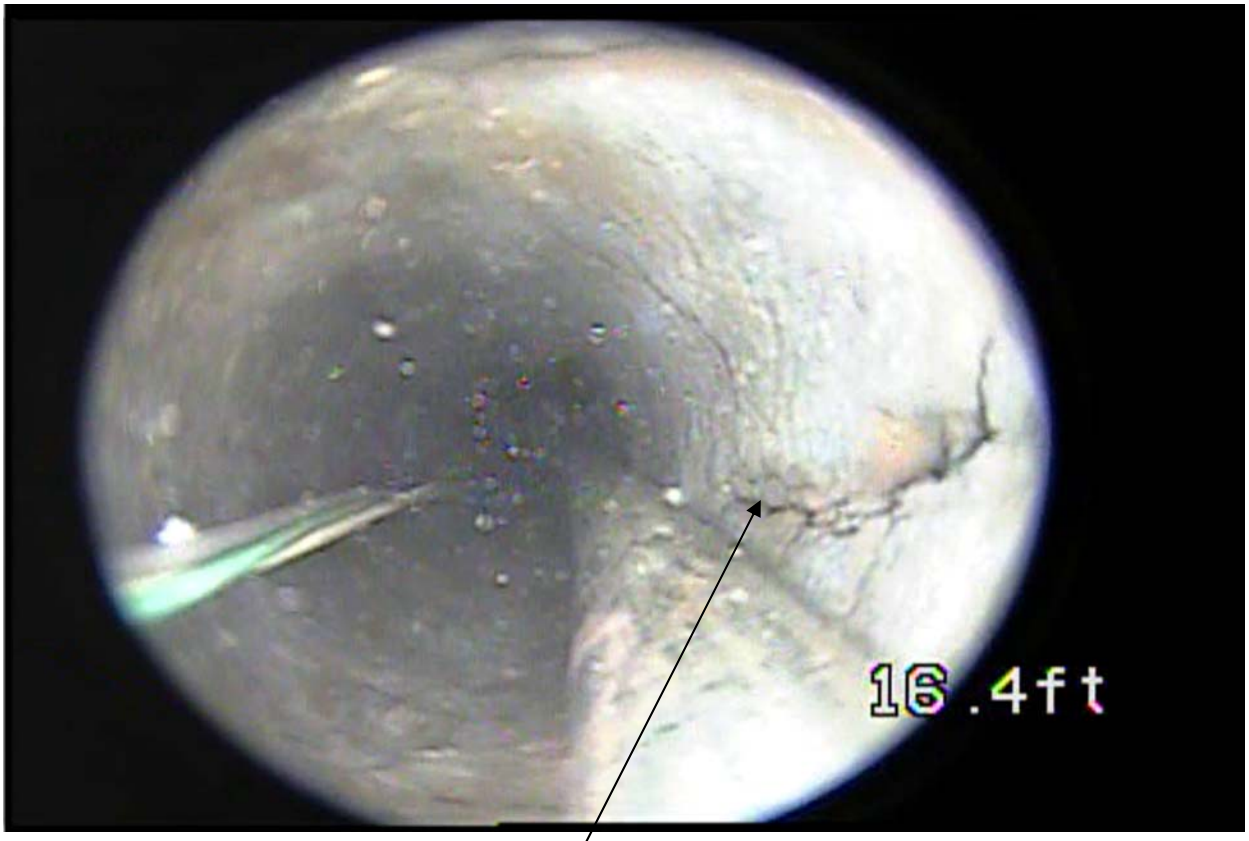


Photo 3-17 Of Photo group 3-15 to 3-18 for Video Snapshots showing major fracturing from 14 ft. to 19 ft. at 16MW20A. Well 16MW20A is located near IOL and 14th St. boundary. Photo also included in Appendix 72.

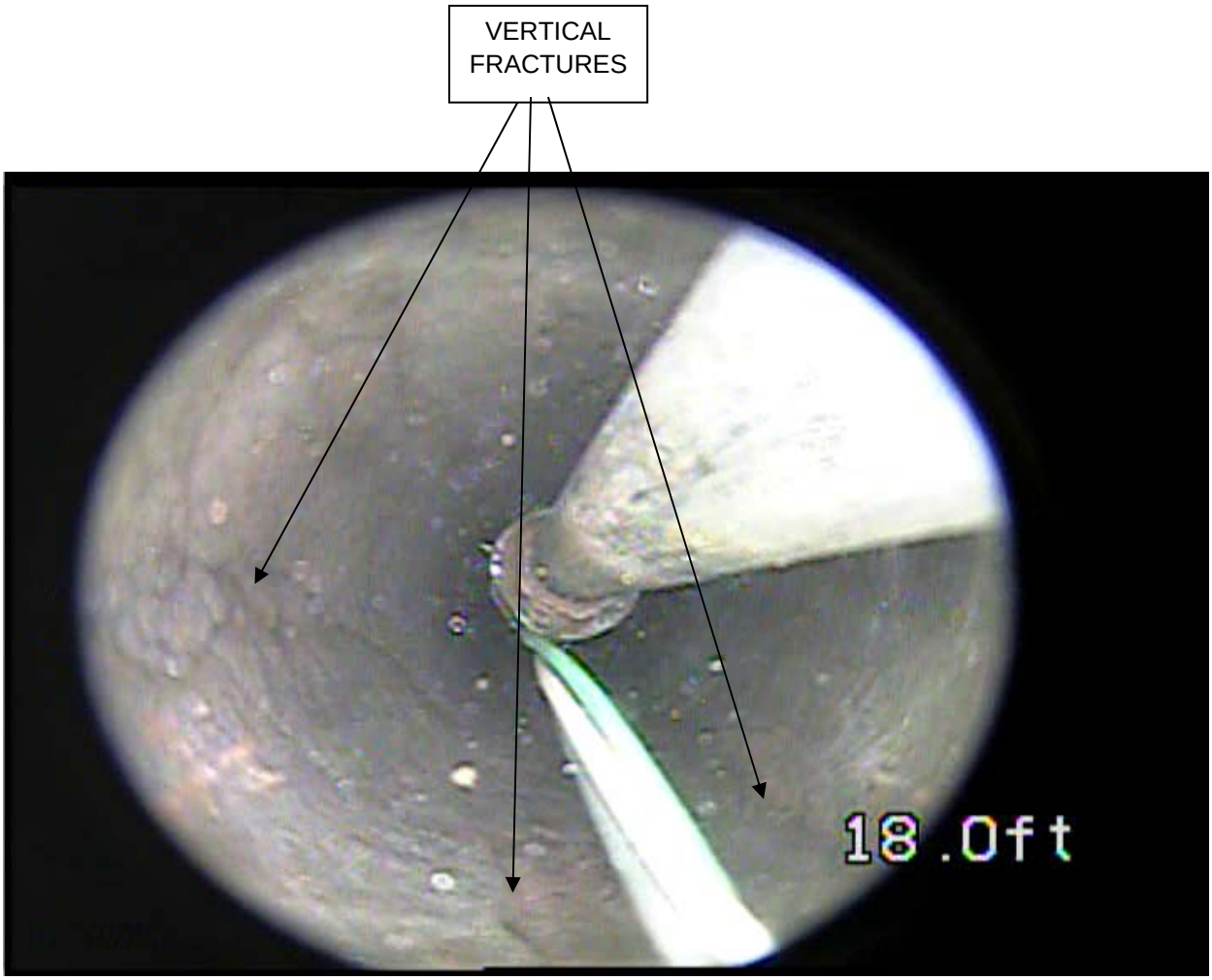


Photo 3-18 Of Photo group 3-15 to 3-18 for Video Snapshots showing major fracturing from 14 ft. to 19 ft. at 16MW20A. Well 16MW20A is located near IOL and 14th St. boundary. Photo also included in Appendix 72.

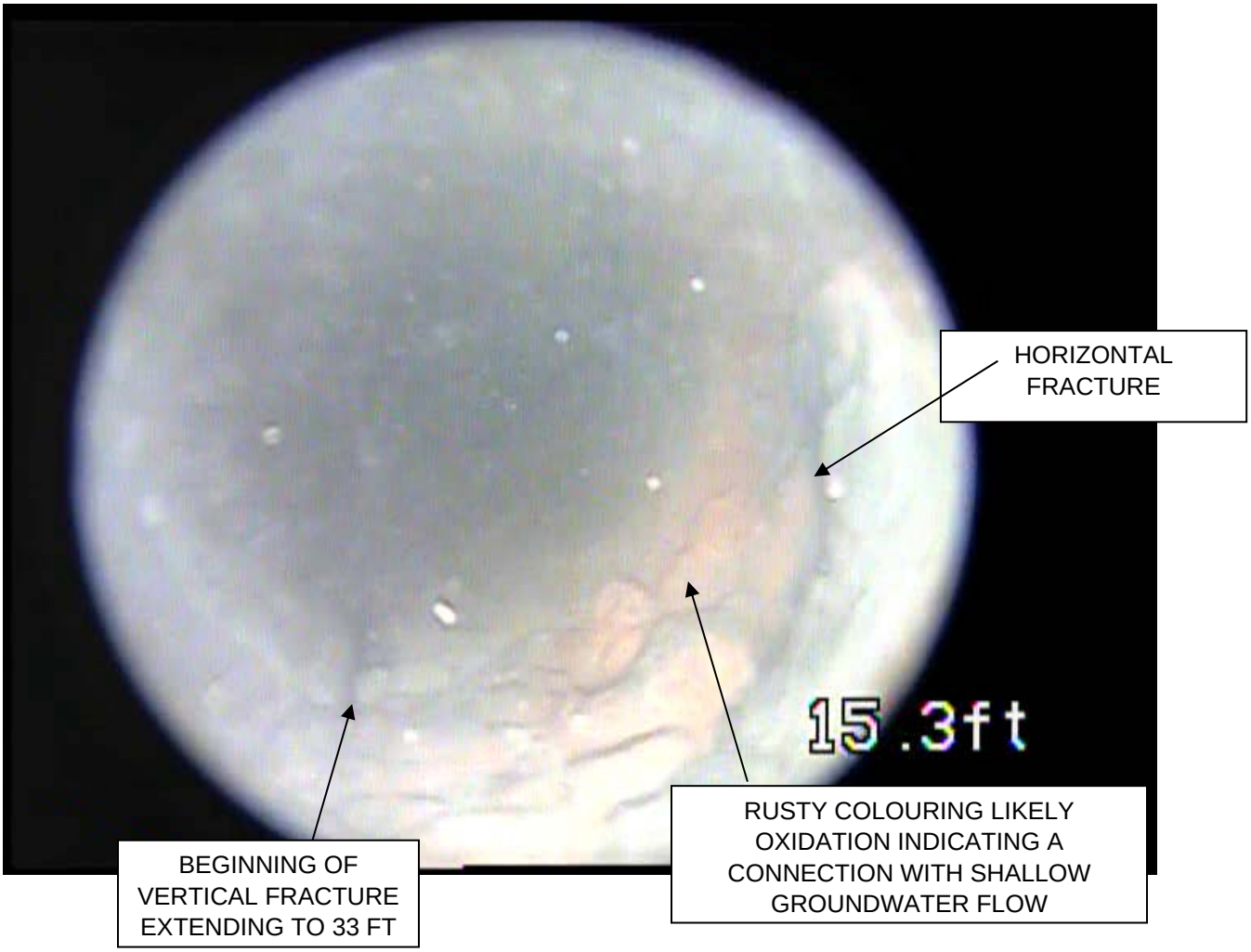


Photo 3-19 Of Photo group 3-19 to 3-22 for Video Snapshots showing major fracturing from 15.4 ft. to 33 ft. at 16MW22B. Well 16MW22B is located near the northeast corner of the MEL building about 150 metres from 16MW20 located on the IOL bulk plant property, in the direction of the wharf and several metres from the IOL underground gasoline transfer line and the FN water supply well that is constructed to 120 foot depth. Photo also included in Appendix 72.

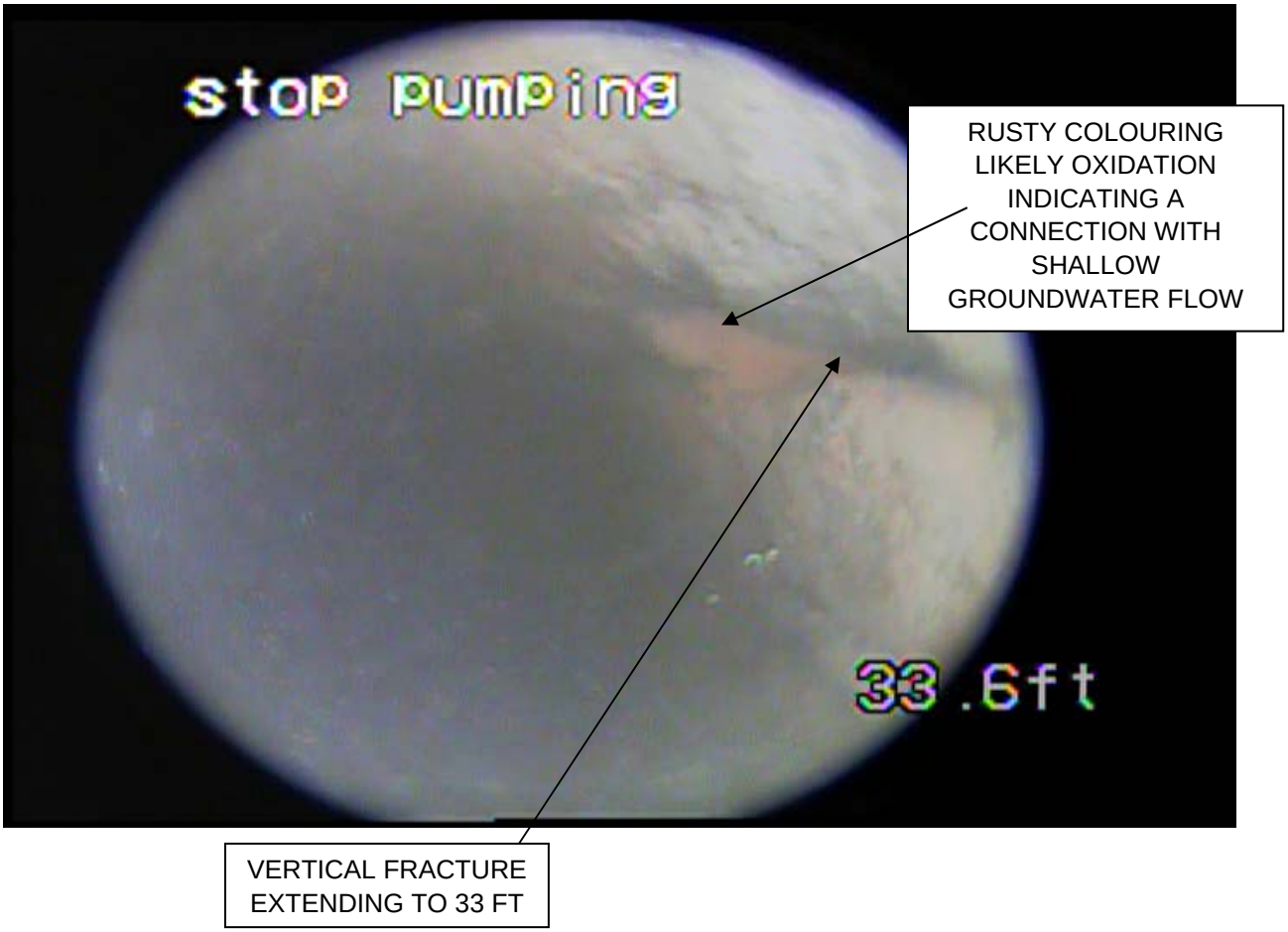


Photo 3-20 Of Photo group 3-19 to 3-22 for Video Snapshots showing major fracturing from 15.4 ft. to 33 ft. at 16MW22B. Well 16MW22B is located near the northeast corner of the MEL building about 150 metres from 16MW20 located on the IOL bulk plant property, in the direction of the wharf and several metres from the IOL underground gasoline transfer line and the FN water supply well that is constructed to 120 foot depth. Photo also included in Appendix 72.

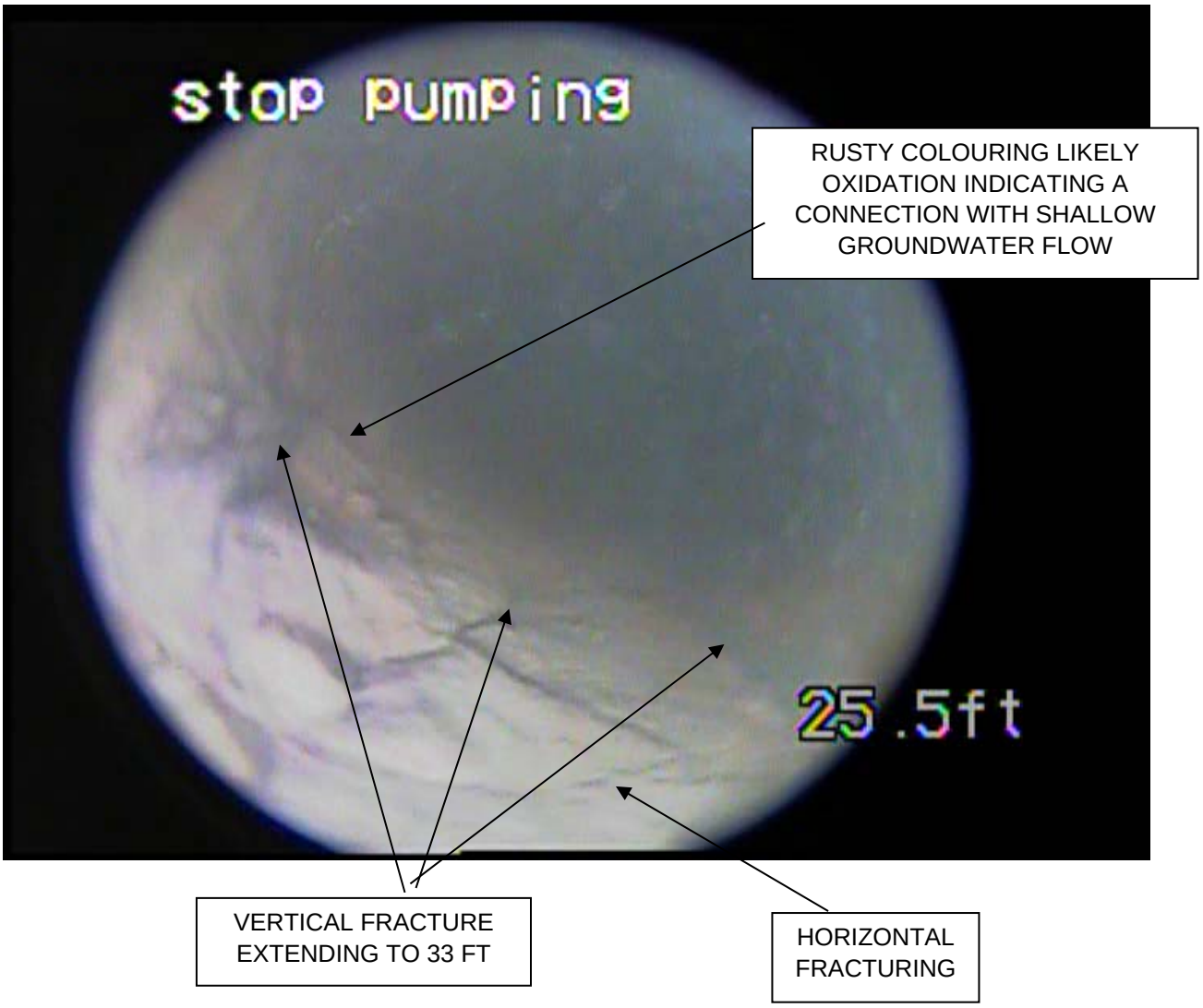


Photo 3-21 Of Photo group 3-19 to 3-22 for Video Snapshots showing major fracturing from 15.4 ft. to 33 ft. at 16MW22B. Well 16MW22B is located near the northeast corner of the MEL building about 150 metres from 16MW20 located on the IOL bulk plant property, in the direction of the wharf and several metres from the IOL underground gasoline transfer line and the FN water supply well that is constructed to 120 foot depth. Photo also included in Appendix 72.

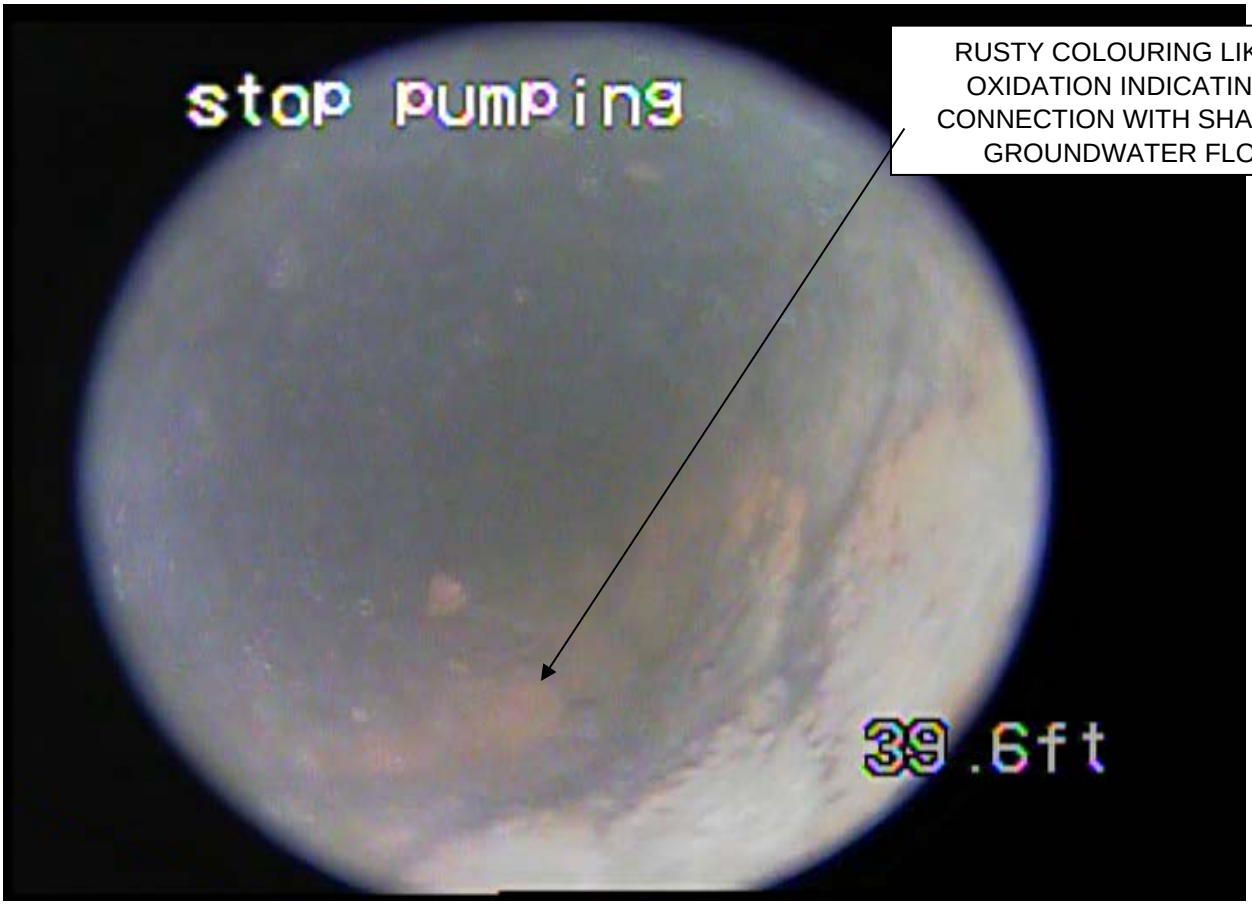


Photo 3-22 Of Photo group 3-19 to 3-22 for Video Snapshots showing major fracturing from 15.4 ft. to 33 ft. at 16MW22B. Well 16MW22B is located near the northeast corner of the MEL building about 150 metres from 16MW20 located on the IOL bulk plant property, in the direction of the wharf and several metres from the IOL underground gasoline transfer line and the FN water supply well that is constructed to 120 foot depth. Photo also included in Appendix 72.

In general, a layer of fill material consisting of brown sand and gravel with some silt and traces of clay was typically encountered at sample locations. This layer ranged from 1.2 to 2.5 metres below grade with the greater depths occurring in areas between the IOL bulk plant and the east end of the FN/MEL properties. The fill was underlain by a layer of sand with some silt over most of the area, except an area on the south west corner of the MEL property where a till layer of about 4 metres depth was evident. The sand/silt ranged in thickness from 0.15 to 1.8 m, normally 0.6 to 1.2 metres, was underlain by completely to highly weathered and fractured bedrock as indicated from the test pit findings.

For the IOL bulk plant, the fill layer in the driveway areas and office/trailer was underlain by the sand/silt layer normally 0.6 to 1.2 in thickness. The sand/silt was underlain by a completely to highly weathered and fractured sandstone in most areas with some areas showing a layer of completely weathered mudstone measuring up to 0.5 metres followed by the weathered/fractured sandstone. The weathered/fractured sandstone was typically 1.8 m below surface grade. For the eastern containment dike area, a 1.8 m layer of sand was shown for the tank pads that was directly underlain by completely to highly weathered and fractured sandstone. Based on survey measurements, there is only 0.3 metres of soil from surface grade to the bedrock for the spill/sump collection trench located in this containment area. For the western containment dike area, a 0.05 m layer of sand and gravel was shown for 16MW15 located adjacent to the eastern containment dike, with weathered/fractured sandstone directly below this layer. Other areas of the western containment dike showed 1.2 metres of sand and silt for former tank locations and sand and gravel for remaining areas, directly underlain by 1.2 m of weathered/fractured sandstone. This was followed by thin intermittent layers of completely weathered mudstone and sandstone.

For the FN/MEL, former CN ROW and SCH/DFO properties the sand/silt layer was normally 0.6 to 1.8 metres, with areas on the southerly side of the MEL property showing a till type material. The sand/silt and till type material was typically underlain by weathered/fractured sandstone, with some areas showing a thin layer of completely weathered mudstone or intermittent layers of completely/highly weathered mudstone/sandstone.

In general, the soil conditions under the FN and MEL buildings were similar to adjacent areas. The area under the footprint of the FN building indicated soils generally consisted of a 1.2 to 2 metre layer of fill, with fill being in the order of 3 metres for the eastern portion of the building. This was underlain by sand with some silt and traces of clay to a depth of about 3.6 metres where augering was discontinued due to cave in. Some wood debris and metal and cable material was found towards the east end of the building.

The area under the footprint of the MEL building consisted of a fill layer about 1.4 metres in thickness that was underlain by a sand with some silt and traces of clay and gravel. Completely to highly weathered sandstone was evidenced at a depth of about 2.4 metres based on material removed from the sample device and split spoon refusal.

Several definable zones of highly fractured bedrock were identified as indicated from downhole videos for monitoring well locations on the bulk plant and FN/MEL properties. Observations made from the videos are detailed in the borehole logs in Appendix 71 for 16MW20A and 16MW20B for the bulk plant site and 16MW22A and 16MW22B at a location on the northern edge of the MEL property. Key details are also provided on the soil and bedrock profiles presented on Figures 3-2 and 3-3. A video for the FN water supply well is provided in Appendix 32.

The bedrock fracture zones that dip downward between the IOL bulk plant and wharf are defined on Figure 3-3 in Appendix 72. A completely to highly weathered and fractured layer of sandstone ranging from about 1.3 m in thickness on the IOL property and decreasing to about 0.25 metres in the mid portion of the FN and MEL properties and then increasing to about 1.7 metres for the remainder of the distance to the wharf. This is followed by a zone of highly fractured bedrock measuring about 1.7 metres at the bulk plant then increasing to about three

metres in the middle portion of the FN and MEL properties and decreasing to 1.5 metres for the remainder of the distance to the wharf.

The bedrock underlying the completely to highly weathered and fractured layer of sandstone consists of a layer of sandstone that ranges from a depth of about 20 metres on the IOL bulk plant property at 16MW20A to 35 metres near the wharf, dipping down at an angle of about 4 percent. The surface of the bedrock dips down at an angle of about 1 degree for most of the transect, but with some areas indicating steeper angles in the order of 14 degrees evident on the east side of the bulk plant and CN ROW. The top 5 metres of the bedrock was highly weathered and significantly fractured. Fracturing was evidenced from downhole videos and the response of the drill rigs during drilling, as well as water yields observed during drilling.

Video stills showing the highly fractured bedrock are provided in Photos 3-15 to 3-18 (also in Appendix 72) for 16MW20A located on the IOL bulk plant property, and Photos 3-19 to 3-22 (also in Appendix 72) for 16MW22B located on the MEL property opposite the FN industrial/commercial water supply well. The downhole video stills show rubble/cobble and cave type fractures that are indicative of significant fracturing. It is also shown that vertical fractures are both large, with openings of several centimetres apparent, and can extend over several metres. Significant fractures are evident from the bedrock surface to 15 metres below the bedrock surface, with two zones having evidence of significant fractures as shown in Figure 3-3, also included in Appendix 72. The sandstone was underlain by soft shale with what appeared to be thin zones with sandstone fracturing.

It is noted that the surface of the bedrock and underlying bedrock zones show a downward dip between the IOL site and the wharf that would be expected to promote the movement of contamination toward the harbour as shown in Figure 3-3, also included in Appendix 72.

In general, the soil conditions under the FN and MEL buildings were similar to adjacent areas. The area under the footprint of the FN building indicated soils generally consisted of a 1.2 to 2 metre layer of fill, with fill being in the order of 3 metres for the eastern portion of the building. This was underlain by sand with some silt and traces of clay to a depth of about 3.6 metres where augering was discontinued due to cave in. Some wood debris and metal and cable material was found towards the east end of the building.

The area under the footprint of the MEL building consisted of a fill layer about 1.4 metres in thickness that was underlain by a sand with some silt and traces of clay and gravel. Completely to highly weathered sandstone was evidenced at a depth of about 2.4 metres based on material removed from the sample device and split spoon refusal.

3.2.2 Hydrogeology

The depth to the shallow groundwater and potentiometric surface for the shallow and deeper groundwater zones in the bedrock are shown on Figures 3-2 and 3-3 (also contained in Appendix 72) for a transect between the IOL bulk plant site and the edge of the wharf as shown on Figure 3-1 (also contained in Appendix 70). Monitoring by ACER indicated the depth to groundwater for wells located in the overburden and highly fractured bedrock transition zone to range from 0.08 to 2.7 metres. Most wells indicated depth to groundwater to be in the range of 1.2 to 2.3 metres with some MWs showing 0.5 to 0.7 m depth including the IOL bulk plant site, that were also noted to reduce to as little as 0.08 metres during wet/recharge periods such as rainfall events and spring snowmelt.

Monitoring carried out by Aspen Environmental Inc. (AEI) for the adjacent DFO and Department of Natural resources (DNRE) showed the depth to groundwater to range from 1.66 to 2.56 m below existing grade (AEI, August 2001). Section 3.1.3 of the Phase II report by ARC as A-332 in Appendix 22, (AG-438 better figures, Appendix 23), for the depth to groundwater it was indicated “Groundwater was normally encountered within 2.0 to

2.5 of ground surface" but in the borehole logs the depth to groundwater was reported to range from 1.4 to 2.3 metres with five MWs showing less than 2 m depth.

As indicated in Figure 3-3, also included in Appendix 72, the shallow groundwater flow system is located in the overburden and a completely to highly weathered layer of sandstone ranging from about 1.3 m in thickness on the IOL property and decreasing to about 0.25 metres in the mid portion of the FN and MEL properties and then increasing to about 1.7 metres for the remainder of the distance to the wharf. This is followed by a zone of highly fractured bedrock measuring about 1.7 metres at the bulk plant then increasing to about three metres in the middle portion of the FN and MEL properties and decreasing to 1.5 metres for the remainder of the distance to the wharf. The property is located in a tidal setting and groundwater levels were observed that demonstrated tidal loading effects are evident from the wharf to the western property boundary of the IOL bulk plant.

As indicated in Section 3.2.1, Geology, a number of observations were made regarding bedrock fracturing by way of a downhole video. At 16MW22B on the MEL property, the video imagery for the 3.35 to 6.5 m depth in bedrock (overburden soils to a depth of 3.2 m) indicated particle movement upward, horizontally, swirling and downward with some turbulent behaviour in a zone with significant vertical and horizontal fracturing shown. There also appeared to be oxidation on the rock surface that would indicate flow of oxygenated groundwater from near surface. Major vertical and horizontal fracturing, including "cave fractures" with horizontal flow indicated, and oxidation continued to be evident from the 7.2 to 13 m depth.

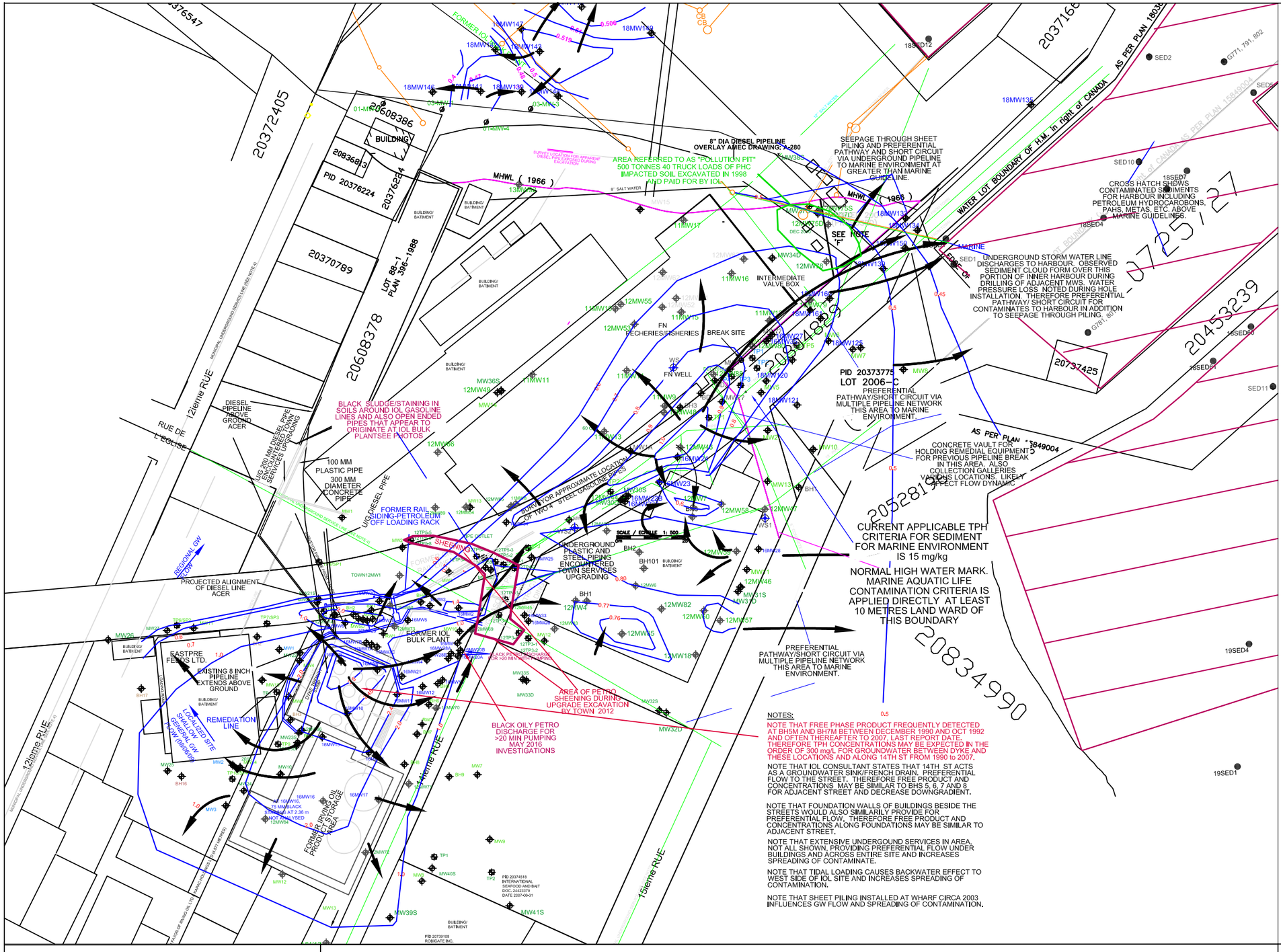
At 16MW20B (overburden soils to a depth of 2.5 m followed by completely to highly weathered and fractured bedrock) significant vertical and horizontal fracturing is evident, with "rubble fractures" shown. Black petroleum sheen discharged from this monitoring well when drilling at about 6 metre depth. Minor downward movement of particles evident. From 9.6 to 12.6 m downward movement of particles was very obvious, with a "cave fracture" shown at 12.3 m and there appeared to be oxidation on the rock surface.

Donald Gemmell of Three-D GeoConsultants Ltd. was on site for 2016 investigations on the IOL bulk plant and MEL/FN properties and observed (FN A-2719 in Appendix 4), that intra formational flow conditions evidenced for vertical fractures showed a connection of the lower zones with the upper contaminated zones, allowing for lower zones to be contaminated and facilitate spreading of contamination laterally and vertically.

Groundwater flow contours based on groundwater level measurements for wells that typically extended to a depth of 5 metres plus or minus, with a number of wells penetrating into the upper highly fractured bedrock zone, are shown in Figure 3-4 (also in Appendix 73) for a monitoring event on May 18, 2017 for a high tide event. However it is noted that the high tide in this instance only represented a lower range for the high tide cycle. The site tide elevation was 0.4 metres, noting that the normal tidal range is -0.5 m as low tide and 1.5 m as high tide, with mid tide being 0.5 m. Groundwater flow was somewhat variable across the properties, but with flow gradients favouring roadways with underground services including 14th St and the driveway and former railway tracks located between the FN and MEL properties.

For this event the flow contours show flow occurring from the IOL bulk plant property toward 14th St. and continuing into the driveway area between the FN and MEL properties and former CN ROW. Flow also occurs along the driveway between the FN and MEL properties that is in a landward direction from the DFO and FN property boundary that also splits north and south onto the FN and MEL properties, respectively.

The potentiometric water level for the shallow water table and bedrock aquifer is shown on Figures 3-3 and 3-4. With respect to the deeper groundwater aquifer(s), water veins were identified at depths of 19 and 21 metres



LEGEND

- ACER BHs/MWs IN GREEN TEXT FOR MW21 TO MW42 FOR JUNE, 2010, 11MW8 TO 11MW17 APRIL 2011, MW30 TO MW42 JULY 2011, 12MW1 TO 12MW92 IN 2012 AND 13MW93 IN 2013, 16MW1 TO 16MW35 2016, 18MW120 TO 18MW162 AND 19MW150 IN BLUE TEXT.
- WMS/ARC BHs/MWs IN LIGHT GREEN TEXT BEGINNING 1989 RELATED TO IOL BULK PLANT
- JWEL BHs/MWs IN BLUE TEXT THREE D GEOCONSULT. IN BROWN EASTPRE FEEDS 1996
- BHs/MWs BY OTHERS UNKNOWN IN BLACK TEXT
- EXISTING RECOVERY WELL (RW) LOCATION (ASPEN, MARCH 2000)
- FN PECHERIES WATER SUPPLY (WS) WELL
- TEST PIT LOCATION IN BLUE TEXT BY JWEL 1995 DFO/DNR PROPERTY
- WMS/ARC TEST PITS IN LIGHT GREEN TEXT BEGINNING IN 1989 RELATED TO IOL BULK PLANT
- TEST PIT LOCATIONS IN GREEN TEXT BY ACER, SEPT, 2010
- 3.2 TPH CONCENTRATION CONTOUR

16MW12 Sample ID
23000 F G Analysis Resembles Gas, Diesel, Fuel oil, Lube oil
Depth (m) Depth (m)

RBCA CRITERIA GROUNDWATER			
RES. SITE POTABLE COARSE SOIL			AQUATIC LIFE
Publication year		1999, 2003 2012, 2015	2015
TPH	Total Petroleum Hydrocarbons	4.4 mg/L [1] 3.2 mg/L [2] 7.8 mg/L [3]	1.5 mg/L [1] 0.1 mg/L [2] 0.1 mg/L [3]
Note: Gasoline, fuel oil and lube oil present at site			

1 Guideline for Gasoline (G)
2 Guideline for Diesel (D), Fuel oil (F) is APPLICABLE
3 Guideline for Lube Oil (L)

NOT SAMPLED ns
NOT DETECTED nd

NOTE: nd INDICATES BELOW REPORTING LIMIT

PROBABLE GROUNDWATER FLOW DIRECTION FOR SHALLOW AQUIFER

TRACE OVERLAY OF IRVING OIL LIMITED SITE PLAN FOR AS BUILT REMEDIATION SYTEM AND FORMER RAIL LOADING RACK SHOWN IN IN BLUE. REFERENCE: CAMPBELL, OCTOBER 30, 1992, INTER-OFFICE MEMO.

Some BHs/MWs and Feature locations approximate.BH/MW locations extrapolated from ASPEN, MARCH 2000, AMEC, 2001 and ARC documents, and railway siding features from Cambell, 1992.

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ACER Environmental Services (2015) Ltd.

PHASE II & III ENVIRONMENTAL SITE ASSESSMENT
MEL, FN, EFL SHIPPAGAN, NB

FIGURE 3-4

GROUNDWATER FLOW MID TIDE LEVEL MAY 18, 2017

FILE NAME: Nov 1 Fg GW Flo Dir R2 May 18 2018 v2	JOB NO.: CBI 60-1	MADE: GP	CHKD: GP	DATE: Jan 29, 2020

below surface grade in the deeper bedrock groundwater aquifer system. Both brackish and freshwater veins were identified in the deeper bedrock. Water level measurements for shallow and deep wells indicated a downward gradient of flow. Water level measurements for the shallow 16MW20A and deep 16MW20B monitoring wells on the IOL bulk plant site, indicated a downward flow gradient for a monitoring event on May 18, 2017 with groundwater elevations of 0.805 m and 0.74 m, respectively. For the FN/MEL properties, the mid depth well 16MW22A (screened 9.5 m to 10.8 m) and deep 16MW22B (screened from 18 m to 20 m) bedrock monitoring wells also indicated a downward flow gradient for the monitoring event on May 18, 2017, with groundwater elevations of 1.58 m and 0.65 m, respectively. Shallow monitoring wells in this area showed groundwater elevations of 1.06 m, 1.42 m and 0.85 m for 12MW43, 12MW44 and 12MW81, respectively.

It is also evident that draw down areas, also referred to as sinks, occur in several locations including the east end of the MEL property, the west side of the MEL building, the south east corner of the IOL bulk plant property (the IOL consultant ARC noted this as well), with a component also being toward the sink located at the west end of the MEL building. Flow in that direction is attributed to the driveway with underground services as well as the ditch located parallel to the driveway on the west end of the MEL property. There is also a component of flow evident from the south side of the MEL building toward the harbour in the direction of the boat unloading facilities. There is also a component of flow from the south west corner of the IOL tank farm toward an ARC monitoring well MW13 that ARC had identified as the location of a sink.

For a monitoring event carried out on July 18, 2019 with a tide elevation of 0.11 metres, versus 0.4 m for the aforementioned tide event, similar areas showed draw down behaviour, but for the area of 18MW121 and 18MW125 a water level elevation of (minus) - 0.28 metres was observed compared with the site general level of 0.6 m. This was more pronounced compared with the May 18, 2018 event, but noting that the tide level was transitioning from high to low and was also about 0.1 metres lower for the readings taken for this well. The draw down was not as evident during the May 19, 2017 event likely due to the higher tide level. This is an area that ARC also identified as being unusual in regards to groundwater flow behaviour as well as the area of MW13, near ACER well 12MW47 but also with 12MW59 being nearby that showed multi directional flow behaviour as well.

It was noted by ACER that on the south side of the MEL property that locations 12MW59, 12MW46 and 12MW57 showed multidirectional flow behaviour, attributed for the most part to 15th street and underground services but also due in part with the storm sewers also having a link to the wharf and probable leakage in and out of the pipes with tidal changes. During drilling of monitoring well 19MW150, located about 5 m from the corner of the wharf and adjacent to an underground storm discharge line, there was a loss of downhole water pressure at approximately 4 metres depth. Within several minutes, a cloud of dirty water was observed to be discharging from the storm line located at the corner of the wharf that spread across the inner harbour and persisted for several hours (see Photos in Appendix 100).

It is also noted that water flow occurs toward the boat storage area as well. The sinks noted for these monitoring events are suspected of being associated with pumping of lift stations by the Town with the reportedly poor integrity of the lines allowing contaminated groundwater to be “sucked in” to the lines. It is indicated from an incident in December 1997 that required a lift station located on 16th St, one street over from 14th St. for the IOL bulk plant, to be shut down **due to gasoline <u>infiltration into the sewer lines</u>** between 12th St and 15th St (FN A-1887 a in Appendix 64). Gaskets on the sewer line were reported to breakdown due to gasoline in the soils and groundwater in the area of 12th St to 15th St, with IOL bulk plant and underground petroleum transfer lines being located between these streets. The deteriorated lines would provide an opportunity for contaminated groundwater to be “sucked in” to the sewer lines. Based on concentrations, only a limited amount of product was removed from a manhole with pumping carried out over a 25 day period using a pump with a pump rate of 400 gallons per minute

that was operated 24 hours a day. This would indicate a significant draw by the system that could account for the "sink" locations observed.

Contaminated groundwater would tend to be drawn through the soils and fractured bedrock where these conditions exist. In addition, it would also contribute to the movement of contaminated groundwater from one area to another similar to a remedial well, thereby increasing the spreading of contamination.

Storm lines that discharge to the harbour would also be susceptible to deteriorating gaskets and provide an opportunity for contaminated groundwater to move more easily and faster to the marine receiving waters.

General regional flow is toward the harbour and subject to influences due to wharf and pipeline construction that likely provide for preferential flow along backfill areas containing granular type fill material.

3.3 Analytical Results

Although a number of the default criteria/conditions for application of select federal CCME and provincial RBCA guidelines are not met, CCME and RBCA are used for comparison/screening assessment purposes with pathway specific considerations applied and for consistency, given that CCME and RBCA criteria have been applied historically for assessment purposes by others on behalf of property owners in the study area.

It is also critical to recognize that the property boundary for the SCH property is defined by the 1966 Mean High Water Level (MHWL) as shown in the drawings. Therefore contamination that occurs on the SCH/DFO property in areas that are located between the property line and the current edge of the marine receiving waters, defined by the edge of the wharf structures, is actually occurring within the boundaries of the MHWL for the marine receiving waters. Not withstanding this and that contamination has been historically identified within 150 metres of receiving waters and therefore requires appropriate considerations in any assessment, but there are also multiple underground services including water supply, storm water, waste water and water supply lines that provide preferential pathways for migration of contaminants to the marine receiving environment.

The eastern edge of the FN Fisheries building extends across the MHWL with the MEL property being approximately 10 m from this boundary, being separated by 15th St. and the EFL property being located about 30 metres from FN. Therefore, direct application of the CCME marine guidelines to the assessment of soils in terms of leaching to groundwater, and groundwater criteria applied at the source property in consideration of the groundwater to surface water pathway and risks to the marine environment is considered an appropriate screening approach for the FN, MEL, EFL, SCH/DFO properties, former CN ROW/driveway with the two IOL underground gasoline transfer lines, former IOL CN rail tanker car petroleum offloading facility, IOL bulk plant, and other residential/commercial/institutional properties indicated to be contaminated. Further to the above, also of note is the provincial and federal guidelines that indicate the boundary for the marine aquatic assessment is to include **areas at least 10 m landward of the Ordinary High Water Mark**. Of further note is that if there are preferential pathways such as fractured rock and tidal influences that also includes underground services, the guidelines should be applied at source areas (see Section 2.0 for details).

As indicated, the additional investigations carried out by ACER in 2016, (internal record Affidavit A-1877 for reference purposes but not included in an appendix in this report) included additional intrusive investigations to further assess conditions near the DFO/SCH property boundaries with FN and MEL. A cross section of the overburden and bedrock conditions is provided in Figure 3-2, also included in Appendix 72. Photos taken during rehabilitation of underground services by the Town that show the overburden and bedrock conditions as well as petroleum sheening and staining in the soils and groundwater are provided in Photos 3-1 to 3-14 below (also included in Appendix 72). Several downhole video stills showing the extensive and significant fracturing in the bedrock are provided in Photos 3-15 to 3-18 for 16MW20A located on the IOL bulk plant and adjacent to 14th St.

and Photos 3-16 to 3-19 for 16MW 22B located about 140 metres down gradient of 16MW20A and are also included in Appendix 72. The cobble and cave fractures appear to represent zones of significant fracturing and vertical fractures are evident that extend several metres, providing an interconnection with the two highly fractured zones in the bedrock, providing an interconnection with the two highly fractured zones in the bedrock, that show a downward dip from the IOL site toward the FN/MEL properties and the wharf. Water flow rates for these zones ranged from 20 GPM to 50 GPM.

Prior to RBCA Version 2.0 with Appendix 1: Reference Guidelines Tier I Checklist for Ecological Receptor Assessment in Atlantic Canada., the owner's consultant was responsible for carrying out the ecological assessment to identify receptors potentially at risk. Appendix 1 provided a documented protocol for assessing potential receptors at risk, with a distance of 150 metres identified as a minimum distance to consider receptors. However, in the same Appendix 1, the consultant was also required to indicate if in their professional opinion if there was potential for petroleum hydrocarbons to reach any ecological receptors irrespective of distance, recognizing that pathways may exist that increased the potential for a receptor to be impacted even if the distance was greater than 150 metres.

It is indicated in Appendix 1 of Version 2.0 of RBCA that:

"The following guidelines are intended to be the minimum requirements for a preliminary assessment. They should in no way be construed as limiting, if your professional judgment determines that additional or different evaluation is required for a particular site."

It is further indicated that;

"Step 1 identifies presence of ecological receptors on or adjacent to the site, within a suggested distance of about 150 metres. This distance is subject to professional judgment."

Appendix 1 of RBCA 2012 Version 3.0 continues to indicate that

"The objectives of collecting assessment data are to characterize:

1) the nature and extent of soil and groundwater contamination in three dimensions

2) potential migration pathways and

3) potential receptors. These characterizations must be achieved with an acceptable level of certainty."

However, Best Management Practices (BMPs) have been introduced that are intended to reflect "the minimum level of effort for collection of such data at typical sites; ***for more complicated or sensitive sites it may be necessary to increase the scope of the assessment to achieve an acceptable level of certainty."***

In the first two versions of the Atlantic RBCA User Guidance (1998 and 2007), potential risks to ecological receptors and habitat due from exposure to petroleum hydrocarbons were qualitatively assessed with a series of questions. In keeping with other Canadian approaches and to parallel the human-health based Atlantic RBCA process, the Task Group's first step was to include ecologically-based screening levels, or benchmarks, to which site assessment data could be compared. Appendix 2 of RBCA Version 3.0 contains tables with ecological specific screening criteria.

It is indicated in Appendix 2 of RBCA Version 3.0 that

"The ecological screening protocol is intended to determine whether chemical hazards, ecological receptors and/or exposure pathways are present at a given site. Completion of the protocol does not suggest that an ecological risk assessment (ERA) has been completed. Rather, the outcome of the protocol is a determination of whether or not

an ERA or remediation/risk management should be conducted, and whether or not additional site data are required to conduct an ERA, or proceed with risk management options.

This screening protocol is intended to be used in conjunction with Appendix 1 of the Atlantic RBCA Version 3 User Guidance (i.e., "Best Management Practices for Environmental Assessment of Petroleum Impacted Sites in Atlantic Canada"). These guidelines should be met prior to the evaluation of any site using this protocol.

Provincial RBCA protocols have been applied, with the Guideline for the Management of Contaminated Sites Version 2, 2003 (update of Version 1, 1999) being recognized. Reference is made to Provincial guidelines established in 1992 and Provincial RBCA criteria established in 1999, 2007, 2012, and 2015 in recognition of assessments and remediation being undertaken in the area since circa 1997, ACER having undertaken an initial assessment of the EFL, FN and MEL properties in 2009, and other phased assessments continuing into 2017.

It is indicated in RBCA 2015 that

“This protocol is applicable only to sites with petroleum hydrocarbon impacts. It should not be used for sites where other potential contaminants of concern (e.g., PCBs, PAHs, dioxins/furans, metals/ metalloids, nutrients, pesticides, etc.) have been identified, as screening levels for such potential contaminants of concern have not been provided.”

It is further indicated in RBCA that

“If multiple non-petroleum contaminants are included in the risk assessment at Tier II or III (assuming approval from the regulatory agency having jurisdiction), it may be necessary to consider the cumulative effects in the derivation of SSTLs. Different compounds may act on different body organs, thereby affecting the compounds that need to be considered as having cumulative effects.”

This is also reflected in previous versions of RBCA and the Provincial 1992 guidelines.

Although several of the default criteria for application of RBCA are not met, the RBCA Tier I criteria are used for comparative/screening assessment purposes and given that the criteria have been applied historically for assessment purposes by other consultants on behalf of property owners in this area.

Analysis results obtained for groundwater and soil samples for petroleum hydrocarbons are compared with RBCA Tier I Criteria and CCME Guidelines for residential land use, in recognition of the FN brackish/saltwater supply aquifer being used for food grade operations and water quality meeting an equivalent standard with respect to contaminates. Certificates of analysis are provided in Appendix 74. However, it should be noted that the following conditions may not have been considered historically or for subsequent application of the RBCA Tier I criteria, for the IOL site or consideration of the FN, EFL, MEL and other adjacent and nearby properties including residential and commercial land use as well as the SCH federal property and marine environment.

Defaults and Mandatory Criteria
Required to Use RBCA Tier I Criteria
Taken From Appendix 6 of RBCA

Confirm no free product in soil or water	**Requirement not satisfied.** Evidence of petroleum sheening and odours. No apparent free product on site but additional investigations warranted to confirm.
Confirm no odours or explosive conditions in buildings or infrastructure	**Requirement not satisfied.** Objectionable odours detected from Borehole/Monitoring Wells during sampling and excavation at IOL bulk plant and FN/MEL property boundaries. Workers wore masks due to petroleum fumes during installation of underground services. No

**Defaults and Mandatory Criteria
Required to Use RBCA Tier I Criteria
Taken From Appendix 6 of RBCA**

	monitoring carried out to confirm non-explosive conditions and suitable air quality inside buildings.
Confirm that depth to groundwater approximately 3 metres	**Requirement not satisfied.** Depth to groundwater during summer typically noted to range from 1.66 to 2.56 metres below surface grade with most locations showing about 2.1 metres. Water level recorded to rise by 0.3 m and up to 1.0 m for episodic rainfall events as well as longer term seasonal conditions (fall and spring conditions). This results in a change of minimum depth of 1.66 m noted above to as little as 0.55 to 1.36. A number of sample locations showed water levels about 10 cm below surface grade. Note also that it is not apparent that other default groundwater parameters were satisfied.
Confirm that default foundation crack fraction is appropriate	**Requirement not satisfied.** Not assessed.
Confirm that two floors exist in using a residential scenario	**Requirement not satisfied.** Single story dwellings evident in adjacent areas.
Confirm that no foundation walls are hydrocarbon impacted above RBSL or PSSL Table soil criteria	**Requirement likely not satisfied.** Sampling indicated exceedences of RBSL and PSSL with TPH concentrations of 6,600 mg/kg at a depth of 0.6 m below the floor at 12MW81 about 2.5m from concrete foundation wall and 780 mg/kg opposite outside edge of wall for MEL. TPH of 2,200 mg/kg in soil at a depth of about 2.1m below the floor at 11MW13 about 6 m from the concrete foundation wall and 950mg/kg at 12MW48 opposite at exterior edge of wall for FN building.

In addition to the above, the footprint of contamination below the buildings is greater than the default for application of the RBCA and CCME screening criteria. As stated in the DLEG Guidelines, "A critical factor associated with an ESA is that the extent of the contamination in both soil and groundwater must be adequately defined and delineated, even if it has crossed the source property boundary**. Delineation to applicable screening criteria levels is the minimum level of delineation required in all situations."**

Based on our assessment of site conditions and application of the Tier I Commercial criteria for potable water for the IOL and adjacent and nearby properties, it would appear that the following requirements identified in the RBCA guidelines may not be addressed for assessment and remedial considerations for onsite and adjacent land use considerations.

**Minimum Site Assessment Requirements
Required to Use RBCA Tier I Criteria
Taken From Appendix 6 of RBCA**

Current and future land use identified	**Requirement not satisfied.** Possible future residential use on EFL and FN Pecheries Ltd. property. EFL and FN Pecheries Ltd. is located adjacent to residential development as is

**Minimum Site Assessment Requirements
Required to Use RBCA Tier I Criteria
Taken From Appendix 6 of RBCA**

	IOL.
Review of underground services as conduits	**Requirement not satisfied** Underground services extensive and groundwater to surface water pathway or transport to adjacent properties including marine environment.
Local groundwater use identified	**Requirement not satisfied.** Local private commercial wells historically used for food processing. Wells for ice production also in area.
Adjacent land use and receptors identified	**Requirement not satisfied.** Residential land use not considered adjacent to IOL or FN Pecheries Ltd. and for Federal properties.
Ecological screening completed	**Requirement not satisfied**. Assessment not considered adequate for groundwater to surface water pathway. Underground services along streets and roads provide conduits for faster groundwater flow. Significantly fractured bedrock providing preferential flow and also tidal influence.
Contamination in contact with the foundation wall that may exceed the guideline criteria	**Requirement not satisfied.** It is probable, but unconfirmed if contamination is in contact with the foundation wall
Soil and groundwater impacts delineated to Tier I criteria for potential receptor (adjacent property receptor may be lower Tier I criteria)	**Requirement not satisfied.** Residential properties not considered. Private water supply wells for commercial food processing use not considered. Marine environment not considered.
Receptor building characteristics obtained (storeys, floor condition, ceiling height, etc.	**Requirement not satisfied.** Adjacent properties also include residential properties. FN Pecheries Ltd. building has 4 metre ceiling heights. EFL building has a partial basement about 1 metre below grade.

There are other limitations that must be considered in the application of RBCA that is consistent with site assessments prior to and for the historical application of RBCA and other various guidelines/criteria including CCME. It is indicated in RBCA 2012 that for "identification of potential transport mechanisms and exposure pathways" that "Conduits such as service trenches can provide preferential and high velocity pathways. Pathways must be assessed for immediate and long term human and ecological exposure.", and Is it reasonable to conclude that site petroleum hydrocarbon contamination could impact aquatic receptors or aquatic habitat in surface water bodies via ….preferential subsurface flow pathways (e.g. culvert, trench, sewer line, pipelines, swales) … such that aqueous media concentrations would potentially exceed surface water and/or sediment quality screening levels (Table 3a and Table 4)?

If the answer to any of questions 1 to 4 in Part III is "YES", then further action is required."

For this project, a "YES" answer applies and further action is required, consisting of additional detailed assessment of the ecological environment (aquatic life and environment in particular), likelihood that Tier III criteria be developed rather than using Tier I or Tier II screening levels.

Naphthalene was detected as well as heavy metals and other PAHs in the soils, with petroleum hydrocarbons, Polycyclic Aromatic Hydrocarbons (PAHs), heavy metals, PCBs and pesticides identified in the sediments of the

marine environment that exceed applicable criteria and RBCA Tier I does not consider multiple parameters and cumulative effects in this context.

It should also be noted that there are limitations with respect to the application of the CCME guidelines as well. The RBCA criteria for aquatic/marine life was selected recognizing the extensive network of underground water supply lines, storm water and sewage lines, saltwater pipelines and road construction that provide preferential pathways for faster and easier movement of petroleum hydrocarbons. In addition, the 2016 intrusive sampling program showed that the bedrock has extensive vertical and horizontal fracturing with large fractures evident. It is noted that the CCME 2008 Federal guidelines indicate that for "Fractured bedrock or fractured silt/clay…The transport models used to develop the numerical guidelines assume that contaminant transport occurs through unconsolidated soils. If transport between the contaminant source and receptor (e.g. surface water body) is through fractures instead of unconsolidated soils, either a transport distance of zero should be assumed (i.e. the Canadian Water Quality Guidelines for the Protection of Aquatic Life should be applied to groundwater), or a site-specific risk assessment should be conducted." This would also apply to a water supply well used for food grade operations with a zone of pumping influence that extends to include nearby contaminated properties. Similar conditions apply to the CCME criteria; however, both the marine life guidelines and groundwater to surface water guidelines have been included for comparison purposes.

As indicated in **CCME, March, 1991**, it is critical to recognize that when assessing risks to the environment that the assessment should also recognize the **combined or synergistic effects of contaminates**. It is indicated in RBCA 2015 that "This protocol is applicable only to sites with petroleum hydrocarbon impacts. It should not be used for sites where other potential contaminants of concern (e.g., PCBs, PAHs, dioxins/furans, metals/ metalloids, nutrients, pesticides, etc.) have been identified, as screening levels for such potential contaminants of concern have not been provided." It is further indicated in RBCA that "If multiple non-petroleum contaminants are included in the risk assessment at Tier II or III (assuming approval from the regulatory agency having jurisdiction), it may be necessary to consider the cumulative effects in the derivation of SSTLs. Different compounds may act on different body organs, thereby affecting the compounds that need to be considered as having cumulative effects." This is reflected in previous versions of RBCA.

If Tier I screening levels are not satisfied due to elevated concentrations or limitations in the application of the criteria as discussed above, Tier II Pathway Specific Screening Criteria may be considered and/or criteria may be applied accordingly based on exposure pathway considerations. It is indicated from RBCA and CCME that a transport distance of zero should be applied if it is assessed that transport between the contaminant source and receptor marine/aquatic receptors is a risk of concern. Although several of the default criteria/conditions for application of select CCME guidelines are not met, pathway specific considerations have also been applied in the evaluation of risks of concern.

The CCME Guidelines were also used for this assessment in recognition of:

- the groundwater pathway and Marine Aquatic Life receptors associated with Shippagan Harbour, and potential impacts to the DFO property associated with migration of contaminates from the FN, MEL and EFL properties, and also in consideration of possible future Federal occupancy of the Assessed Property and adjacent Federal land use;
- Human Health
- PAHs in Groundwater for food grade operations. No RBCA guideline.
- PAHs in Groundwater, Inhalation Risks
- PAHs in Groundwater,

- For **Groundwater to Surface Water Pathway and Risks to Marine Aquatic Life**
- Petroleum Hydrocarbons in Surface Soils and Leaching for Potable Water Consideration For Food Grade **Water Supply Wells Historically Used on Site, Commercial Land Use, Coarse Grain Soils**
- Petroleum Hydrocarbons in Subsurface Soils for **Vapour Inhalation for Human Health, Commercial Land Use, Coarse Grain Soils**
- Petroleum Hydrocarbons in Subsurface Soils, Management Considerations for **Free Phase Formation, Explosive Hazards, and Buried Infrastructure Effects for Human Health, Commercial Land Use, Coarse Grain Soils**
- Petroleum Hydrocarbons in Subsurface Soils, **Leaching Into Groundwater and Risks to Marine Life**,
- Commercial Land Use, **petroleum hydrocarbons in groundwater** and Coarse Grain Soils

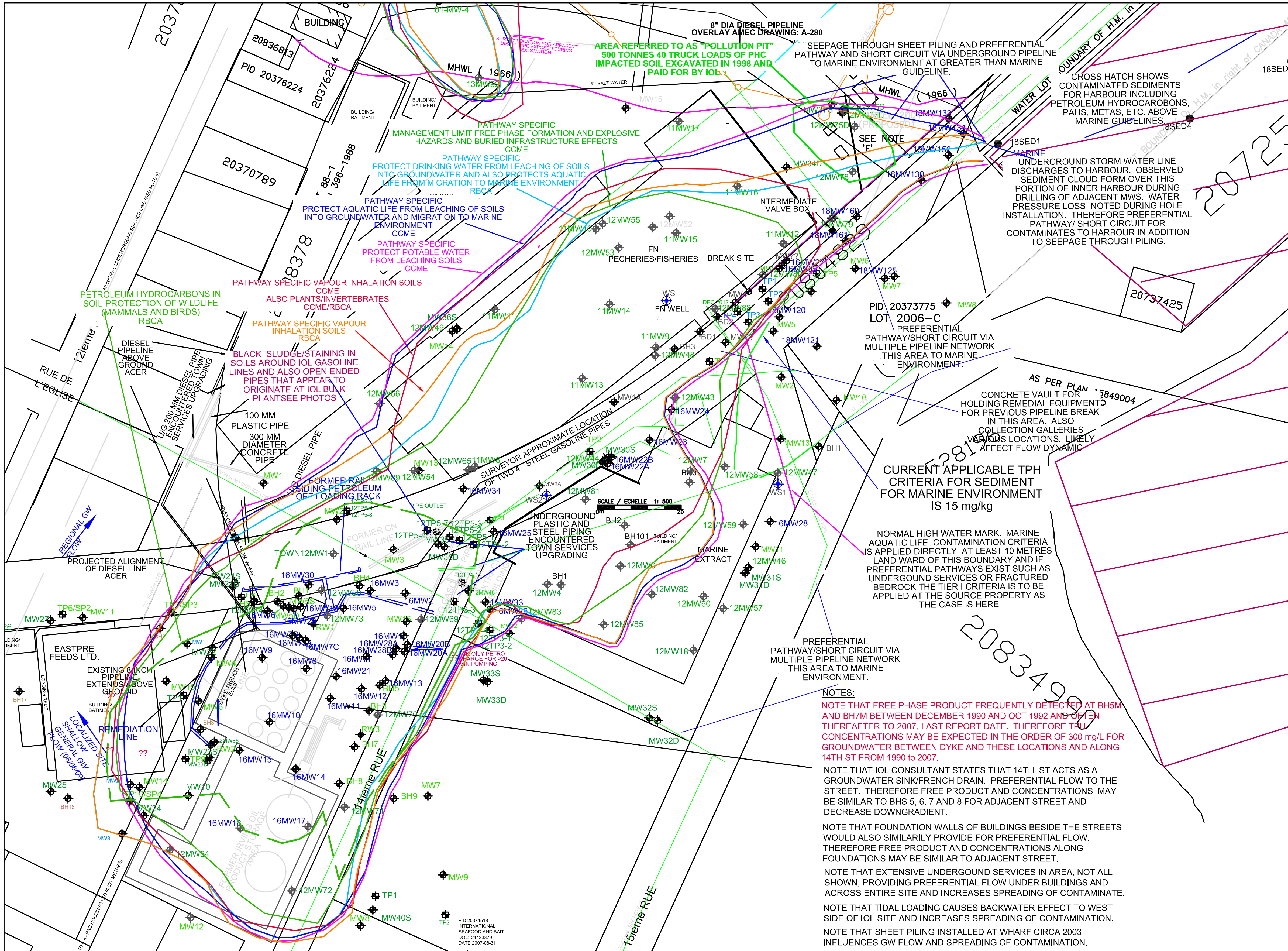
Provincial RBCA and federal CCME criteria are provided for potable water conditions. In some instances, concentrations obtained using RBCA analysis methods have been used to estimate values for comparison with federal guidelines. It is noted for RBCA 2007 that direct comparison of laboratory data from the Atlantic RBCA method and the CCME Canada Wide Standards-Petroleum Hydrocarbons (CWS-PHC) method is not recommended due to differences in the methodologies. However, changes were made to the Atlantic RBCA 2012 Method to enable more direct comparison of data generated by the two methods. The result is the Atlantic RBCA results are now directly comparable to either the PIRI guidelines or the CCME CWS Guidelines. Although changes have been made to harmonize the data generated by the two methods, differences between the methods remain. ACER utilised the CCME 2010 guidelines for groundwater for initial assessments completed on or before July, 2012. The groundwater guidelines were unchanged for the CCME update in November 2012.

There are several saltwater supply wells that have been historically utilized in the area. Two wells are used for ice processing for fisheries operations. Since 1950 or earlier, FN utilized the brackish/saltwater *supply aquifer* in the area of the FN and MEL properties for food grade fish processing purposes. Refer to Section 1.2.2 for details.

With respect to detectable petroleum hydrocarbon concentrations, a saltwater well must not exceed the same criteria established for a potable water well used for residential purposes. As such, c**oncentrations of BTEX and TPH were compared with RBCA potable water criteria for residential use and the CCME guidelines**.

3.3.1 Soil Analysis Results

The laboratory certificates of analysis are contained in Appendix 74. The analysis results for the sampling programs carried out between 2009 and 2019 are provided in Tables 1 to 11 in Appendix 75. The footprints showing the extent of contamination are shown in Figure 3-5 (also contained in Appendix 76) for risks to human health and the marine environment. Analysis results for soils show petroleum hydrocarbon **concentrations exceeded RBCA commercial and industrial criteria with Potable Water Use** in consideration of human health, with inhalation of petroleum vapours for indoor air and leaching of petroleum hydrocarbons from soils to groundwater aquifers used for water supplies including the brackish saltwater aquifer used by FN for food grade operations as well as wells used for production of ice for fishing operations, being the primary risk of concern. This is applicable for the MEL, FN, EFL and Town properties as well as the IOL bulk plant and underground gasoline transfer line and SCH/DFO properties. See Table 1 in Appendix 75 and Figure 3-5 (also contained in Appendix 76).



NOTES:

NOTE THAT FREE PHASE PRODUCT FREQUENTLY DETECTED AT BH5M AND BH7M BETWEEN DECEMBER 1990 AND OCT 1992 AND OFTEN THEREAFTER TO 2007, LAST REPORT DATE. THEREFORE TPH CONCENTRATIONS MAY BE EXPECTED IN THE ORDER OF 300 mg/L FOR GROUNDWATER BETWEEN DYKE AND THESE LOCATIONS AND ALONG 14TH ST FROM 1990 to 2007.

NOTE THAT IOL CONSULTANT STATES THAT 14TH ST ACTS AS A GROUNDWATER SINK/FRENCH DRAIN. PREFERENTIAL FLOW TO THE STREET. THEREFORE FREE PRODUCT AND CONCENTRATIONS MAY BE SIMILAR TO BHS 5, 6, 7 AND 8 FOR ADJACENT STREET AND DECREASE DOWNGRADIENT.

NOTE THAT FOUNDATION WALLS OF BUILDINGS BESIDE THE STREETS WOULD ALSO SIMILARILY PROVIDE FOR PREFERENTIAL FLOW. THEREFORE FREE PRODUCT AND CONCENTRATIONS ALONG FOUNDATIONS MAY BE SIMILAR TO ADJACENT STREET.

NOTE THAT EXTENSIVE UNDERGOUND SERVICES IN AREA, NOT ALL SHOWN, PROVIDING PREFERENTIAL FLOW UNDER BUILDINGS AND ACROSS ENTIRE SITE AND INCREASES SPREADING OF CONTAMINATE.

NOTE THAT TIDAL LOADING CAUSES BACKWATER EFFECT TO WEST SIDE OF IOL SITE AND INCREASES SPREADING OF CONTAMINATION.

NOTE THAT SHEET PILING INSTALLED AT WHARF CIRCA 2003 INFLUENCES GW FLOW AND SPREADING OF CONTAMINATION.

LEGEND

- ACER BHs/MWs IN GREEN TEXT FOR MW21 TO MW42 FOR JUNE, 2010, 11MW8 TO 11MW17 APRIL 2011, MW30 TO MW42 JULY 2011, 12MW1 TO 12MW92 IN 2012 AND 13MW93 IN 2013, 16MW1 TO 16MW35 2016, 18MW120 TO 18MW162 AND 19MW150 IN BLUE TEXT.
- WMS/ARC BHs/MWs IN LIGHT GREEN TEXT BEGINNING 1989 RELATED TO IOL BULK PLANT
- JWEL BHs/MWs IN BLUE TEXT THREE D GEOCONSULT. IN BROWN EASTPRE FEEDS 1996
- BHs/MWs BY OTHERS UNKNOWN IN BLACK TEXT
- EXISTING RECOVERY WELL (RW) LOCATION (ASPEN, MARCH 2000)
- FN PECHERIES WATER SUPPLY (WS) WELL
- TEST PIT LOCATION IN BLUE TEXT BY JWEL 1995 DFO/DNR PROPERTY
- WMS/ARC TEST PITS IN LIGHT GREEN TEXT BEGINNING IN 1989 RELATED TO IOL BULK PLANT
- TEST PIT LOCATIONS IN GREEN TEXT BY ACER, SEPT, 2010
- SEDIMENT 18SED1 & 19SED1 ACER 2018 & 2019
- SEDIMENT SED 1 & 12SED1 MGI 2001 & 2012
- 3.2 TPH CONCENTRATION CONTOUR

RBCA TIER I COMMERCIAL POTABLE LAND USE CRITERIA, COARSE SOIL

	Sample ID	GW (Depth) dd/mm/yy			
		RBCA			
		1999	2003 2007	2012	2015
B	Benzene	0.005 mg/L	0.03 mg/kg	0.042 mg/kg	0.005 mg/L
T	Toluene	0.024 mg/L	0.38 mg/kg	0.35 mg/kg	0.024 mg/L
E	Ethylben.	0.0016 mg/L	0.08 mg/kg	0.065 mg/kg	0.0016 mg/L
X	Xylene	2.4 mg/kg	11 mg/kg	11 mg/kg	0.02 mg/L
TPH	Total Petroleum Hydrocar.	80 mg/kg[1] 185 mg/kg[2] 10000mg/kg[3]	450 mg/kg[1] 7400 mg/kg[2] 10000mg/kg[3]	870 mg/kg[1] 1800 mg/kg[2] 10000mg/kg[3]	870 mg/kg[1] 1800 mg/kg[2] 10000mg/kg[3]

1 Guideline for Gasoline (G) 2 Diesel (D), Fuel oil (F) (APPLICABLE) 3 Lube Oil (L)

CONCENTRATIONS WITHIN GUIDELINES
CONCENTRATIONS EXCEEDING GUIDELINES
NOT SAMPLED ns NOT DETECTED nd
NOTE: nd INDICATES BELOW REPORTING LIMIT

PROBABLE GROUNDWATER FLOW DIRECTION FOR SHALLOW AQUIFER

TRACE OVERLAY OF IRVING OIL LIMITED SITE PLAN FOR AS BUILT REMEDIATION SYTEM AND FORMER RAIL LOADING RACK SHOWN IN IN BLUE. REFERENCE: CAMPBELL, OCTOBER 30, 1992, INTER-OFFICE MEMO.

Some BHs/MWs and Feature locations approximate. BH/MW locations extrapolated from ASPEN, MARCH 2000, AMEC, 2001 and ARC documents, and railway siding features from Cambell, 1992.

ACER Environmental Services (2015) Ltd.

PHASE II & III ENVIRONMENTAL SITE ASSESSMENT
MEL, FN, EFL SHIPPAGAN, NB

FILE NAME: Fig 3-5 RBCA Soil Com Pot | JOB NO.: CBT 60-1 | MADE: GP | CHKD: GP | DATE: Jan 29, 2020

FIGURE 3-5
CONTAMINATION PLUME SOIL RBCA COMMERCIAL LAND USE POTABLE, CCME LEACHING TO WATER SUPPLY & LEACHING TO GROUNDWATER AND AQUATIC LIFE PATHWAY, INHALATION, EXPLOSIVE AND BURIED INFRASTRUCTURE EFFECTS, PLANTS, WILDLIFE

Further to the above, analysis results for soils <u>also show</u> petroleum hydrocarbon **concentrations exceeded RBCA commercial and industrial criteria with <u>Non-Potable Water</u>** use in consideration of human health, on the MEL, FN, EFL and Town properties as well as the IOL bulk plant and underground gasoline transfer line and SCH/DFO properties. See Table 2 in Appendix 75 and Figure 3-5 (also contained in Appendix 76).

Analysis results for soils show petroleum hydrocarbon concentrations exceeded CCME criteria in consideration of human health with leaching of BTEX and TPH components from soils to a water supply being the primary risk of concern, on the MEL, FN, EFL and Town properties as well as the IOL bulk plant and underground gasoline transfer line and SCH/DFO properties. See Table 3 in Appendix 75 and Figure 3-5 (also contained in Appendix 76).

Analysis results for soils showed petroleum hydrocarbon concentrations exceeded RBCA criteria in consideration of Pathway Specific Screening Levels (PSSL) for leaching of soils into groundwater for BTEX and TPH components and potable groundwater, on the MEL, FN, EFL and Town properties as well as the IOL bulk plant and underground gasoline transfer line and DFO properties. See Table 4 in Appendix 75 and Figure 3-5 (also contained in Appendix 76).

Given that RBCA PSSL concentrations for groundwater consumption would be higher than criteria applicable for marine receiving waters recognizing that a transport distance of zero is applicable due to preferential pathways, concentrations in the groundwater would exceed the marine guidelines for the groundwater to surface water pathway on the MEL, FN, EFL and Town properties as well as the IOL bulk plant and underground gasoline transfer line and DFO properties. Federal CCME criteria are identified in Table 16 in Appendix 77.

Analysis results for soils showed petroleum hydrocarbon concentrations exceeded RBCA criteria in consideration of PSSLs for BTEX and TPH components from soils and indoor vapour inhalation on the MEL, FN, EFL and Town properties as well as the IOL bulk plant and underground gasoline transfer line and DFO properties. See Table 5 in Appendix 75 and Figure 3-5 (also contained in Appendix 76).

Sampling results for subsurface soils showed petroleum hydrocarbon concentrations exceeded CCME criteria in consideration of vapour inhalation for indoor air for slab on grade construction on the MEL, FN, EFL and Town properties as well as the IOL bulk plant and underground gasoline transfer line and DFO properties. See Table 6 in Appendix 75 and Figure 3-5 (also contained in Appendix 76).

Sampling results for subsurface soils showed petroleum hydrocarbon concentrations exceeded CCME criteria in consideration of Management Considerations for Free Phase Formation, Explosive Hazards, and Buried Infrastructure Effects for Human Health, on the MEL, FN, EFL and Town properties as well as the IOL bulk plant and underground gasoline transfer line and DFO properties. See Table 7 in Appendix 75 and Figure 3-5 (also contained in Appendix 76).

Sampling results for subsurface soils showed petroleum hydrocarbon concentrations exceeded CCME criteria in consideration of leaching into groundwater and the groundwater to surface water pathway risks to marine life, on the MEL, FN, EFL and Town properties as well as the IOL bulk plant and underground gasoline transfer line and DFO properties. See Table 8 in Appendix 75 and Figure 3-5 (also contained in Appendix 76).

Sampling results for surface and subsurface soils showed petroleum hydrocarbon concentrations exceeded RBCA Tier I criteria in consideration of protection of plants and invertebrates, on the MEL, FN, EFL and Town properties as well as the IOL bulk plant and underground gasoline transfer line and DFO properties. See Table 9 in Appendix 75. The RBCA Tier I criteria are sourced from the CCME 1999 and CCME 2008 guidelines that have also been

adopted as environmental standards by the Nova Scotia Department of Environment and Figure 3-5 (also contained in Appendix 76).

Sampling results for surface and subsurface soils showed petroleum hydrocarbon concentrations exceeded RBCA Tier I criteria in consideration of risks to wildlife (mammals and birds) on the MEL, FN, EFL and Town properties as well as the IOL bulk plant and underground gasoline transfer line and DFO properties. See Table 10 in Appendix 75. The RBCA Tier I criteria are sourced from the Alberta Environment 2010 guidelines and Figure 3-5 (also contained in Appendix 76).

Sampling results for soils showed naphthalene exceeded CCME criteria in the area of 12MW81-2. See Table 11 in Appendix 75. This also exceeded the Nova Scotia Department of Environment criteria of 25 mg/L for indoor air inhalation adopted from the Alberta Environment 2010 and criteria of 53 mg/kg for leaching to potable water sources.

3.3.2 Groundwater Analysis Results

The analysis results for groundwater are provided in the Tables 12 to 22 contained in Appendix 77. The footprints showing the extent of contamination in groundwater in consideration of human health and the groundwater to surface water pathway for aquatic life are shown in Figures 3-6 and Figure 3-7 (also contained in Appendix 76). Concentrations for petroleum hydrocarbons for a number of monitoring wells are also shown in Figure 3-3 (also contained in Appendix 72) for the transect showing the overburden and bedrock profile between the IOL bulk plant and the edge of the wharf.

Sampling results for groundwater showed petroleum hydrocarbon concentrations for deep and shallow wells exceeded RBCA commercial and industrial and CCME potable water criteria in consideration of on-site water supply wells established in the saltwater/brackish aquifer used for food grade operations, on the MEL, FN, EFL and Town properties as well as the IOL bulk plant and underground gasoline transfer line and DFO property. See Tables 12 and 13, respectively, in Appendix 77 and Figure 3-6 (also contained in Appendix 76).

Sampling results for groundwater showed petroleum hydrocarbon concentrations exceeded RBC A (CCME being the same criteria) commercial and industrial criteria in consideration of ecological (plant and invertebrate life), on the MEL, FN, EFL and Town properties as well as the IOL bulk plant and underground gasoline transfer line and DFO properties. See Table 14 in Appendix 77 and Figure 3-7 (also contained in Appendix 76).

Results for petroleum hydrocarbons analysis show that concentrations for **BTEX and TPH fractions exceeded the RBCA criteria for MAL** in recognition of multiple preferential pathways applicable to the properties, **MEL, FN, EFL and Town properties as well as the IOL bulk plant and underground gasoline transfer line and DFO properties in consideration of the groundwater to surface water pathway. See Table 15 in Appendix 77 and Figure 3-7 (also contained in Appendix 76).**

Results for petroleum hydrocarbons analysis show that concentrations for Benzene, Toluene and Ethylbenzene were above the CCME guidelines for MAL in recognition of multiple preferential pathways applicable to the properties, MEL, FN, EFL and Town properties as well as the IOL bulk plant and underground gasoline transfer line and DFO properties in consideration of the groundwater to surface water pathway. See Table 16 in Appendix 77 and Figure 3-7 (also contained in Appendix 76).

Results for PAHs showed that concentrations exceeded Nova Scotia Department OF Environment (NSDOE) Standards that include CCME and other guidelines for groundwater use on the MEL, FN, EFL and

LEGEND

- ACER BHs/MWs IN GREEN TEXT FOR MW21 TO MW42 FOR JUNE, 2010, 11MW8 TO 11MW17 APRIL 2011, MW30 TO MW42 JULY 2011, 12MW1 TO 12MW92 IN 2012 AND 13MW93 IN 2013, 16MW1 TO 16MW35 2016, 18MW120 TO 18MW162 AND 19MW150 IN BLUE TEXT.
- WMS/ARC BHs/MWs IN LIGHT GREEN TEXT BEGINNING 1989 RELATED TO IOL BULK PLANT
- JWEL BHs/MWs IN BLUE TEXT THREE D GEOCONSULT. IN BROWN EASTPRE FEEDS 1996
- BHs/MWs BY OTHERS UNKNOWN IN BLACK TEXT
- EXISTING RECOVERY WELL (RW) LOCATION (ASPEN, MARCH 2000)
- FN PECHERIES WATER SUPPLY (WS) WELL
- TEST PIT LOCATION IN BLUE TEXT BY JWEL 1995 DFO/DNR PROPERTY
- WMS/ARC TEST PITS IN LIGHT GREEN TEXT BEGINNING IN 1989 RELATED TO IOL BULK PLANT
- TEST PIT LOCATIONS IN GREEN TEXT BY ACER, SEPT, 2010
- SEDIMENT 18SED1 & 19SED1 ACER 2018 & 2019
- SEDIMENT SED 1 & 12SED1 MGI 2001 & 2012
- 3.2 TPH CONCENTRATION CONTOUR

RBCA TIER I COMMERCIAL POTABLE LAND USE CRITERIA, COARSE SOIL EXCEPT NOTED OTHERWISE

	Sample ID	SOIL (Depth) dd/mm/yy			
		RBCA			
		1999	2003 2007 RES	2012	2015
B	Benzene	0.005 mg/L	0.005 mg/L	0.005 mg/L	0.042 mg/L
T	Toluene	0.024 mg/L	0.024 mg/L	0.024 mg/L	0.35 mg/L
E	Ethylben.	0.0024 mg/L	0.0024 mg/L	0.0024 mg/L	0.043 mg/L
X	Xylene	0.3 mg/L	0.3 mg/L	0.3 mg/L	0.73 mg/L
TPH	Total Petroleum Hydrocar.	2.8 mg/L [1] 1.7 mg/L [2] 8.4 mg/L [3]	4.4 mg/L [1] 3.2 mg/L [2] 7.8 mg/L [3]	4.4 mg/L [1] 3.2 mg/L [2] 7.8 mg/L [3]	4.4 mg/L [1] 3.2 mg/L [2] 7.8 mg/L [3]

1 Guideline for Gasoline (G) 2 Diesel (D), Fuel oil (F) (APPLICABLE) 3 Lube Oil (L)

CONCENTRATIONS WITHIN GUIDELINES
CONCENTRATIONS EXCEEDING GUIDELINES
NOT SAMPLED ns NOT DETECTED nd
NOTE: nd INDICATES BELOW REPORTING LIMIT

PROBABLE GROUNDWATER FLOW DIRECTION FOR SHALLOW AQUIFER

TRACE OVERLAY OF IRVING OIL LIMITED SITE PLAN FOR AS BUILT REMEDIATION SYTEM AND FORMER RAIL LOADING RACK SHOWN IN IN BLUE. REFERENCE: CAMPBELL, OCTOBER 30, 1992, INTER-OFFICE MEMO.

Some BHs/MWs and Feature locations approximate. BH/MW locations extrapolated from ASPEN, MARCH 2000, AMEC, 2001 and ARC documents, and railway siding features from Cambell, 1992.

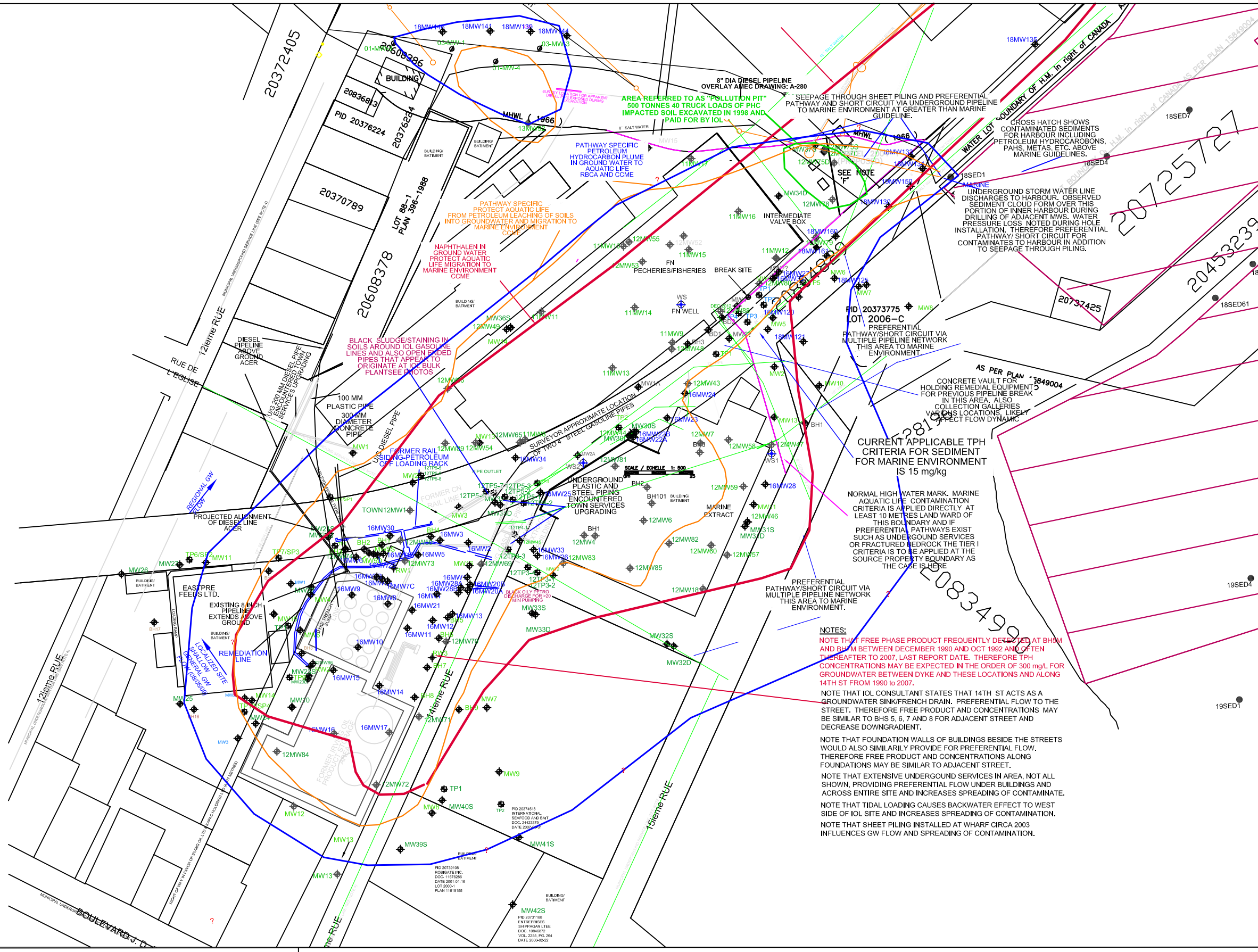
ACER
Environmental Services (2015) Ltd.

PHASE II & III ENVIRONMENTAL SITE ASSESSMENT
MEL, FN, EFL SHIPPAGAN, NB

FILE NAME: Fig 3-6 RBCA GW Com Pot | JOB NO.: CBT 60-1 | MADE: GP | CHKD: GP | DATE: Jan 29, 2020

FIGURE 3-6

CONTAMINATION PLUME GROUNDWATER RBCA COMMERCIAL LAND USE POTABLE & PLANT AND INVERTEBRATE & MIGRATION FOR AQUATIC LIFE AND CCME FOR NAPTHALENE AND MIGRATION AQUATIC LIFE



LEGEND

- ACER BHs/MWs IN GREEN TEXT FOR MW21 TO MW42 FOR JUNE, 2010, 11MW8 TO 11MW17 APRIL 2011, MW30 TO MW42 JULY 2011, 12MW1 TO 12MW92 IN 2012 AND 13MW93 IN 2013, 16MW1 TO 16MW35 2016, 18MW120 TO 18MW162 AND 19MW150 IN BLUE TEXT.
- WMS/ARC BHs/MWs IN LIGHT GREEN TEXT BEGINNING 1989 RELATED TO IOL BULK PLANT
- JWEL BHs/MWs IN BLUE TEXT THREE D GEOCONSULT. IN BROWN EASTPRE FEEDS 1996
- BHs/MWs BY OTHERS UNKNOWN IN BLACK TEXT
- EXISTING RECOVERY WELL (RW) LOCATION (ASPEN, MARCH 2000)
- FN PECHERIES WATER SUPPLY (WS) WELL
- TEST PIT LOCATION IN BLUE TEXT BY JWEL 1995 DFO/DNR PROPERTY
- WMS/ARC TEST PITS IN LIGHT GREEN TEXT BEGINNING IN 1989 RELATED TO IOL BULK PLANT
- TEST PIT LOCATIONS IN GREEN TEXT BY ACER, SEPT, 2010
- SEDIMENT 18SED1 & 19SED1 ACER 2018 & 2019
- SEDIMENT SED 1 & 12SED1 MGI 2001 & 2012
- 3.2 TPH CONCENTRATION CONTOUR

CCME AQUATIC LIFE & RBCA AQUATIC LIFE

Sample ID		GW dd/mm/yy		
		CCME		RBCA
				2012 & 2015
B	Benzene		0.11 mg/L	2.1 mg/L
T	Toluene		0.215 mg/L	0.77 mg/L
E	Ethylben.		0.025 mg/L	0.32 mg/L
X	Xylene		NG	0.33 mg/L
TPH	Total Petroleum Hydrocar.	RBCA DOPTED	1.5 mg/L [1] 0.10 mg/L [2] 0.10 mg/L [3]	1.5 mg/L [1] 0.10 mg/L [2] 0.10 mg/L [3]

1 Guideline for Gasoline (G) 2 Diesel (D), Fuel oil (F) (APPLICABLE) 3 Lube Oil (L)

CONCENTRATIONS WITHIN GUIDELINES
CONCENTRATIONS EXCEEDING GUIDELINES
NOT SAMPLED ns NOT DETECTED nd
NOTE: nd INDICATES BELOW REPORTING LIMIT

PROBABLE GROUNDWATER FLOW DIRECTION FOR SHALLOW AQUIFER

TRACE OVERLAY OF IRVING OIL LIMITED SITE PLAN FOR AS BUILT REMEDIATION SYTEM AND FORMER RAIL LOADING RACK SHOWN IN IN BLUE. REFERENCE: CAMPBELL, OCTOBER 30, 1992, INTER-OFFICE MEMO.

Some BHs/MWs and Feature locations approximate. BH/MW locations extrapolated from ASPEN, MARCH 2000, AMEC, 2001 and ARC documents, and railway siding features from Cambell, 1992.

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PHASE II & III ENVIRONMENTAL SITE ASSESSMENT
MEL, FN, EFL SHIPPAGAN, NB

FILE NAME: Fig 3-7 RBCA CCME Aquat Life	JOB NO.: CBT 60-1	MADE: GP	CHKD: GP	DATE: Jan 29, 2020

FIGURE 3-7
PETROLEUM HYDROCARBONS IN SOIL WITH LEACHING AND PETROLEUM HYDROCARBONS IN GROUNDWATER WITH MIGRATION TO AQUATIC RECEPTORS RBCA & CCME & NAPHTHALENE MIGRATION AQUATIC LIFE CCME

Town properties as well as the IOL bulk plant and underground gasoline transfer line and DFO properties. See Table 17 in Appendix 77 and Figure 3-6 (also contained in Appendix 76).

Results for PAHs show that concentrations exceed Standards that include CCME and other guidelines **for MAL in consideration of the groundwater to surface water pathway in recognition of multiple preferential pathways applicable to the properties, MEL, FN, EFL and Town properties as well as the IOL bulk plant and underground gasoline transfer line and DFO properties.** See Table 18 in Appendix 77 and Figure 3-7 (also contained in Appendix 76).

3.3.3 Marine Sediment

In August 2018 and 2019 sampling of the marine receiving environment was carried out, involving surface sediment grab samples and deeper core sampling with depths of about 2 metres achieved. Analysis results are provided in Table 19 for petroleum hydrocarbons, Tables 20 and 21 for PAHs in consideration of CCME Interim Sediment Quality Guidelines (ISQG) and Probable Effect Levels (PEL), and Tables 21 and 22 for metals in consideration of CCME ISQG and PELs. The Tables are contained in Appendix 29. As previously indicated, the PEL is a CCME guideline that is indicated to represent a Probable Effect Level and the ISQL is an Interim Sediment Quality Level. The ISQG are intended to be used for evaluating the potential for biological effects, CCME, 1999, updated 2001. The PEL "defines the level above which adverse effects are expected to occur frequently"….."(i.e., more than 50% adverse effects occur above the PEL)." CCME, 1999 updated 2001."

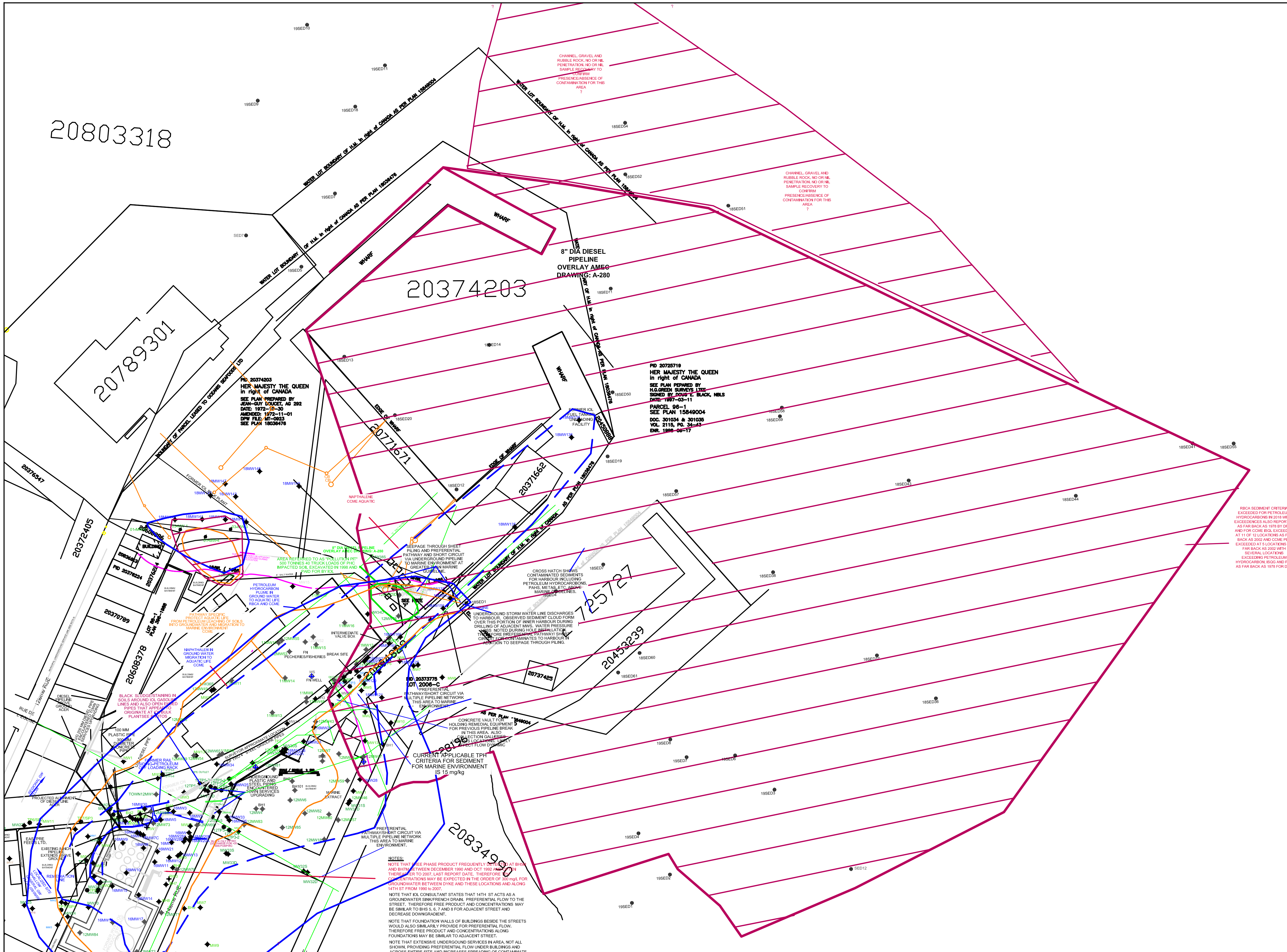
The footprint for contamination is shown in Figure 3-8 and is also included in Appendix 76. The footprint of the area of impacted sediments is approximately 30 acres, and additional sampling is required to further delineate impacts given that coarse materials were encountered in some areas, near the edge of the main channel, that prevented penetration of the sample equipment.

Of 24 sample locations established (over 80 samples collected for analysis), over 50% of the locations showed petroleum hydrocarbons, PAHs and heavy metals that exceeded guidelines including core samples (depth of 2 metres). Contamination was evident at a distance of 2.6 KM from the edge of the Shippagan wharf structure. The large 50 acre footprint of petroleum hydrocarbon and PAH contamination historically and still currently evident in the immediate harbour area and inland, would be indicative of a large quantity of contaminate(s) having been released to the environment.

In a number of instances, core samples (obtained below the grab sample depth of 5 to 7 cm) which extended to a depth of 2 metres at a number of locations, showed concentrations to be higher than the surface grab sample at that location, with contaminates also occurring to the full depth of 2 m for locations. Core sampler refusal (penetration less than 25 mm for 15 blows) occurred at various locations and it is possible that the contamination may extend deeper at specific locations. Within the inner harbour and outer harbour near the wharf structures, it is reported that bed sediments are disturbed by commercial boats hauling catches, as evidenced from dirty water occurring in the harbour area. Boats are reported to plough through the bottom sediments during low tides in particular. As such, resuspension of contaminated sediments at depths greater than 5 cm represent a risk of concern to marine life.

3.4 Quality Assurance/Quality Control Results

Recoveries obtained for the laboratory and spiked samples were within acceptable tolerances, indicating that concentrations for samples reasonably reflected actual conditions.



LEGEND

- ACER BHs/MWs IN GREEN TEXT FOR MW21 TO MW42 FOR JUNE, 2010, 11MW8 TO 11MW17 APRIL 2011, MW30 TO MW42 JULY 2011, 12MW1 TO 12MW92 IN 2012 AND 13MW93 IN 2013, 16MW1 TO 16MW35 2016, 18MW120 TO 18MW162 AND 19MW150 IN BLUE TEXT.
- WMS/ARC BHs/MWs IN LIGHT GREEN TEXT BEGINNING 1989 RELATED TO IOL BULK PLANT
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- TEST PIT LOCATIONS IN GREEN TEXT BY ACER, SEPT, 2010
- SEDIMENT 18SED1 & 19SED1 ACER 2018 & 2019
- SEDIMENT SED 1 & 12SED1 MGI 2001 & 2012
- 3.2 TPH CONCENTRATION CONTOUR

CCME AQUATIC LIFE & RBCA AQUATIC LIFE

	Sample ID		GW dd/mm/yy
		CCME RBCA DOPTED	RBCA 2012 & 2015
B	Benzene	1.2 mg/kg	1.2 mg/kg
T	Toluene	1.4 mg/kg	1.4 mg/kg
E	Ethylben.	1.2 mg/kg	1.2 mg/kg
X	Xylene	1.3 mg/kg	1.3 mg/kg
TPH	Total Petroleum Hydrocar.	15 mg/kg [1] 25 mg/kg [2] 43 mg/kg [3]	15 mg/kg [1] 25 mg/kg [2] 43 mg/kg [3]
	OCEAN DISPOSAL OIL AND GREASE	10 mg/kg	

1 Guideline for Gasoline (G) 2 Diesel (D), Fuel oil (F) (APPLICABLE) 3 Lube Oil (L)

CONCENTRATIONS WITHIN GUIDELINES

CONCENTRATIONS EXCEEDING GUIDELINES

NOT SAMPLED ns NOT DETECTED nd

NOTE: nd INDICATES BELOW REPORTING LIMIT

PROBABLE GROUNDWATER FLOW DIRECTION FOR SHALLOW AQUIFER

TRACE OVERLAY OF IRVING OIL LIMITED SITE PLAN FOR AS BUILT REMEDIATION SYTEM AND FORMER RAIL LOADING RACK SHOWN IN IN BLUE. REFERENCE: CAMPBELL, OCTOBER 30, 1992, INTER-OFFICE MEMO.

Some BHs/MWs and Feature locations approximate. BH/MW locations extrapolated from ASPEN, MARCH 2000, AMEC, 2001 and ARC documents, and railway siding features from Cambell, 1992.

ACER Environmental Services (2015) Ltd.

PHASE II & III ENVIRONMENTAL SITE ASSESSMENT
MEL, FN, EFL SHIPPAGAN, NB

FIGURE 3-8
PETROLEUM HYDROCARBONS, PAHS AND METALS IN SEDIMENT INCLUDING 10 m LANDWARD OF OHWM WITH LEACHING OF SOILS AND GROUNDWATER TO SURFACE WATER PATHWAY

FILE NAME: Fig 3-8 RBCA Sediment	JOB NO.: CBT 60-1	MADE: GP	CHKD: GP	DATE: Jan 29, 2020

4.0 IDENTIFICATION OF CONTAMINATION SOURCES

Historical reports regarding potential and known areas of contamination were reviewed to assist in the identification of source areas, including consideration of migration and spreading of contaminates, with analysis results presented in Section 3.0 used to develop contamination contours used to identify footprints for areas with elevated TPH concentrations indicative of a contaminate source. This data was also used to evaluate remedial measures in consideration of contaminate sources and migration/spreading consideration as presented in Section 5.0.

4.1 Historical Reports With Potential and Known Contamination Sourcing Focus

The following reports were specifically identified as having a primary objective of assessing and identifying potential environmental issues and potential sources of contamination for the study area.

- IOL retained ARC to carry out an "Environmental Review, former CN Rail Track, and KAPAC Property, Shippagan, NB." (was changed from KAPAC to EFL property) A-353 a, December 1997 in Appendix 21, to identify contamination issues.
- IOL retained AMEC Earth & Environmental Limited (AMEC) to carry out a "Historical Review of the Irving Oil Limited Bulk Plant and surrounding Properties Shippagan, NB" (Phase I ESA of the study area), September 2001, A-280 in Appendix 78.
- The Royal Bank of Canada Bathurst, NB retained Jacques Whitford Environmental Limited to carry out a "Phase II Environmental Site Assessment KAPAC Holdings Limited Site, Shippagan, NB" (now referred to as the EFL property, A-567, January 1996 in Appendix 79.
- Donald E. Gemmell and Mark Holder of Three-D GeoConsultants Ltd. re "Preliminary Outline of Shippagan Harbour Contamination" (TDG, 2001, June 26, 2001, Affidavit document A-281 a in Appendix 4).
- Investigations carried out in 2002 by TDG on the Eastpre Feeds Ltd. property only, "Report of Findings Shippagan Harbor Contamination Eastpre Feeds Ltd." (TDG, 2002, December 6 2002, Affidavit document A-285 in Appendix 80).
- IOL retained ARC to complete a "Site Investigation Report, Department of Natural Resources and Energy, Shippagan, New Brunswick, ARC Associates Limited, April 1998". A-117 in Appendix 28.
- IOL retained ARC to complete a "Site Investigation Report, Department of Fisheries Property, Shippagan, New Brunswick", ARC Associates Limited, April 1998. A-330 in Appendix 81.
- IOL retained ARC to complete a "Phase II – Investigation Report Shippagan, New Brunswick", A-332, August 1998 in Appendix 22.
- A "Phase I ESA Department of Fisheries and Oceans (DFO) Property Shippagan Small Craft Harbour (ID#2630) Shippagan, New Brunswick" was carried out by MGI, May 2001 in A-298 in Appendix 37 for the. Prepared for Environmental Services Public Works and Government Services Canada and Department of Fisheries and Oceans.
- Phase II and III ESA were carried out by MGI between 2002 and 2013 for the Department of Fisheries and Oceans (DFO) Property Shippagan Small Craft Harbour (ID#2630) (RPISCS#SM00400 LDU#04981) Shippagan, New Brunswick – Prepared For: Environmental Services Public Works and Government Services Canada and Fisheries and Oceans. A-307, February 2002, in Appendix 42 and A-308, July 2002 in Appendix 39, and FN A-931, February 2013, in Appendix 54.

Following is a discussion of the above noted reports in consideration of potential sources of contamination.

4.1.1 Former CN Rail Track and KAPAC (EFL) Property, Shippagan, NB.

The former CN Rail Track is referred to in this report as former CN ROW and was ownership was transferred to the NB Department of Natural Resources subsequent to rail operations being discontinued. As indicated previously, the site name/operation for EFL was previously KAPAC. The discussion in this section includes the following reports:

- DFO retained JWEL to carry out a "Preliminary Review-DFO Wharf-Shippagan, NB, letter report dated March 25, 1997, A-83 in Appendix 20.
- The Royal Bank of Canada Bathurst, NB retained Jacques Whitford Environmental Limited to carry out a "Phase II Environmental Site Assessment KAPAC Holdings Limited Site, Shippagan, NB" (now referred to as the EFL property, A-567, January 1996 in Appendix 79.
- IOL retained ARC to carry out an "Environmental Review, former CN Rail Track, and KAPAC Property, Shippagan, NB." (was changed from KAPAC to EFL property) A-353 a, December 1997 in Appendix 21, to identify contamination issues.
- IOL retained ARC to complete a "Site Investigation Report, Department of Natural Resources and Energy, Shippagan, New Brunswick, ARC Associates Limited, April 1998". A-117 in Appendix 28.
- IOL retained ARC to complete a "Site Investigation Report, Department of Fisheries Property, Shippagan, New Brunswick", ARC Associates Limited, April 1998. A-330 in Appendix 81.
- IOL retained ARC to complete a "Phase II – Investigation Report Shippagan, New Brunswick", A-332, August 1998 in Appendix 22.
- Donald E. Gemmell and Mark Holder of Three-D GeoConsultants Ltd. re "Preliminary Outline of Shippagan Harbour Contamination (TDG, 2001, June 26, 2001, Affidavit document A-281 a in Appendix 4)
- Investigations carried out in 2002 by TDG on the Eastpre Feeds Ltd. property only, "Report of Findings Shippagan Harbor Contamination Eastpre Feeds Ltd." (TDG, 2002, December 6 2002, Affidavit document A-285 in Appendix 80).

Preliminary investigations were carried out in December 1996 by JWEL on behalf of DFO (JWEL March 25, 1997A, A-83 (Contained in Appendix 20) as recommended by JWEL following pressure testing on the IOL underground petroleum transfer lines on September 13, 1996 (JWEL, November 13, 1996B, A-81 a in Appendix 19). The pressure testing was carried out by JWEL at the request of IOL and it was reported that "The testing revealed that these two abandoned pipelines did not pass pressure testing and were suspected of having been leaking during their operating life." It was indicated in the JWEL report, (A-83 in Appendix 20) that **"The preliminary investigation revealed significant hydrocarbon impacts to DFO property, with the greatest impacts being closest to the DNRE property. The adjacent DNRE property has been confirmed as being contaminated by hydrocarbons (gasoline).", and further indicated that "JWEL recommends that the extent of the contamination (both on and off DFO property) be established prior to DFO initiating any remedial action. DFO clean-up activities should be part of a joint effort which should include all impacted property owners. Premature clean up may result in recontamination of DFO property"**, and also "JWEL recommends that a copy of this report be sent to the DNRE to inform them of their obligation to address a known contamination problem in accordance with the New Brunswick Clean Environment Act (NB Regulation 87-97). JWEL also recommends that a copy of this report be sent to IOL. **Although preliminary investigations has not confirmed**

the IOL pipelines have contributed to the gasoline contamination, they are presently the most probable source.". ACER notes that the wording of the last sentence "has not confirmed the IOL pipelines have contributed to the gasoline contamination" with the term "contributed" likely infers recognition that the IOL bulk plant was known to be contaminated and a source to the area.

ACER Photos 3-6, 3-7 and 3-9 (also included in Appendix 72) taken in 2012 during upgrading of the Town underground services on the former CN ROW/driveway shows the two IOL underground gasoline lines uncovered. Petroleum staining is evident around the pipes with evidence of seepage. It is also evident from Photo 3-7 that there is petroleum discharge occurring from a nearby concrete pipe that originates from the IOL bulk plant property as indicated from Photo 3-6. It appears that the petroleum discharge is migrating through the soils with a portion of the flow following the gasoline pipeline as a preferential pathway. It is noted in IOL A-8 (Appendix 13) related to review of plan related to the CN license agreement with IOL for installation of underground petroleum lines that indicates "….to lay and maintain a 4 inch steel pipe, encased in a six inch iron pipe. On the present plan there are two (2) four inch pipes encased in concrete." It is also indicated in correspondence from DFO to Eric Smith, FN A-996 (Appendix 127) "that although the pipelines and unloading facility were removed in 1995-96, they have no documents attesting such." IOL was in non-compliance with conditions originally identified, pipes were to be installed inside iron pipes, and there was confusion related to the removal status of the lines. Further to this IOL did not follow through on their commitment to install the pipes in concrete, if that was actually approved. There did not appear to be any measures implemented for corrosi0on protection. The 6 inch encasement pipe or concrete would have provided a better quality installation with additional being provided from breakage and corrosion.

With respect to the"Environmental Review, former CN ROW , and KAPAC Property" (A-353 a, December 1997 in Appendix 21) by ARC, it is indicated in a letter dated January 23, 1998 to Claude Burry of DFO from Tom Gallagher of JWEL regarding his review of the report that **"The ARC report does not present the consultants field observations with respect to hydrocarbon odours or staining, or groundwater seepage and makes no conclusions based on the results of the soil samples analyzed, therefore, we can only provide comment on the laboratory results presented."** (A-353 a, December 1997 in Appendix 21). In the conclusions JWEL indicates that

""The investigation presented in this report does not delineate the gasoline impacts encountered on the DFO property beneath the abandoned IOL pipeline, and does not provide any conclusive information regarding the potential for other gasoline impacts beneath the pipeline.

The ARC investigation appears to be directed at shallow impacts in the area of the pipeline. Deeper investigations of the soil and groundwater will be required to determine the extent of the gasoline contamination encountered beneath the abandoned IOL gasoline pipeline on DFO property, or the potential for other gasoline impacts beneath the pipeline.""

In the letter to Mike Sauerteig of IOL from Claude Burry of DFO regarding the review completed by JWEL it is indicated that "**The findings of this review indicate that the ARC report does little to establish any conclusive results pertaining to hydrocarbon contamination of DFO property originating from adjacent Irving Oil operations.** We are quite disheartened to say the least, with the findings of the review. The local community council, harbour authority and SCH have been waiting 7 months since our site meeting of June 3rd. for a commitment and action plan from Irving Oil."

ACER also noted that the ARC "Environmental Review" report did not make any comments concerning the source of contamination identified on the KAPAC (EFL) site, located immediately adjacent to IOL bulk plant operations.

It is indicated in the ARC report "Environmental Review, former CN Rail Track, and KAPAC Property" (A-353 a, December 1997 in Appendix 21), that investigations were **carried out in October 1997** as follow up to preliminary investigations carried out in December 1996 by JWEL (A-83, contained in Appendix 20). The ARC report made reference to the preliminary investigations carried out by JWEL following pressure testing on IOL underground petroleum transfer lines on September 13, 1996 (JWEL, November 13, 1996B, A-81 a in Appendix 19). It was indicated in the ARC report that petroleum hydrocarbon contamination was reported by JWEL to be present for the test pit investigations carried out with respect to the two IOL underground gasoline transfer lines and on the EFL (formerly identified as KAPAC) property and that "Consequently, in late October 1997 ARC Associates Ltd. undertook a test pitting and soil and groundwater sampling program along the former pipeline route (ACER Note: former pipeline being referenced are the two IOL underground gasoline transfer lines that are still in place on the former CN ROW), and between the KAPAC Holdings property and the Irving Oil Bulk Plant.".

ACER further noted that the ARC "Environmental Review" report did not make any reference to the following two reports for investigations undertaken in March 1997, that provide additional information and bridging between the JWEL November 1996 (A-83, contained in Appendix 20) preliminary assessment in the area of the gasoline pipelines and the October 1997 preliminary assessment by ARC:

- IOL retained ARC to complete a "Site Investigation Report, Department of Fisheries Property, Shippagan, New Brunswick", ARC Associates Limited, April 1998. A-330 in Appendix 81.
- IOL retained ARC to complete a "Site Investigation Report, Department of Natural Resources and Energy, Shippagan, New Brunswick, ARC Associates Limited, April 1998". A-117 in Appendix 28.

It was indicated in A-117 that "A phase I test pitting investigation program was conducted by ARC Associates Ltd for Irving Oil on March 1997 with the construction of four test pits **on or adjacent to the break area**. This program detected the presence of petroleum hydrocarbon in the soils adjacent to and nearby the break." There was no mention of the pressure testing or JWEL site assessment reports. This report indicated that "This report provides details of a **Phase II investigation of the DNRE property**. The purpose of the investigation was to define the extent and concentration of contamination, resulting from the pipeline break, present on DNRE land."

It was indicated in A-330 that "A phase I test pitting investigation program was conducted by ARC Associates Ltd for Irving Oil on March 1997 with the construction of four test pits **on or adjacent to the DFO property**. This program detected the presence of petroleum hydrocarbon in the soils adjacent to and nearby the break." Similarly, there was no mention of the pressure testing or JWEL site assessment reports. This report indicated that "This report provides details of a **Phase II investigation of the DFO property**. The purpose of the investigation was to define the extent and concentration of contamination resulting from the pipeline break."

It would have been expected that ARC would have also made reference to these reports for the"Environmental Review, former CN Rail Track, and KAPAC Property" (A-353 a, December 1997 in Appendix 21) as the information would have been relevant to the "Environmental Review". The findings of these two assessment reports are discussed in Section 4.1.3, with "Pipeline Break" being the commonly used reference/catch phrase for related investigations for the SCH/DFO and DNRE properties located down gradient of the former CN ROW/driveway, associated with the two IOL underground gasoline pipelines.

The ARC "Environmental Review" report also made reference to the "Phase II Environmental Site Assessment KAPAC Holdings Limited Site, Shippagan, NB" (now referred to as the EFL property), carried out by Jacques Whitford Environmental Limited on behalf of The Royal Bank of Canada Bathurst, NB (A-567, January 1996 in Appendix 79). ACER noted that in the JWEL Phase II assessment that it is indicated that concentrations of petroleum hydrocarbons for one of the three soil samples exceeded NBDELG criteria for a Level II non- sensitive

site, with concentrations for the three groundwater samples below Level II criteria, but **the JWEL report also did little to establish any conclusive results pertaining to the source of hydrocarbon contamination identified on the KAPAC (EFL) property**. JWEL was aware of contamination issues for the adjacent IOL bulk plant property operations.

ACER further noted that in a ***May 2, 1997***, (A-87, in Appendix 43) NBDELG occurrence report No. 97-BA-0060 regarding an oil spill at the wharf, that a lobster fisherman reported petroleum sheening at the Old North Wharf at 8:00 in the morning and the coast guard investigated and reported that the petroleum product was coming from the rock around the wharf and notified DELG at 2:00 in the afternoon. It is indicated in the report that an NBDELG inspector went on site three days later on May 5, 1997 at 11:00 in the morning and checked around the end of the line formerly used by IOL. The inspector reported that **"There is quite a sheen, its hard to tell since I'm standing maybe 20 feet above water level but in some places it looks like it's thicker than the usual rainbow**." **It was noted in the report for the date of *May 6, 1997* that nothing could be done about the petroleum in the water but they wanted to "find and control the source". It was indicated that on June 3, 1997 that Raymond Morin met with the bulk plant manager Bruno Roussel and Johnny Grant regional Manager for IOL and it was indicated that "DNR will determine who owns what, then IOL will make a site assessment.". It was indicated on *April 4, 1998* at a meeting held with all parties involved that "IOL will try to schedule clean up in July" (1998).**

ACER notes that the comment "**it looks like it's thicker than the usual rainbow**" for the petroleum sheen would indicate that discharge of petroleum in this area of the wharf was a common occurrence, providing further evidence of a long term persistent source of contaminates that would be consistent with assessments for the IOL bulk plant property operations (constructed circa 1944) and/or the IOL gasoline pipeline "suspected of having been leaking during their operating life", installed circa 1938. As indicated, the IOL underground petroleum transfer lines extend from the IOL bulk plant property to the end of the wharf to the former tanker ship offloading facilities. The location of the pipeline break and the intermediate valve box are shown on Figure 1 of the ARC A-117 report in Appendix 28. The location of the pipeline break and the intermediate valve box are also shown on Figures 4-15 and 4-16 (also provided in Appendix 96), as an overlay on an ARC drawing for soil and groundwater **hydrocarbon concentration contours**, respectively, for the IOL bulk plant area **and the FN, MEL and DFO/DNRE properties in *August 1998*,** with the WS/FN WELL also identified. The location of the pipeline break and the intermediate valve box are also identified on ACER Figures 4-1 and 4-2 showing soil and groundwater contamination contours for the more current ACER investigations, respectively (also included in Appendix 97). It appears from the field log/monitoring report that **groundwater remediation did not commence until circa *July 1999*** (FN A-1804 in Appendix 27).

The above describes the progression of incidents and activities that resulted in the discovery of significant contamination of the former CN ROW/driveway with the two IOL underground gasoline transfer pipelines leading to additional investigations by IOL for the SCH/DFO and NBDNRE properties (reports A-330 in Appendix 81 and A-117 in Appendix 28 indicated above not to be included in the ARC "Environmental Review", A-353 a, in Appendix 21) and subsequently the FN and MEL properties. Further details are presented in Section 4.1.3, for investigations associated with the two IOL underground gasoline pipelines including the SCH/DFO and DNRE properties (former CN ROW/driveway). The above further supports that contamination was reaching the harbour with the CN ROW/driveway and underground services that extend to the wharf providing for preferential flow, with the IOL bulk plant, former CN Rail tanker car offloading area and the two IOL underground petroleum transfer lines representing apparent sources, with contamination also spreading across the SCH/DFO, DNRE, FN and MEL properties.

With specific reference to the KAPAC/EFL property there are several IOL consultant reports that contend that there is a contamination source on the EFL or another property that impacts the EFL property and in turn the IOL property. The ACER report A-219 in Appendix 7 for the EFL property indicates that the IOL property is the apparent source of contamination to the EFL property. In brief, the IOL property is considered to be the apparent source of contamination to the EFL property for the following reasons:

- for initial investigations by ACER for the EFL localized site shallow groundwater flow on the EFL property was indicated to be from south to north with a flow divide likely for the IOL bulk plant due to mounding. ACER 2016 investigations that included the IOL bulk plant confirmed strong groundwater flow gradients south to north from the IOL bulk plant property onto the EFL property and components north to south towards 14th St and towards the FN and MEL properties(Figure 3-4 in Appendix 73);
- IOL sample locations MW4 and MW6 were located on the EFL property but were immediately adjacent to northern property boundary with the bulk plant site where the sump trench and underground service trenches for the remediation system are located and given groundwater gradients being towards EFL are considered to represent groundwater contamination migrating off the IOL property at the property.
- concentrations were significantly lower for the Eastpre Feeds Ltd. property for all reporting events between 1992 and 2007 compared with the IOL property that showed significant increases in concentrations and thicknesses of free phase product.
- with concentrations for the groundwater being 4 to 8 times higher for groundwater samples at the southern IOL property boundary compared to IOL sampling locations MW4 and MW6 for the northern property boundary and eastern property boundary with the former rail siding petroleum offloading rack. Contamination in the soil was also greatest in the shallow soils, 1.2 to 1.5 metres below existing grade, south of the Truck Loading Stand located on the opposite (southern) side of the IOL property.
- free phase (floating) petroleum product was first detected/reported on the IOL property in December 1990, with free phase product measured at 37 cm near the former Truck Loading Stand, with only a petroleum sheen being reported for IOL locations MW4 and MW6 on the EFL/IOL property boundary, with locations being immediately adjacent to the property boundary with IOL.
- insufficient containment of contamination noting that RW2 located at the EFL and IOL property boundary drawing contamination in the direction the south west corner of the EFL building where MW14 is located, and increasing the potential for contaminant to move in that direction during periods of non-operation of the pumps (days to months);
- frequent periods of non-operation of the remedial wells due to pump failure or otherwise.
- groundwater flow conditions that temporarily occur as a result of rainfall events and raising of the water table on the bulk plant site such that there is an additional increase in flow that occurs toward EFL and tidal loading effects increasing spreading;
- preferential flow towards the EFL property further afforded by the underground service trenches installed for the remediation system that are located parallel to the sump collection trench located at the EFL/IOL northern property boundary where spillage is collected for the containment dike (see Photo 4-4).
- the underground fuel oil transfer line exits the dike near the sump trench and based on contamination contours, shown in Figures 4-1 and 4-2, (also provided in Appendix 97) for soils and groundwater, respectively, represents an apparent source pathway for contamination to the EFL property.

- with migration expected to be promoted by the presence of underground services lines reported to be located between EFL and the IOL property as well as the underground services on the EFL property and 12th St. likely having a ""french drain" effect.
- with migration expected to be further facilitated by the foundation wall on the south west side of the EFL building and Town underground storm lines near the building.
- land use on the EFL property was for cold storage with freezer operations with no requirement for petroleum storage for heating or otherwise..

Details regarding and supporting the above statement are provided below from ACER, 2012A, A-291 in Appendix 7.

Sampling and reporting was undertaken by IOL for neighbouring properties including Eastpre Feeds Ltd. to the north, FN Pecheries to the east, Marine Extract Ltd. to the east and Enterprise Shippagan Ltd. to the south as part of IOL supplemental investigations with respect to the IOL bulk plant property. The IOL environmental consultants carried out intrusive BH/MW investigations for Eastpre Feeds Ltd. for the first time in March 1992, and groundwater reporting for April 1992 (ARC, 1992, Affidavit document A-450, in Appendix 101).

With specific regards to the EFL property, as discussed in Section 4.1.2 to follow, it is documented in the AMEC 2001 report (A-280 in Appendix 78), a historical review of study area on behalf of IOL (ACER notes that this was equivalent to a Phase I ESA), that the EFL property was identified as a contaminated site and was cleaned up with no further action required, with confirmation sampling having been carried out by the DELG. Two 45 gallon storage drums containing refrigeration oil and stained surface soils were the basis for DOE indicating storage that the Eastpre Feeds Ltd. property required some remedial clean-up in November 1992. The two 45 gallon storage drums and seven 45 gallon drums of stained soils excavated from a localized area to a depth of about 20 cm, containing unidentifiable products in the heavy petroleum hydrocarbon range were removed, and sampling carried out by DOE in July 1993 confirmed remedial clean-up was acceptable. The remedial file was officially closed in March 1994 based on the July 1993 sampling.

ACER, FN A-943 in Appendix 122 indicates:

""Nolan Davis & Associates Limited (NDA) carried out an assessment for the Bulk Storage Plant to evaluate the permeability of the floor and surrounding berms for the diked containment area of the tank farm (December 22, 1992- from MD Riley, Nolan Davis and Associates to Ian Mosher, IOL, site assessment of permeability of the floor and surrounding berms of the diked containment area, Affidavit document A-469 in Appendix 83). **The liner soils were described as a "silty sand and gravel"**. Hydraulic conductivity testing indicated the soils to have a coefficient of permeability of 5x10-6 cm/sec. It was reported that The Province of New Brunswick Construction Standard for Petroleum Storage Systems specify "the walls and floors of the diked area and any interconnecting channel shall have an impermeable lining of a material designed and maintained to be liquid tight to a permeability of 1x10-7 cm/sec". The difference between the laboratory value and the Provincial requirement is 50 times different/higher.

The permeability of the soil lined bulk storage petroleum containment diking system was not in compliance with Regulatory requirements, with the permeability being 50 times higher. Due to the large quantity of petroleum product was spilled in 1989 (over 3,600 litres), groundwater sumps installed to capture petroleum had to be pumped into the on-site 20,000 gallon diking system. Quantities spilled and pumped to the 20,000 gallon diking system and time frames for storage and removal could not be confirmed**. The higher permeability of the dike system soils provide an opportunity for increased infiltration and migration of petroleum hydrocarbons into the underlying soils during storage periods."**

There would also be an increase in contaminated water infiltration into the completely to high weathered bedrock and groundwater.

In addition to the above, the sump collection trench where petroleum spillage is collected for the containment dike of one of the tank farms is located at the EFL/IOL northern property boundary (see Photo 4-4). Petroleum spilled in the containment dike or intentionally stored in the dike area, as reported to occur for the site, ponds in the sump trench and given the location, poor liner conditions of the dike liner, location of adjacent services lines and site flow gradients, flow would be expected to favour migration onto the EFL property as supported from the contamination contours in Figures 4-1 and 4-2 (also provided in Appendix 97) for soil and groundwater, respectively. Similarly, these conditions would be expected to also result in flow favouring migration towards the former CN ROW from the sump trench, as supported from the contamination contours in Figures 4-1 and 4-2.

It is indicated in ACER 2012, A-291 in Appendix 7 that:

""ARC 1992, indicated that the "Groundwater flow beneath the bulk plant is from east to west." As shown in Figure 2 in Appendix A2, and this mindset carried forward in subsequent reports. From the historical review it was noted that in the ARC as built report dated May 20, 1993 (ARC 1993A) that ARC indicated for RW2 that "Consideration of the drawdown data available from the pumping of RW-1 indicated that in the area of MW6, drawdown effects from pumping of RW1 were minimal. Consequently, it was decided to place the second remedial well in this area in order to achieve more efficient zone of capture for the contaminated groundwater across the site." The change made by ARC on the basis that there was no influence at MW6, would indicate that there was a concern with flow of contaminated groundwater from the bulk tank storage areas towards the Eastpre Feeds Ltd. property.""

The above conditions are likely a key factor in accounting for the surges in concentrations observed at monitoring locations on the EFL property during periods that typically result in increased mobilization of contamination such as spring and fall wet periods, with localized flow of contaminated groundwater in the tank farm favouring the direction of the sump trench and continuing to migrate off site for reasons given above. There were no pumps or treatment systems on site to collect and treat liquids from the sump trench(es). Similarly, accidental spillages would also be expected to result in surges, with surges in turn also being a likely indicator of spillage, while seasonal influences should also be factored in.

Further to the above, IOL recovery well RW2 being located on the EFL property and several metres from the sump trench, would also draw contamination onto the EFL property from the bulk plant property in addition to migration occurring due to site groundwater flow gradients. It is indicated in ACER 2012, A-291 in Appendix 7 that "In a monitoring report dated January 15, 1993 (ARC, 1993J) the following was indicated concerning groundwater flow "Groundwater elevation data collected during the monitoring visit, December 22, 1992, indicates the remedial wells are only partially effecting local groundwater flows to control the migration of dissolved hydrocarbons." In a letter from ARC to Ian Mosher dated Jan 20, 1993 it was indicated that "it is apparent that we need to effect a greater influence on the dissolved hydrocarbon plume at the site, we would suggest the installation of an additional remedial well located in the area of BH8M (Figure 1) and to increase the pumpage from RW1 and RW2". Containment was an initial concern expressed by the DOE and continued to be a concern."

ARC, 1994 reported on the installation of RW3, installed in November 1993, located in the area of BH8M where free phase product continued to be detected with thicknesses of 35cm being recorded. Prior to this IOL relied upon RW1 and RW2 installed in 1992 to recover contaminated groundwater and it is expected that higher volumes of more highly contaminated groundwater from the southern side of the bulk plant moved towards and onto the EFL property. Of particular note is that the RWs were frequently reported to be non-operational for weeks and months and during these periods, there was additional opportunity for highly contaminated groundwater drawn

towards the EFL property to continue to move onto and across the property due to site groundwater flow gradients. This in turn would also provide an opportunity for more highly contaminated groundwater to flow onto adjacent residential and commercial properties west, north and east of the EFL property. Concentrations obtained by ACER in 2009 showed petroleum concentrations at the west, north and east property boundaries to be below RBCA residential non-potable criteria and CCME guidelines. The concentrations in the groundwater were lower for these boundaries indicating no other apparent sources for the EFL property other than the IOL bulk plant.

ACER, FN A-943 in Appendix 122 further indicates:

“”For the IOL property, gasoline range hydrocarbons were reported in November 1989 at all sampling locations, with fuel oil range hydrocarbons reported for the second monitoring event in July 1990, and gasoline and fuel oil range hydrocarbons reported for the third sampling event in December 1990, with free phase fuel oil product reported in the area of BH5M and BH7M in the area of the former truck loading stand. Sampling carried out by WMS (Subsequently ARC was established by senior personnel of WMS) in November 1989 (WMS, 1990A, Affidavit document A-435 a in appendix 102). showed petroleum hydrocarbon concentrations to be about five times higher for soil samples located near the southern property boundary immediately south of the Truck Loading Stand (upper value of 230 ppm in the soil at BH5-M), with concentrations for the groundwater being 4 to 8 times higher for groundwater samples in this area (upper value of 46 ppm in groundwater at BH7-M) compared to sampling at IOL MWs4 and MW6 (ACER inserting “at IOL MWs4 and MW6”) on the IOL property near the property boundary with Eastpre Feeds Ltd. (upper value of 43 ppm in soil at BH1-M and 6.36 ppm in groundwater at BH1-M). **Contamination in the soil was also greatest in the shallow soils, 1.2 to 1.5 metres below existing grade, south of the Truck Loading Stand compared with 2.7 to 4.6 m depths at locations on the IOL property near the northern property boundary for IOL/Eastpre Feeds Ltd.””**

Normally a contamination source property shows higher concentrations in the shallow soils, supporting that the bulk plant property is an apparent source.

ACER, FN A-943 in Appendix 122 further indicates:

“”Naphthalene concentrations increased by several orders of magnitude at these locations for this event as well. However, initial sampling and analysis of groundwater samples on the Eastpre Feeds Ltd. property in April 1992 (ARC, 1992, Affidavit document A-450, in Appendix 101), at locations established by an IOL consultant on behalf of IOL, indicated only low level (ACER inserting “low level”) gasoline range hydrocarbons to be present. **Given the following:**

- **that only MW10 located between the IOL storage berms showed fuel oil and gasoline PHCs and only gasoline concentrations were detected at the other three locations on the Eastpre Feeds Ltd. property when first sampled in April 1992;**
- **and recognizing that only gasoline was initially reported in November 1989 at all sampling locations on the IOL property, but fuel oil range hydrocarbons were reported for the third sampling event in December 1990, with free phase fuel oil product reported in the area of BH5M and BH7M in the area of the former loading rack for the IOL property;**

this supports the assertion that the IOL property is an apparent source of PHCs…””

The IOL property is an apparent source of PHCs recognizing that the highest concentrations and free phase product present are expected to occur on the source property, and particularly more so if the thickness of free phase product is comparably greater. In addition, after initial sampling in April 1992, gasoline and fuel oil range hydrocarbons were reported for the second, fourth and fifth events, with resemblance not reported for the third event for the Eastpre Feeds Ltd. property, and concentrations were also significantly lower for

the Eastpre Feeds Ltd. property compared with the IOL property**. The IOL bulk plant was the only apparent source of fuel oil and would be expected to migrate onto the EFL property given groundwater flow gradients and RW2 pumping. This further supports the assertion that the IOL property is an apparent source of PHCs**.

ACER, FN A-943 in Appendix 122 further indicates:

The thicknesses of free phase petroleum product reported by the IOL consultants is provided in Tables 1-1A through 1-1D, in Attachment 15, from ACER 2012, A-291 in Appendix 7. **Free phase (floating) petroleum product was first detected/reported on the IOL property in December 1990 (WMS, 1991, letter report dated February 25, 1991 to IOL, Affidavit document A-445 a in Appendix 103, after initial sampling in November 1989 showed gasoline at all locations** (WMS, 1990A, Affidavit document A-435 a, in Appendix 102). **The free phase product was reported for locations immediately south of the former Truck Loading Stand. Free product was not observed at any of the other boreholes on the bulk plant site or those located on the Eastpre Feeds Ltd. property (including MW4 and MW6 adjacent to the IOL/EFL property boundary). Free phase product thicknesses in the order of 35 cm were measured in the area of the former Truck Loading Stand in May 1993**, (ARC, 1993, Affidavit document A-489 in Appendix 115) and **subsequently being reported frequently at locations immediately south of the former Truck Loading Stand near 14th St**. **Free product was reported for the IOL and EFL properties for the last IOL monitoring report provided in 2007 (FN A-1027, FN A-1028, FN A-1029 and FN A-1030 in Appendix 17).**

Continuing, ACER, FN A-943 in Appendix 122 further indicates:

The measurements provided in Tables 1-1A through 1-1D, from ACER 2012, Affidavit document A-291 in Appendix 7) **indicate that only trace amounts of free phase product were first detected/reported in water samples collected from several locations established on the Eastpre Feeds Ltd. property in April 1993** (ARC,1993B, Affidavit document A-489, in Appendix 115), **after initial sampling in April, 1992** conducted on behalf of IOL assessment and remedial efforts showed gasoline at all locations on the IOL property, except MW10 located on the EFL property that extends between the IOL containment berms (ARC,1992, Affidavit document A-450, in in Appendix 101). **In May 1993 free phase product was measured at 37 cm near the former Truck Loading Stand (ARC, 1993, Affidavit document A-489, in Appendix 115), with only a petroleum sheen being reported for locations on the Eastpre Feeds Ltd. property, but noting the locations are immediately adjacent to the property boundary with IOL (MW4 and MW6) and subject to influence/migration from the IOL property due to natural groundwater flow, and recovery well and pipe trenching influences for the groundwater remediation system.** However, concentrations reported for some of the Eastpre Feeds Ltd. property samples did not appear to be of a magnitude that would reflect/indicate measureable free phase product to be present.""

For May 1993 (A-485 in Appendix 123) TPH concentrations on the EFL property ranged from non-detectable at MW11 and MW14 to 3,100 mg/L at MW15 (at end of ELF building opposite the IOL bulk plant property) compared with values ranging from non-detectable to 13,000 mg/L at MW6 (at the EFL/IOL property boundary and adjacent to the petroleum spill "sump collection trench" of an IOL tank farm). Free product thicknesses were greater on the bulk plant site for MWs located between the truck loading rack and 14th St. Properties with greater free product thicknesses are typical of an apparent source property and given that the bulk plant showed between 5 and 37 cm for a long period of time compared with sheening as reported for the EFL property several months after free product was reported for the bulk plant and groundwater flow occurs toward the EFL property, this supports IOL being an apparent source property.

Free product layers or sheening detected on the Eastpre Feeds Ltd. property between April 1993 and October 1994 were for MW4 at the EFL IOL boundary, and between April 1993 and March 1994 for MW6 at the EFL/IOL boundary several months after remedial pumping wells were put into operation. Operation of the RWs would further increase groundwater flow gradients toward the EFL property from the bulk plant site with increased potential for contaminated groundwater to move further onto the EFL property with normal flow gradients. Particularly given that trenches were excavated for remedial lines to the recovery wells adjacent to MW4 and MW6 and provided for preferential flow conditions and RW3 was not installed until almost two years later on the opposite side of the bulk plant in an effort to improve the capture area for contaminated groundwater.

Free product was not detected between October 1994 and April 1999 at any of the MWs on the EFL property, with free product only being detected between April and December 1999 at MW14, when increases were even more significant on the IOL bulk plant property (ACER indicates likely Event related).

Continuing, ACER, FN A-943 in Appendix 122 further indicates:

""It was further noted by ACER that order of magnitude increases in petroleum hydrocarbon concentrations were evidenced at a number of locations on the IOL property (371,000 to 411,000 ppb) for the April 21, 1993 sampling event with only traces of free phase petroleum hydrocarbons detected at BH5M, BH6M, BH7M as gasoline, MW5S as gasoline, with MW4 as fuel oil, and MW6 and MW15 as fuel oil and gasoline (21,300 to 27,400 ppb) on the Eastpre Feeds Ltd. property (see Tables 1-1A to 1-1D, in ACER, 2012, A-291 in Appendix 7). It is our opinion that concentrations reported for MW4, MW6 and MW15 were not representative of significant free phase product being present. **It was noted from this assessment that hydrocarbon concentrations at MW4, located adjacent the IOL and Eastpre Feeds Ltd. property boundary, became elevated in April 1993 at the time when free phase product was detected at BH5M, BH7M and BH8M located between the truck loading stand and 14th St., measuring in the order of 35 cm in thickness between May and September 1993. For December 1993 sampling, free phase product was present at BH6M and BH7M with adjacent BH8M showing gasoline. However, there was no free phase product reported for MW4, MW6 (at EFL/IOL northern property boundary) or MW15 (located near the EFL building foundation wall opposite the IOL property), and concentrations had decreased significantly compared with the April 1993 observations.""**

The order of magnitude increase in concentrations in April 1993 indicated above may be associated with seasonal fluctuations but an increased thickness of free phase product over a 5 month period would typically be expected to be due to additional release of product. Historical information regarding reported and unreported spills provided in Section 1.3. It is demonstrated in the documentation frequently, that IOL did not appear to be diligent in taking/expediting corrective measures to address spill containment and remediation issues (see Background, Section 1.3 in the ACER, 2012 EFL report, A-291 in Appendix 7, and Section 1.3 of this report).

Given that concentrations of PHCs continued to be highest on the IOL property, the presence of petroleum sheening was first detected on the IOL property, petroleum first being recorded on the IOL property with values of 37cm thickness compared with only sheening for wells at the EFL and IOL property boundary, supports that the IOL property was the apparent source of contamination.

It is indicated in several of the IOL consultant reports that based on the results for MW14 located on the EFL property that there is another source. For monitoring last reported for 2007 by Dillon, FN A-1028 in Appendix 17, it is indicated that "The source of the product is potentially located off site." This well was installed in 1992 and it was not until sampling carried out in June 1993 that petroleum hydrocarbons that resembled gasoline were first detected in the groundwater at MW14 at a low TPH value of 0.055 mg/L, with subsequent concentrations reported as non-detectable until November 1997 when free phase product was indicated (see Tables 1-1A through 1-1D, in

ACER 2012, A-291 in Appendix 7). It is important to note that between December 1995 and November 1997, that orders of magnitude increases in petroleum hydrocarbon concentrations occurred on the IOL property, and significant issues with providing containment of the contaminate plume on the IOL property occurred, **with increases also occurring on the Eastpre Feeds Ltd. property *but to a lesser extent***. In our opinion, the significant increases are attributed to an "Event" associated with contamination issues on the IOL property.

It is indicated in ACER 2012, A-291 in Appendix 7 that:

"In a monitoring report dated January 15, 1993 (ARC, 1993J) the following was indicated concerning groundwater "Groundwater elevation data collected during the monitoring visit, December 22, 1992, .indicates the remedial wells are only partially effecting local groundwater flows to control the migration of dissolved hydrocarbons." In a letter from ARC to Ian Mosher dated Jan 20, 1993 it was indicated that "it is apparent that we need to effect a greater influence on the dissolved hydrocarbon plume at the site, we would suggest the installation of an additional remedial well located in the area of BH8M (Figure 1) and to increase the pumpage from RW1 and RW2". Containment was an initial concern expressed by the DOE and continued to be a concern. ARC, 1994 reported on the installation of RW3, installed in November 1993, located in the area of BH8M where free phase product continued to be detected with thicknesses of 35cm being recorded. This suggests a misleading position concerning soil treatment efforts and ensuring that the impacted groundwater plume was being adequately contained.""

Location BH8M is located between the truck loading rack and IOL southern property boundary where free phase product was first reported 3 years earlier in December 1990.

Continuing, it is further indicated in ACER 2012, A-291 in Appendix 7 that:

""IOL monitoring in January, 1995 (ARC, 1995A) showed some notable increases in petroleum hydrocarbon concentrations at select locations for both properties, with monitoring in August 1995 showing some increases in petroleum hydrocarbon concentrations in both the fuel oil and gasoline range for the IOL property and significant improvements at MW4 on the Eastpre Feeds Ltd. property (ARC, 1995D). Free phase product was recorded for the IOL property only. Concentrations of TPH in the groundwater on the Eastpre Feeds Ltd. property for August, 1995 ranged from 1.6 mg/L as gasoline at MW6 to 37 mg/L as fuel oil at MW4. However, it was noted that an independent assessment of the Eastpre Feeds Ltd. property was carried out by Jacques Whitford Environment Limited (JWEL) in December 1995 on behalf of the Royal Bank of Canada (JWEL, 1996A). Results showed concentrations of TPH in the groundwater to range from 0.23 to 0.39 mg/L as fuel oil at locations in close proximity to MW4 and MW6, in the area between MW4/MW6 and the Eastpre Feeds Ltd. warehouse. Relative concentrations appear to indicate the source to be located on the IOL property, having higher values. The footprint of the groundwater plume depicted midway between January and September 1995 is provided in Figure 3 of the May 1995 monitoring event (ARC, 1995C). The figure shows groundwater contamination extending across the IOL site and onto the Eastpre Feeds Ltd. property as well as the former railway line, FN Fisheries, and a property to the south (ARC, 1995C).""

Continuing, it is further indicated in ACER 2012, A-291 in Appendix 7 that:

""Additional investigations were carried out in November 1997 by ARC (ARC, 1997B in A-353 a in Appendix 21), on behalf of IOL, that included the Eastpre Feeds Ltd. property (referred to at that time as the KAPAC Property in the ARC report), and the former CN rail track. The December 1995 sampling by JWEL, 1996A and November 1997 sampling by ARC, 1997B in A-353 a in Appendix 21 indicated TPH concentrations in the soil and groundwater to be low compared with values being reported for the IOL property, and concentrations were of similar magnitude for the soil and groundwater for the respective reports. Soil analysis results for samples obtained at a depth interval of 1.7 to 2.1 m below ground surface, based on the Test Pit logs, showed TPH

concentrations of 460 mg/kg as fuel oil and115 mg/Kg as fuel oil, and non-detectable at locations TP7, TP9 and TP10 established on the Eastpre Feeds Ltd. property, respectively. Location TP10 is in close proximity to MW2 installed by JWEL, 1996 that showed a concentration of 440 mg/kg for a soil sample obtained at a depth interval of 1.22 to 1.75m below ground surface. The maximum TPH value in soil recorded for the Eastpre Feeds Ltd. property by ARC, 1997A in A-592 a,b in Appendix 21 was 0.46 mg/kg for TP9 located adjacent to the RW2.""

Continuing, it is further indicated in ACER 2012, A-291 in Appendix 7 that;

""Sample location MW2 (JWEL, 1996A) and MW14 (ARC, 1992B) are located in very close proximity to each other on the Eastpre Feeds Ltd. property. ARC 1997B reported that MW14 contained free phase product that was reported to resemble neat motor oil. However, the adjacent location MW2 showed a TPH concentration for groundwater of 0.3 mg/L as fuel oil reported for a sample collected in December 1995 by JWEL, 1996 (maximum TPH value of 0.39 mg/L as fuel oil obtained for MW1). Previous sampling, initially carried out in April 1993 by ARC (ARC 1993B) at MW14, showed concentrations in the groundwater to be non-detectable as did the May 1993 event (ARC 1993C).""

Continuing, it is further indicated in ACER 2012, A-291 in Appendix 7 that:

""It was not until sampling carried out in June 1993 that petroleum hydrocarbons were first detected at MW14 at a TPH value of 0.055 mg/L, that resembled gasoline, with concentrations reported as non-detectable for August 1993 (ARC, 1993E), November 1993 (ARC, 1993F), November 1994 (ARC, 1994B) and August 1995 (ARC, 1995D). Concentrations of TPH were detected in the groundwater at TP6/SP2 and TP7/SP3, located along the former rail track east of the Eastpre Feeds Ltd. building and adjacent to residential areas to the west, with values of 0.16 mg/L as gasoline and 0.28 mg/L as fuel oil, respectively. It is important to note that between December 1995 when JWEL (1996) carried out investigations and November 1997 when ARC (1997B) conducted investigations, that order of magnitude increases in petroleum hydrocarbon concentrations possibly due to an "Event(s)" and significant issues with providing containment of the contaminate plume on the IOL property occurred as discussed below.""

Continuing, it is further indicated in ACER 2012, A-291 in Appendix 7 that:

""Monitoring for 1996 generally showed concentrations to be increasing throughout the year with significant values being reported for November 28, 1996, showing TPH ranges of 130 mg/L as fuel oil at MW4, 7.5 mg/L at MW6 as gasoline and 200 mg/L at MW15 as fuel oil and gasoline for the Eastpre Feeds Ltd property and 0.23 mg/L at BH1as fuel oil to 310 mg/L at BH7M as fuel oil and gasoline for the IOL property (ARC, 1997A in A-592 a,b in Appendix 21). Free phase product was recorded for the IOL property only, with 0.25 litres of free phase product being removed from BH6M and BH7M. It was odd to observe that a monitoring event was also conducted on November 25, 1996 (1997A in A-592 a,b in Appendix 21), with results in the area of BH7M and BH8M on the IOL property showing a very low TPH concentration of 1.2 mg/L as fuel oil and gasoline at BH8M, compared with a value of 310 mg/L fuel oil and gasoline at BH7M on November 28. It was similarly observed that for the Eastpre Feeds Ltd. property, the concentration at MW4 also increased from a value of non-detect on the November 25 sample date, compared with a TPH value of 130 mg/L as fuel oil for the November 28 sample date.""

Continuing, it is further indicated in ACER 2012, A-291 in Appendix 7 that"

""It was further noted from the historical review that according to the sampling checklist dated November 25, 1996 that none of the three recovery wells were operating. It was also noted from the review that RW2 that has an influence in the area of MW4, and RW3 that has an influence in the area of BH7M and BH8M were not pumping (ARC, 1997A in A-592 a,b in Appendix 21). It was also noted from the review that MW5D appeared to have been decommissioned circa January 1997. The footprint of the groundwater plume is provided in the Figure in the

November 1996 monitoring event (ARC, 1997A in A-592 a,b in Appendix 21). The figure shows groundwater contamination extending across a large portion of the IOL site and onto the Eastpre Feeds Ltd. property as well as the former railway line, FN Fisheries, and a property to the south (ARC, 1997A in A-592 a,b in Appendix 21)."

Continuing, it is further indicated in ACER 2012, A-291 in Appendix 7 that:

""Monitoring results for August and September 1996 showed that petroleum hydrocarbon concentrations on the IOL and Eastpre Feeds Ltd. properties may experience an order of magnitude increase. However, it was also noted from the review that RW2 that has an influence in the area of MW4, MW6 and MW15, and RW3 that has an influence in the area of BH7M and BH8M were not pumping (ARC, 1997A ACER adding reference of A-592 a,b in Appendix 21 to this quotation). It was also indicated that "It should be noted that a 0.01 m layer of undissolved petroleum product was measured in monitoring well BH6.", and that "Consequently, groundwater flow beneath the remainder of the site moves from west to east/northeast under natural groundwater conditions." being in the direction of the FN/MEL, SCH properties and marine receiving waters. In a letter from ARC to Mr. Mike Sauerteig dated October 10, 1996, ARC indicated that "MW3 has shown a steadily increasing level of dissolved hydrocarbons (e.g., 2,300 ppb in April 1996 to 6,100 ppb in August 1996). This well is located approximately 3.0 metres beyond the IOL property boundary."" and that "These concentrations would indicate the plume is moving off-site in a northerly direction….".

ACER notes that ARC indicates the plume is moving off-site in a "northerly direction" based on steadily increasing levels of dissolved hydrocarbons at MW3, but MW3 is located to the east on the CN ROW property towards the harbour. ACER believes the north arrow is incorrectly referred to in this instance. Refer to the Figure in the ARC monitoring report (ARC, 1997A, A-592 a,b in Appendix 21) that shows the north arrow in the title box and may be mistakenly used for referencing, when compared with ARC Figure 4 (in A-450 in Appendix 101) that shows the north arrow outside the title box and MW3 to the east of the IOL property. Also refer to Figure 1-5 of ACER report (is Figure from ARC A-481a in Appendix 24, with ACER Figure 1-5 also included in Appendix 24) that shows the north arrow outside the title box and context for groundwater flow off the IOL property (but did not include location MW3), with Figure 3-4 (also in Appendix 73) for the ACER investigations showing groundwater flow for the study area.

Continuing, it is further indicated in ACER 2012, A-291 in Appendix 7 that:

""Monitoring for February 18, 1997 showed continued increases in petroleum hydrocarbons for both properties with BH5M located on the IOL property showing an unusually high TPH concentration of 150 mg/L, in the fuel oil range and the nearby RW3 contained hydrocarbon product (IOL laboratory analysis report dated February 26, 1997). Free phase product was recorded for the IOL property only. The increases observed for 1995, 1996 and 1997 appear to reflect "EVENTS" or an "EVENT" associated with the IOL property, also recognizing that fuel oil and gasoline were detected at significant concentrations on the IOL and Eastpre Feeds Ltd. properties. Firstly, it was noted that order of magnitude increases appeared to first occur in the fall and winter periods. This may be associated with increased water levels due to the more significant tidal effects that may occur in the fall to spring period, in combination with the pumps not operating consistently. An increase in the elevation of the groundwater table may result in the mobilization of residual hydrocarbons from impacted soils by washing/flushing, with a resultant increase in hydrocarbon concentrations in the groundwater. As indicted previously, a VES was not installed until the fall of 1994 and was only connected to BH6M and BH8M (ARC 1995A).""

Therefore, contaminated soils that represent an on-going persistent long term source would be mobilized thereby resulting in an increase in concentrations as previously discussed.

Continuing, it is further indicated in ACER 2012, A-291 in Appendix 7 that:

""The increases in hydrocarbon concentrations observed for 1994, 1995, 1996, 1997, 1998 and 2000 appear to reflect "EVENTS" or an "EVENT" associated with the IOL property, also recognizing that fuel oil, gasoline and Naphthalene were detected at significant concentrations on the IOL and Eastpre Feeds Ltd. property, with increases observed for 1998, 1999 and 2000 being primarily limited to the IOL property. A possible "EVENT(s)" may have also occurred in the fall to spring periods in 2000 based on the significant increase in TPH concentrations on the IOL property compared with 1999 values.""

Continuing, it is further indicated in ACER 2012, A-291 in Appendix 7 that:

""From the historical review it was noted that there was a gasoline spill due to gasket failure on a tank recorded for July 13, 1994, with an unknown amount of product spilled (DOE Occurrence Report No. 94-BA-0177, Dated 13/07/94). It is critical to note that there was no quantity identified, but given that water was pumped from a sump location for almost two months and a sheen was still evident it would appear that there was a significant release. It is also critical to note that the failure was indicated to be a gasket failure, and it is likely that product was being released for a number of weeks or months before the "failure" was detected. This would contribute to contamination of soil and completely to highly weathered bedrock and groundwater, and a long term persistent source of contamination from the soils and weathered bedrock.""

It is also noted that there was an incident in December 1997 that required a lift station located on 16th St, one street over from 14th st for the IOL bulk plant, to be shut down **due to gasoline infiltration into the sewer lines** between 12th St and 15th St (see Section 9.5a in FN A-1887 a in Appendix 64). Gaskets on the sewer line are reported to breakdown due to gasoline in the soils and groundwater in the area of 12th St to 15th St, with IOL bulk plant and underground petroleum transfer lines being located between these streets. Environment NB measured the gasoline content in the manhole at 67 percent. Product was removed from a manhole with pumping carried out over a 25 day period using a pump with a pump rate of 400 gallons per minute that was operated 24 hours a day until the gasoline level diminished below the explosion level. The remaining product was allowed to move through the system to the Town lagoon, although the system is reportedly not equipped to provide treatment, with discharge to the ocean.

It is further indicated in ACER 2012, A-291 in Appendix 7 that:

""On April 6, 1998 a spill of diesel fuel was reported for the bulk plant due to overflow. The liquid was contained within the dike. Quick dry material was spread to absorb the spilled material (DOE Occurrence Report 98BA-0023 and dated 98/04/06). It is believed that soils were excavated to a depth of about 30cm, based on documentation provided in DOE Occurrence Report No. 98BA-0026 dated 98/04/08. **A spill of stove oil was reported on April 8, 1998 due to a leaking manhole on another tank (Occurrence Report No. 98BA-0026 dated 98/04/08).** It was estimated that 500 L was released and the product and water was collected by pumping. It was indicated that "most of the contaminated soil was removed". The report indicated that soil was excavated to a depth of approximately 30 cm, and was terminated because of the frozen ground. It was further noted that "Its all contained within the diking system, there was just a sheen on the water, they'll pump it to their shop tank."

It should be noted that "estimates" of spillage and contaminated soil removal is indicated for the April 6, 1998 spills. The volume spilled should have been able to be determined based on "blue book" values that track volumes coming in and going out with the difference representing the change/difference. The comment that "Its all contained within the diking system, there was just a sheen on the water" is problematic given that permeability of the containment dike liner was 5 times higher than required and therefore allowing for increased flow of contaminated water into the soils and groundwater as indicated previously. Further to this the comment that there

is “just a sheen on the water” indicates that contaminated water had accumulated into the “sump collection trench” and given there was ponding this results in additional driving head (pressure to move groundwater due to higher water levels) thereby increasing flow of contaminated groundwater into the soils and groundwater as indicated previously.

Estimates of impacted soils removed and statements that “ìt is believed that soils were excavated to a depth of about 30 cm” and “most of the contaminated soil was removed” are considered to be potentially misleading statements for the following reason. Spills have occurred frequently in the past and the soils of the containment dikes have a higher permeability than required and therefore, would be expected to be contaminated over the entire dike area as indicated from the ACER 2016 investigations (see concentration contours in Figure 4-1 also provided in Appendix 97) and footprints of contamination in soils and groundwater in Figures 3-5 and 3-6, respectively (also contained in Appendix 76). In this situation, given that most of the soils were significantly impacted “removal of contaminated soils” associated with a spill incident such as that indicated would, in principal, be expected to result in all soils in the containment dike having to be removed. This is likely not the case and as such can be a misleading statement. It is more likely that soils with petroleum sheening evident were removed as would be more consistent with the statement that “most of the contaminated soil was removed”

There was no indication of any sampling being carried out to confirm removal of contaminated soils for the spills noted above, or other spills within the containment dikes. If soil removal is limited to soils with evidence of petroleum sheening, concentrations for adjacent soils can still be problematical. As indicated, this would contribute to contamination of soil, completely to highly weathered bedrock and groundwater, and in turn contribute to the soil and bedrock as long term persistent sources of contamination.

ACER, A-291 in Appendix 7 noted that:

Free phase product was recorded for the IOL property only for 1998 and was reported for the IOL and EFL properties for 1999……. hydrocarbon concentrations showed increases at BH6M and BH7M (identified as BH6 and BH7 in the AEI 2000 report (A-635 in Appendix 123), for the June, July and August 1998 period. The TPH concentrations increased from approximately 40 mg/L to over 80 mg/L compared with the Tier I criteria of 20mg/L. Based on our observation that increases in hydrocarbons were typically evidenced in the September to April period, it is our opinion that the accidental spills that occurred in April 1998 were likely contributing factors to the increases recorded for the summer June and July period.

It was indicated that free product was still detected at MW5M in December 1998, MW5S in February 1999, and MW14 throughout most of 1999 (ACER note insert: 4 of 12 sample events but with no analysis to indicate range of petroleum hydrocarbons). It was also noted from this assessment that hydrocarbon concentrations showed increases at BH6M and BH7M (identified as BH6 and BH7 in the AEI 2000 report), for the June, July and August 1998 period.””

ACER notes that the increases in TPH were for fuel oil range hydrocarbons for both properties with gasoline range hydrocarbons also showing an increase for the IOL property for 1998. There was no sample collected for analysis for MW14 located on the EFL property that was reported to have free phase product, to indicate the range/type of petroleum hydrocarbons present.

ACER, A-291 in Appendix 7 noted that:

““In a fax dated October 11, 2001 IOL was directed by DOE to shut down the treatment unit immediately, due to strong odours being detected in the manhole where the outlet for the treatment system is located for the discharge of treated effluent from groundwater pump and treat operations. The concentration of TPH for the manhole sample

was 1.6 mg/L as fuel oil and lube oil range hydrocarbons. This compared with a TPH value of 0.73 mg/L of A-925denatured gasoline for the IOL effluent discharge (Fax from Michael Poirier of the DOE to Mike Sauerteig dated October 24, 2001). ""

Continuing, it is further indicated in ACER A-291 in Appendix 7 that:

""It was noted from this assessment that the groundwater pump and treat system was not operating between October 2001 and sometime after July 23, 2002 based on reporting by Neil And Gunter (Neil and Gunter 2002A).""

and

""Sampling in 2000 showed significant increases in hydrocarbon concentrations at BH6M for the IOL property compared with 1999"".

Sampling carried out on April 19, 2000 (Hydrocarbon Analysis report with report date May 24, 2000, A-637 in Appendix 123), showed a TPH concentration at BH6, located adjacent to BH5, BH7and former BH8 near the truck loading stand at 412.2 mg/L as fuel oil with MW5S having a TPH value of 11.51 mg/L. Location MW4 on the EFL/IOL property boundary showed a value of 2.4 mg/L as fuel oil. August 1999 sampling showed values of 137.8 mg/L, 4.9 mg/L and non-detectable at BH6, MW5S and MW4, respectively (AEI, 2000 in Appendix 124). This would indicate that there may have been an event such as the pumps not operating and or high water table due to tide and/or a storm event, or possibly an accidental release or possibly spring snow melt. There were no formal reports contained in the documentation that may provide information concerning site operations etc. as per past reporting.

It was also noted from the historical review that there were no flow metre readings recorded and this would indicate that the RW pumps were not operating.

Continuing, it is further indicated in ACER A-291 in Appendix 7 that:

""Sampling in 2002 showed essentially similar hydrocarbon concentrations as for 2000 for the IOL property, with results for only one sample event contained in the information. Sampling carried out on April 29, 2002 (Hydrocarbon Analysis report with report date May 12, 2002) showed a TPH concentration at BH6M, located adjacent to BH5M, BH7m and BH8M, at 403.4 mg/L as gasoline and fuel oil compared with 412.2 mg/L as fuel oil only in April 2000. Location MW5S (indicated as MW5 on the data report) showed non-detectable, having a TPH value of 115.1 mg/L in April 2000, and RW1 not being sampled.

Location MW4 on the Eastpre Feeds Ltd. property showed a value of 10.4 mg/L as gasoline compared with the April 2000 value of 2.4 mg/L as fuel oil. A location identified as MW1A, that appears to be a new location, showed a value of 47.5 mg/L. The location of this well is unknown. (ACER insert note: MW1A is located on the former CN ROW). It was noted from this assessment that the groundwater pump and treat system was not operating between October 2001 and sometime after July 23, 2002 based on reporting by Neil And Gunter (Neil and Gunter 2002A). It would appear that groundwater conditions do not show any measurable improvement without remedial operations being active. This would also indicate that it is likely that there is a persistent source, and in this instance the source would most likely be associated with residual contamination in the overburden soils and bedrock above and within the tidal zone associated with the IOL property, and possibly the movement of contamination deeper within the bedrock.""

A Limited Remedial Action Closure Report dated May 2004, prepared by Neil And Gunter Limited was associated with a 60 litre spill of diesel fuel at the IOL bulk plant site **with impacted soils left in place below the underground piping network and no specific remediation of groundwater**, A-925a,b,c Appendix 114. As

indicated, this would contribute to contamination of soil and completely to highly weathered and fractured bedrock and groundwater, and contribute to the long term persistent source of contamination from the soils and weathered/fractured bedrock.

Investigations were carried out in 2002 by TDG on the Eastpre Feeds Ltd. property only, on behalf of Eastpre Feeds Ltd. Findings showed petroleum hydrocarbon contamination to be present in the Diesel and Fuel Oil range at other locations not previously assessed on behalf of IOL (TDG, 2002, December 6 2002, A-285 in Appendix 80). It was indicated that "The values obtained varied"….."but show an increase from the last study of the area carried out by ARC Associates in 1993 and by analysis reported in ARC Associates report for the year 2000.". The maximum value for TPH was 1,700 mg/kg for BH3, compared with non-detect values obtained by ARC for MW14 and 120 mg/L as fuel oil for MW15 in Irving A-494 in Appendix 82. Concentrations for BTEX and TPH were non-detectable for location B17 situated near 12th St. with the TPH value for B16 being 52 mg/L indicating migration to be negligible to the north towards 12th St. The increases noted by TDG would be expected given concentrations in the groundwater had significantly increased on the IOL property.

It was further indicated by TDG that "It is our belief that the past and current remediation programs will have little or no effect unless a wider area is covered and thus if clean-up is to be done, it should include all properties peripheral to Eastpre Feeds Ltd where contaminates are detected."

An increase in concentrations as indicated by TDG would be expected given that concentration increases were also reported for the IOL property for circa 2000, with the IOL bulk plant being the only apparent source. In addition, there were no petroleum storage tanks introduced to the EFL property, no spill incidents, or other potential contributing source(s).

In addition to the above, in a letter from Service NB taxing authority to Eric Smith dated June 1, 1999 regarding the Eastpre Feeds Ltd (FN A-923 in Appendix 124) it is indicated that "After consulting with the Department of Environment and verifying the report on the property it was concluded that the property under referral" ….."The responsibility for clean up belongs to Irving Oil Ltd.".

ACER reviewed investigations involving intrusive sampling carried out by Roy Consultants Ltee (FN A-882 abc, May 2012 in Appendix 84) on behalf of the Town of Shippagan, to assess soils and groundwater for the proposed sewer upgrading in the vicinity of the former IOL bulk plant. . The consultant's report **associated with the upgrading of the sewer line between 12th and 15th Street** indicated petroleum hydrocarbons to be present in the area of the property boundary between IOL and the former IOL/CNR rail car tanker unloading area, located on land currently owned by the Town of Shippagan.

Soil analysis results for Monitoring Well MW-4, referred to as the Town 12MW1 on the ACER drawings, indicated petroleum hydrocarbon concentrations in soil to be up to 15,000 mg/kg for TPH at a depth of 0.6 m compared with the current 2012 RBCA criteria of 870 mg/kg for a commercial site with coarse grain soils and non-potable water, with Benzene at 13 mg/kg exceeding the potable water criteria of 0.042 mg/kg and non-potable criteria of 2.5 mg/kg. Toluene, ethylbenzene and xylenes in soil also exceeded the potable water criteria. A concentration of 2,000 mg/kg was obtained at a depth of 1.8 m with a corresponding vapour reading of 730 parts per million (ppm) and vapour reading ranging from 220 to 740 ppm to a depth of 4.6 m. Roy Consultants e-mail "Couts associé á la zone contaminée", (FN A-880 abc in Appendix 85), indicated that **over 1,000 tonnes of petroleum contaminated soil was disposed of at an approved disposal facility** and $15,000 was incurred for the treatment of groundwater as part of dewatering operations. Benzene, Toluene, ethylbenzene, xylenes and Total Petroleum Hydrocarbons in groundwater also exceeded the potable water criteria, (FN A-883 a in Appendix 86). Groundwater dewatering was carried out by Sutherland Environmental and Petroleum Ltd during excavation work with treatment required due to petroleum contamination.

Sampling was also carried out (test pit investigations) by ACER in 2012 during the installation of the underground services. Significant fumes were encountered during the installation activities and personnel wore masks for extended periods due to the overwhelming nature of the fumes and health risks (see related info regarding treatment of contaminated soil). Photos 3-6, 3-7 and 3-9 (also included in Appendix 72) show the two IOL underground gasoline lines uncovered during upgrading of the Town underground services. Petroleum staining is evident around the pipes with evidence of seepage. It is also evident from Photo 3-7 that there is petroleum discharge occurring from a nearby concrete pipe that originates from the IOL bulk plant property as indicated from Photo 3-6. Photos 3-10 to 3-14 (also included in Appendix 72) show petroleum staining in the soils and completely to highly weathered bedrock during upgrading of underground services by the Town for 14th St. The apparent source of contamination in this area is the IOL bulk plant, with the former CN Rail tanker car offloading area likely a contributing source as well.

The concentration contours for soil and groundwater presented on Figures 4-1 and 4-2 (also in Appendix 97) respectively, for ACER investigations and Figures 4-15 and 4-16 (also in Appendix 96) for soil and groundwater, respectively, for the ARC 1998 investigations show the IOL bulk plant and former CN Rail tanker car offloading area to have elevated concentrations for TPH in the soil and groundwater indicative of source areas with contours indicating migration onto the EFL CN ROW, FN, MEL and SCH/DFO properties. Groundwater flow conditions presented in Figure 3-4 (also in Appendix 73) by ACER as well as Figures 1-8 and 1-9 by ARC (also in Appendix 24) further supports this assertion.

4.1.2 AMEC "Historical Review of the Irving Oil Limited Bulk Plant and Surrounding Properties

IOL retained AMEC Earth & Environmental Limited (AMEC) to carry out a "Historical Review of the Irving Oil Limited Bulk Plant and surrounding Properties Shippagan, NB" September 2001, A-280 in Appendix 78. This was a Phase I ESA of the study area, with ARC having undertaken an "Environmental Review" (Phase II ESA) for the Kapac (now ELF) and CN Rail line (A-353 a, December 1997 in Appendix 21), to identify contamination issues.

It is indicated in the AMEC report that several of the above noted reports listed in Section 4.1 of this report were included in the review including:

- Donald E. Gemmell and Mark Holder of Three-D GeoConsultants Ltd. re "Preliminary Outline of Shippagan Harbour Contamination" (TDG, 2001, June 26, 2001, Affidavit document A-281 a in Appendix 4).
- IOL retained ARC to complete a "Site Investigation Report, Department of Natural Resources and Energy, Shippagan, New Brunswick, ARC Associates Limited, April 1998". A-117 in Appendix 28.
- IOL retained ARC to complete a "Site Investigation Report, Department of Fisheries Property, Shippagan, New Brunswick", ARC Associates Limited, April 1998. A-330 in Appendix 81.
- IOL retained ARC to complete a "Phase II – Investigation Report Shippagan, New Brunswick", A-332, August 1998 in Appendix 22**.**

It is indicated in the report that "The purpose of the historical review was to provide IOL with an overview of the current and past land use of the IOL Bulk Plant and surrounding properties and to identify potential environmental concerns associated with these properties." AMEC indicates **"concerns are primarily related to the petroleum handling and storage activities conducted on the IOL property and past and present fish processing activities conducted on the surrounding properties.". However, the information contained in the AMEC report demonstrates that present fish processing activities conducted on the surrounding properties are not an environmental concern, and this is actually supported by information also contained in the AMEC**

report as presented in ACER, FN A-943 in Appendix 122. Given that the assessments indicate the bulk plant operations and accidental spills represent an apparent source of petroleum hydrocarbon contaminants to the FN, MEL and EFL and other surrounding properties, the details are considered to be directly relevant. As such, the following Excerpt is inserted from Affidavit document FN A-943 for simplification purposes, and referenced documents can be correlated with corresponding Affidavit numbers and provided upon request. **Note that for clarity for this section, any reference to "AMEC 2001 in Attachment 29" indicated in the Excerpt that follows is with respect to being an Attachment of the ACER letter report FN A-943 (contained in Appendix 122 of this Phase II & III report document). AMEC 2001, Affidavit A-280 is contained in Appendix 78 of this Phase II & III report document.** Also note that for quotes from Affidavit FN A-943, A-291 (contained in Appendix7) that the corresponding Affidavit documents for identified references are provided at the end of this section.

Begin Excerpt

On page 4 Under Section 1.2 entitled "Scope of Work" it is indicated that:

"The scope of work for the historical review consisted of the following tasks:

- review the historical use of the Site and surrounding properties, through the use of available archived municipal and business directories, fire insurance plans and aerial photographs;
- review the current use of the surrounding properties and the practices that may have compromised the environmental condition of the Site;
- conduct a "walk-through" visual assessment (i.e. Site reconnaissance) of the Site and surrounding properties in order to identify the potential presence of environmental contaminants or concerns of environmental significance;
- conduct interviews with representatives of surrounding properties to document past and present land use on the respective properties;
- contact regulatory agencies to determine the existence of records of environmental regulatory non-compliance, if any. Review such records where available;
- review the available site environmental reports provided by IOL, including:
  - *Inspection of Irving Oil Limited Pipelines, Shippagan, New Brunswick, Jacques Whitford Environment Limited, November 1996.*
  - *Preliminary Investigation - DFO Wharf - Shippagan, New Brunswick, Jacques Whitford Environment Limited, March 25, 1997.*
  - *Environmental Review - Former CN Rail Track & Kapac Property, Shippagan, New Brunswick, ARC Associates Limited, December 1997.*
  - *Site Investigation Report, Department of Natural Resources and Energy, Shippagan, New Brunswick, ARC Associates Limited, April 1998.*

- *Phase II Investigation Report, Shippagan, New Brunswick, ARC Associates, August 1998.*
- *Site Monitoring Shippagan New Brunswick, Aspen Environmental Inc, (various dates)*
- *Preliminary Outline of Shippagan Harbour Contamination, Three - D Geoconsultants Limited, June 2001."*

It is evident from the first bullet item above that **the term "Site" is applied in reference to the former IOL Bulk Plant property.** From the first and second bullet items**, it is evident that the purpose of the review was to assess historical and current use of surrounding properties to identify practices that may have compromised the environmental condition of the Site (Bulk Plant property). The scope of work presented above contains many elements of a Phase I Environmental Site Assessment based on CSA Standard Z768-01.**

On page 29 in Section 6.0 entitled "Conclusions" in paragraph 1 it is indicated that "concerns are primarily related to the petroleum handling and storage activities conducted on the IOL property and past and present fish processing activities conducted on the surrounding properties.". It is ACERs opinion that IOL operations are primarily of environmental concern and that the past and present fish processing activities conducted on the surrounding properties are not an environmental concern, and this is actually supported by information also contained in the AMEC report. The basis for this opinion is presented below regarding items in the AMEC report.

Note for the above quotes from Affidavit FN A-943 in Appendix 122, that the corresponding Affidavit documents for identified references are as follows:

- DOE Occurrence Report No. 94-BA-0177, dated 13/07/94 is Affidavit Document A-527 in Appendix 87 and no Irving Affidavit located.
- Letter dated July 8, 2005 from Mr. J. Paul Harquail is contained in Affidavit document FN A-986 provided in Appendix 88.
- Discovery Court File No. M/C/0793/02, March 2004 in Appendix 88.
- ARC, 1993D is Affidavit Document A-493 a in Appendix 67.
- DOE Schedule B Existing Petroleum Storage Tank System (P.S.S.) is Affidavit document A-431 in Appendix 14.
- DOE Occurrence Report 98BA-0023 and dated 98/04/06 is Affidavit document A-600 in Appendix 89.
- Occurrence Report No. 98BA-0026 dated 98/04/08 is Affidavit document A-601 in Appendix 90 and no Irving Affidavit located.

The following is indicated in the AMEC 2001 (A-280 in Attachment 29) historical review, (with ACER comments provided in brackets);

- the bulk plant property is a concern with ministerial orders issued for the Bulk Plant in 1992 and 1993 with IOL as the responsible party (ACER comment: no site closure document located).;
- the IOL pipelines extending from the Bulk Plant to Shippagan Wharf are a concern (and as indicated on page 27, last paragraph "The former CNR railway has been on record as a petroleum contaminated site since May

2, 1997 but has not been issued an order to remediate since IOL is identified as the party responsible for remediation." and on page 25 paragraph 3 it is indicated for monitoring carried out by Aspen Environmental Inc., consultants retained by IOL to conduct regularly scheduled monitoring at the IOL Bulk Plant that "The results of the monitoring conducted on the DFO and former railway spur indicates a dissolved phase hydrocarbon plume exists between the FN Fisheries property and Marine Extract property.".

(ACER comment: See Item 1 for contamination plumes that show contamination extending onto the FN and MEL properties and also note that no site closure documents located for the DFO and former railway spur associated with the IOL pipelines).

- for the EFL property there was derelict fish processing equipment stored around the building. The property was identified as a petroleum contaminated site in 1992 with the property owner identified as the responsible party and remedial action was undertaken with no further action required.

  (ACER comment: As documented in the AMEC 2001 report (A-280, AI-450 in Attachment 29), the site was cleaned up with no further action required. Given this information alone, this item would not be expected to be listed as a concern on the basis of AMEC 2001 documentation. The AMEC 2001 report did not include a copy of Ministerial Orders that typically provides additional details including the nature of the environmental issue and if clean-up was satisfactory etc. Additional information provided based on ACERs 2012 assessment report, Affidavit document A-291 in Attachment 1, further supports this position. In Affidavit document A-291 in Attachment 1, page 1-2 paragraphs four and five and page 1-3 paragraph 1 it is indicated that:

  "As part of this investigation report, the Eastpre Feeds Ltd. property owner advised that the New Brunswick Department of Environment (DOE) was carrying out an inspection in the general area and noted that there were two 45 gallon drums located outside the Eastpre Feeds Ltd. building, and requested that the owner clean up the premises (personal communication: Eric Smith, February 2010). The drums contained refrigeration oil that was originally used for the refrigeration compressor units located in the building, during occupation by the original owners Connors Brothers Ltd. The two drums were re-located inside the building and stained surface soils were excavated and disposed of off-site. The DOE subsequently carried out soil sampling, confirming soil conditions were acceptable (see Appendix A3, DOE Records for details and clarification), and the remediation file was updated circa June 29, 2010 to accurately reflect some information contained in the occurrence report. The remediation sites management system now indicates that two 45 gallon barrels (reported to have contained compressor oil) were identified in November 1992 on this parcel and petroleum contaminated soil was also observed and confirmed by the DOE on PID 20373957 in July 1993. Seven 45 gallon drums of stained surface soils were excavated and disposed of off-site. Based on sampling and analysis carried out by the DOE in July 1993, after remediation of surface soils by means of excavation to a depth of about 15 to 20 cm, the file was officially closed in March 1994. The analysis results indicated the surface soils had been impacted with "unidentifiable products" in the middle to heavy hydrocarbon range."

  See Affidavit Document A-425 in Attachment 36 for DOE records providing analysis results. With respect to derelict fish processing equipment being listed as a concern by AMEC 2001, given there was no indication in the AMEC 2001 report (A-280, AI-450 in Attachment 29) that there was any evidence of petroleum staining noted during the site inspections, the risk of contamination would be considered highly unlikely and further investigations would not be warranted and therefore not a concern for this item based on AMEC 2001 documentation.);

- for the Connors Bros Property located to the north east of MEL that is now a parking lot, there were previously two above ground petroleum storage tanks on the property, but to the knowledge of the former owner there

were no accidental releases of petroleum product, and the property has never been identified as a contaminated site by the DOE.

(ACER comment: Given there was no indication in the AMEC 2001 report (A-280, AI-450 in Attachment 29) that there was any evidence of petroleum staining noted during the site inspections in this area, no accidental releases reported during interviews or the DOE records review, the property has never been identified as a contaminated site by the DOE, the risk of contamination is considered highly unlikely and further investigations would not be considered warranted and therefore not a concern for this item based on AMEC 2001 documentation.);

- for the MEL property, a former bunker C and a fuel oil storage tank were located in concrete dikes and were replaced with on site fuel oil tanks, waste water tanks were identified on site, as well as derelict fish processing equipment. It was indicated during interviews that there were no accidental releases of petroleum product, and the property has never been identified as a contaminated site by the DOE.

  (ACER comment: Given there was no indication in the AMEC 2001 report (A-280, AI-450 in Attachment 29) that there was any evidence of petroleum staining noted during the site inspections in areas with derelict fish processing equipment, no accidental releases reported during interviews or the DOE records review, and the property has never been identified as a contaminated site by the DOE, the risk of contamination is considered highly unlikely and further investigations would not be considered warranted and therefore not a concern for this item based on AMEC 2001 documentation.)

- for the FN property, a Bunker C and a fuel oil tank were identified on the west edge of the boiler building, a gasoline tank south of the fish processing plant (since removed) and waste oil tank at the northwest corner of the property, two Bunker C tanks removed in 1998 along with petroleum contaminated soil with some contaminated soil remaining beneath the footing of the boiler building, a former formic acid tank removed in 1994 and derelict fish processing equipment stored at various locations. It was indicated that to the knowledge of the former and current owner there were no contamination problems associated with the site other than issues associated with the IOL (gasoline from pipeline break at north end of property and diesel at south end of property) and the Bunker C released under the removed AST's which was removed and inspected by NBDOE, and there have been no ministerial orders issued for the property. It was indicated during the interview with Eric Smith that "in the past several years there has been a problem with the organic vapour entering the plant via floor drains. He surmised that due to the resemblance of the odour to gasoline it was a result of the IOL pipeline break." He also indicated that "the apparent diesel contamination at the south end of the property was the result of a spill which had occurred on the IOL property. ES indicated that he was aware of a release caused by a leaky gasket on one of the bulk tanks.". AMEC 2001 (A-280, AI-450 in Attachment 29) also reported that "An order to remediate was issued on June 14, 1992 and subsequently rescinded on August 31, 1992."

  (ACER comment: Given there was no indication in the AMEC 2001 report (A-280, AI-450 in Attachment 29) that there was any evidence of petroleum staining noted during the site inspections in areas where existing or former petroleum storage tanks were located or derelict fish processing equipment was located, the only occurrence of accidental releases of contaminates reported during the interviews and DOE records review was associated with the decommissioning of two Bunker C tanks involving the removal of a limited amount of impacted soils under the supervision of a DOE inspector and no further action being required by the DOE, the risk of contamination is considered highly unlikely and further investigations would not be considered warranted and therefore not a concern for the items listed in the AMEC 2001 report for this site, based on AMEC 2001 documentation. Other additional information is provided below that further supports this position.

Regarding the AMEC 2001 report indicating “An order to remediate on June 12, 1992 and rescinded on August 31, 1992.”, this is incorrect as it is indicated in the DOE records under the item “ORDER(S) SPECIFIC TO REMEDIATION ISSUED: NO”. The following is provided for the purposes of further clarification. AMEC 2001 (A-280, AI-450 in Attachment 29) did not append any documentation related to Ministerial Orders in the report. Therefore, reference is made to Affidavit document A-26 in Attachment 37 as it shows that the file was opened on February 11, 1998 (appears likely there is a typo and date should be November 11, 1998), and was closed on October 15, 2002 according to the DOE file records (Affidavit document A-20 in Attachment 38), and therefore it is reasonable to expect that this information was similar to that available when AMEC undertook the assessment in 2001. A response of “NO” is indicated in the DOE record identified as A-26 in Attachment 37 for the item identified as “ORDER(S) TO REMEDIATE ISSUED”. It is further indicated at the bottom of the document that “2 tanks removed on November 2, 1998. All apparent contamination removed. Some traces of product remained at a small section beneath the building. Appears minimal.” Identical wording is provided in Schedule D of the associated DOE Occurrence Report No 98BA0533 for the 2 Bunker C Tanks Removed at the site provided as Affidavit document A-27 in Attachment 39, that also indicated that additional clean-up was not applicable. Based On the date of November 2, 1998 (11/02/1998) identified in the DOE Occurrence Report, it is also most likely that there is a typo in the “SITE MANAGEMENT FILE OPENED” date of February 11, 1998 (02/11/1998). As indicated in A-26 in Attachment 37 the petroleum source was identified as Bunker C.

With respect to the reference by AMEC that “An order to remediate on June 12, 1992 and rescinded on August 31, 1992.” It is indicated in Affidavit document A-20 in Attachment 38 under Comments that “March 6, 2001- Disregard fish waste contamination and I replaced it with a petroleum contamination event. MP.”, that being associated with the November 11, 1998 Tank removal. As further indicted in Affidavit document A-20 in Attachment 38, under Comments, “Oct. 15, 2002 – Reviewed file, closed RMS file as per occurrence 98BA0553, it has the required PCS tickets on file. No further action required. MP.” The apparent reason the file was not closed until October 15, 2002 was because the petroleum contaminated soil (pcs) disposal tickets associated with the November 11, 1998 Tank removal had not been provided to the DOE. The only other reference to an order being issued and rescinded for the Pecheries FN Fisheries Ltd. property is in Affidavit document A-18 in Attachment 40 dated August 8, 2001 that indicated that “Information pertaining to a Ministerial Order relating to Shippagan (Fish Meal Plant) was served on Pecheries FN Fisheries Ltd. on August 5, 1992 (compared with June 14, in Affidavit document A-26 in Attachment 37) then rescinded on August 31, 1992. With reference to Affidavit document A-26 in Attachment 37 under Comments it is apparent that the comment “March 6, 2001- Disregard fish waste contamination and I replaced it with a petroleum contamination event. MP.”, and the older comment (based on apparent chronology of the comments section) “NON PETROLEUM RELATED – fish waste” is related to the Ministerial Order referred to in Affidavit document A-18 in Attachment 40. Mr. Eric Smith confirmed this, indicating that there was an incident involving a mechanical failure in the fish waste water processing system (Personal communication: December 2014).).

- for the harbour in general AMEC 2001 (Affidavit document A-280, AI-450 in Attachment 29) reviewed a document entitled “Preliminary Outline of Shippagan Harbour Contamination, Three-D-Geoconsultants Limited, June 2001”, Section 4.4.8 on Page 25, and simply indicated that “This report assembled data from all previous reports to depict areas, which are known to be contaminated by petroleum hydrocarbons.” (ACER comment: There was no further discussion by AMEC 2001 regarding the report. Discussion is provided below by ACER.).

Although it is indicated in the Conclusions section on page 29 of the AMEC 2001 report (A-280, AI-450 in Attachment 29) that "The following potential concerns were identified:

IOL Bulk plant:

- Ten existing petroleum AST's containing gasoline and fuel oil,
- Three removed petroleum AST's which contained gasoline and fuel oil
- Petroleum handling piping and loading rack,
- IOL pipelines extending from Bulk Plant to Shippagan wharf, and
- Fenced compound containing assortment of petroleum and propane storage tanks."

there were no specific discussions regarding operations within the IOL Bulk Plant property or reasons indicating why the above items were a potential concern. Further to this, IOL did not provide other documentation obtained by their consultants for the IOL property for which the following potential concerns would have been evident:

- the Rail Car petroleum offloading facilities as a potential source of contamination due to accidental releases of petroleum product;
- that the permeability of the soil lined bulk storage petroleum containment diking system was not in compliance with Regulatory requirements, with the permeability being 50 times higher (see Item 10 for details) and therefore any spills would be more likely to migrate into the overburden soil and groundwater and represent a long term persistent source of contamination to the groundwater given the limited and localized remediation afforded to impacted soils;
- that free phase product thicknesses in the order of 35 cm were measured in the area of the former Truck Loading Stand in May 1993, subsequently being reported frequently at locations immediately south of the former Truck Loading Stand with free product being detected on the IOL property until February 1999 and representing a source of contamination to the shallow and deeper groundwater flow system and associated risks to the marine environment via the groundwater to surface water pathway. See Item 10 for details regarding permeability; or
- that the IOL consultant and DOE representatives expressed concern that off-site migration of petroleum hydrocarbons was occurring prior to and following implementation of the remedial system.

As indicated previously, for the harbour in general AMEC reviewed a document entitled "Preliminary Outline of Shippagan Harbour Contamination, Three-D-GeoConsultants Limited, June 2001", Section 4.4.8 on Page 25, and simply indicated that "This report assembled data from all previous reports to depict areas, which are known to be contaminated by petroleum hydrocarbons.", in Exhibit "F" (Affidavit document A-280, Attachment 29). There was no further discussion regarding the report. However, the assessment of Harbour Contamination carried out on behalf of Eastpre Feeds Ltd., in Exhibit "F" (Affidavit document A-281, Attachment 4), showed the estimated extent of the hydrocarbon plume in the soil and groundwater in Figures 3 and 5, in Exhibit "F" (Affidavit document A-285, Attachment A5), respectively, that showed contamination extending to the marine environment.

END EXCERPT

ACER further noted that AMEC identified several other reports for review that were also listed in Section 4.1 of this report, but made no specific comments regarding the reports. The assessment of the following reports

- *Inspection of Irving Oil Limited Pipelines, Shippagan, New Brunswick, Jacques Whitford Environment Limited, November 1996. (JWEL, November 13, 1996B, A-81 a in Appendix 19)*
- *Preliminary Investigation - DFO Wharf - Shippagan, New Brunswick, Jacques Whitford Environment Limited, March 25, 1997.* (*A-83 in Appendix 20*)
- *Environmental Review - Former CN Rail Track & Kapac Property, Shippagan, New Brunswick, ARC Associates Limited, December 1997.* (*A-353 a, December 1997 in Appendix 21)*

in the context of contamination sources is discussed in Section 4.1.1. For the two IOL underground gasoline transfer lines with reporting by JWEL indicated "The testing revealed that these two abandoned pipelines did not pass pressure testing and were suspected of having been leaking during their operating life." (A-81 a in Appendix 19). Preliminary investigations showed soil and groundwater contamination to be present. The assessment of the following reports

- *Site Investigation Report, Department of Natural Resources and Energy, Shippagan, New Brunswick, ARC Associates Limited, April 1998.* (A-117 in Appendix 28)
- *IOL retained ARC to complete a "Site Investigation Report, Department of Fisheries Property, Shippagan, New Brunswick", ARC Associates Limited, April 1998. (A-330 in Appendix 81)*
- *Phase II Investigation Report, Shippagan, New Brunswick, ARC Associates, August 1998. (A-332, August 1998 in Appendix 22**)***

in the context of contamination sources is discussed in Section 4.1.3, with the reports documenting the extent of contamination.

With respect to contamination sources, AMEC indicated that "concerns are primarily related to the petroleum handling and storage activities conducted on the IOL property and past and present fish processing activities conducted on the surrounding properties.". As indicated from the information/assessment comments presented above there are no issues of concern or apparent sources of contamination on the properties associated with fish processing and as such, the only remaining concerns would be related to the petroleum handling and storage activities conducted on the IOL property.

4.1.3 ARC Investigations, DNRE/Former CN ROW, DFO, Two IOL Underground Gasoline Pipelines.

As indicated in Section 4.1.1, on May 2, 1997 a heavier than usual petroleum sheening was observed in the harbour in the area of the IOL underground petroleum transfer lines formerly used by IOL (A-87, NBDELG occurrence report No. 97-BA-0060, in Appendix 43). Subsequently on ***April 4, 1998 at a meeting held with all parties involved and IOL had made an assessment, it was indicated that "IOL will try to schedule clean up in July" (1998).*** In a letter from Ray Morin of the NBDELG to Johnny Grant of IOL dated June 5, 1997 (A-89 in Appendix 21) it was indicated "Further to our discussions at the meeting of June 3, 1997, this will confirm that we are requesting that you have an intrusive site investigation conducted along the abandoned pipeline. The scope of your investigation should be to determine the extent of gasoline contamination in the soil and in the groundwater which exceeds current Level II guidelines."

Preliminary investigations undertaken between the time of the incident report on May 2, 1997 and April 4, 1998 when it was indicated that "IOL will try to schedule clean up in July" are discussed in Section 4.1.1, with the following outcome.

1. Pressure testing of the IOL underground petroleum lines that extend from the IOL bulk plant to the end of the wharf on September 13, 1996 by JWEL at the request of IOL (JWEL, November 13, 1996B, A-81 a in Appendix 19). It was reported that "The testing revealed that these two abandoned pipelines did not pass pressure testing and were suspected of having been leaking during their operating life.".

2. Preliminary investigations were carried out in December 1996 by JWEL on behalf of DFO (JWEL March 25, 1997A, A-83 (Contained in Appendix 20) as recommended by JWEL following pressure testing. It was indicated in the JWEL report, (A-83 in Appendix 20) that **"The preliminary investigation revealed significant hydrocarbon impacts to DFO property, with the greatest impacts being closest to the DNRE property. The adjacent DNRE property has been confirmed as being contaminated by hydrocarbons (gasoline)." and further indicated that "JWEL recommends that the extent of the contamination (both on and off DFO property) be established prior to DFO initiating any remedial action. DFO clean-up activities should be part of a joint effort which should include all impacted property owners. Premature clean up may result in recontamination of DFO property"**. and also "JWEL recommends that a copy of this report be sent to the DNRE to inform them of their obligation to address a known contamination problem in accordance with the New Brunswick Clean Environment Act (NB Regulation 87-97). JWEL also recommends that a copy of this report be sent to IOL. **Although preliminary investigations has not confirmed the IOL pipelines have contributed to the gasoline contamination, they are presently the most probable source.".**

3. With respect to the"Environmental Review, former CN ROW , and KAPAC Property" (A-353 a, December 1997 in Appendix 21) by ARC, it is indicated in a letter dated January 23, 1998 to Claude Burry of DFO from Tom Gallagher of JWEL regarding his review of the report that **"The ARC report does not present the consultants field observations with respect to hydrocarbon odours or staining, or groundwater seepage and makes no conclusions based on the results of the soil samples analyzed, therefore, we can only provide comment on the laboratory results presented."** (A-353 a, December 1997 in Appendix 21). In the conclusions JWEL indicates that

   "The investigation presented in this report does not delineate the gasoline impacts encountered on the DFO property beneath the abandoned IOL pipeline, and does not provide any conclusive information regarding the potential for other gasoline impacts beneath the pipeline.

   The ARC investigation appears to be directed at shallow impacts in the area of the pipeline. Deeper investigations of the soil and groundwater will be required to determine the extent of the gasoline contamination encountered beneath the abandoned IOL gasoline pipeline on DFO property, or the potential for other gasoline impacts beneath the pipeline."

4. The ARC "Environmental Review" report also made reference to the "Phase II Environmental Site Assessment KAPAC Holdings Limited Site, Shippagan, NB" (now referred to as the EFL property), carried out by Jacques Whitford Environmental Limited on behalf of The Royal Bank of Canada Bathurst, NB (A-567, January 1996 in Appendix 79). ACER noted that in the JWEL Phase II assessment that it is indicated that concentrations of petroleum hydrocarbons for one of the three soil samples exceeded NBDELG criteria for a Level II non-sensitive site, with concentrations for the three groundwater samples below Level II criteria, but **the JWEL report also did little to establish any conclusive results pertaining to the source of hydrocarbon contamination identified on the KAPAC (EFL) property**. JWEL was aware of contamination issues for the adjacent IOL bulk plant property operations.

5. ACER further noted that the ARC "Environmental Review" report did not make any reference to the following two reports for investigations undertaken in March 1997, that provide additional information for soil and groundwater investigations and bridging between the JWEL November 1996 (A-83, contained in Appendix 20) intrusive sampling in the area of the gasoline pipelines and the October 1997 intrusive investigations presented in the report:

   - IOL retained ARC to complete a "Site Investigation Report, Department of Fisheries Property, Shippagan, New Brunswick", ARC Associates Limited, April 1998. (A-330 in Appendix 81)
   - IOL retained ARC to complete a "Site Investigation Report, Department of Natural Resources and Energy, Shippagan, New Brunswick, ARC Associates Limited, April 1998". (A-117 in Appendix 28)

   It was indicated in A-117 that "A phase I test pitting investigation program was conducted by ARC Associates Ltd for Irving Oil on March 1997 with the construction of four test pits **on or adjacent to the break area**. This program detected the presence of petroleum hydrocarbon in the soils adjacent to and nearby the break." There was no mention of the pressure testing or JWEL site assessment reports. This report indicated that "This report provides details of a **Phase II investigation of the DNRE property**. The purpose of the investigation was to define the extent and concentration of contamination, resulting from the pipeline break, present on DNRE land."

   It was indicated in A-330 that "A phase I test pitting investigation program was conducted by ARC Associates Ltd for Irving Oil on March 1997 with the construction of four test pits **on or adjacent to the DFO property**. This program detected the presence of petroleum hydrocarbon in the soils adjacent to and nearby the break." Similarly, there was no mention of the pressure testing or JWEL site assessment reports. This report indicated that "This report provides details of a **Phase II investigation of the DFO property**. The purpose of the investigation was to define the extent and concentration of contamination resulting from the pipeline break.

   It would have been expected that ARC would have also made reference to these reports for the"Environmental Review, former CN Rail Track, and KAPAC Property" (A-353 a, December 1997 in Appendix 21) as the information would have been relevant to the "Environmental Review".

The findings of these two assessment reports are discussed in this Section in the context of contaminate delineation in the area of the two IOL underground gasoline pipelines that was carried out on behalf of IOL

The following reports are associated with investigations carried out to delineate contamination in the area of the two IOL underground gasoline transfer lines..

- IOL retained ARC to complete a "Site Investigation Report, Department of Natural Resources and Energy, Shippagan, New Brunswick, ARC Associates Limited, April 1998". (A-117 in Appendix 28)
- IOL retained ARC to complete a "Site Investigation Report, Department of Fisheries Property, Shippagan, New Brunswick", ARC Associates Limited, April 1998. (A-330 in Appendix 81)
- IOL retained ARC to complete a "Phase II – Investigation Report Shippagan, New Brunswick", A-332, August 1998 in Appendix 22 (ACER note: A-332 is also AG-438 in Appendix 23 with AG-438 intentionally included because of better quality figures and having been an alternative reference in quotations in previous documents to avoid possible oversight).

The footprints assessed for the soil, completely to highly weathered bedrock and groundwater impacts are shown on Figures 4-15 and 4-16 in Appendix 96 for the above noted investigations completed by the IOL consultant ARC in 1998. The figures indicated the extent of contamination was not established on the eastern side of FN, however an area identified as the "pollution pit" (identified on drawings in this report) was excavated in the summer of 1998

with billing, A-39 (Appendix 53) showing IOL having paid the invoice associated with the transport of contaminated soils to Belledune. There was no confirmatory sampling carried out to verify all impacted soils had been removed. Also note Photos CA-357 and CA-359 in Appendixes 44 and 45, respectively, show excavation of contaminated soils for the Old North Wharf adjacent to the IOL underground petroleum transfer lines.

In summary and not withstanding that the IOL bulk plant was known to be impacted and identified as an apparent source based on ACER investigations, in 1998 contaminated soil and groundwater was determined to extend from the bulk plant property across the former CN ROW, the FN and MEL properties and extend onto the SCH/DFO property, with only partial excavation of contaminated soils carried out (excluded soils near the gasoline pipelines, FN foundation wall, under the footprint of the FN and MEL buildings or adjacent to the buildings). Local commercial pumping wells and the Town municipal wells historically operational in the area, as well as remedial pumping wells, would have the potential to draw contamination from impacted sites in the study area deeper into the soils, weathered and fractured bedrock and shallow and deeper bedrock groundwater aquifers. An assessment of drawdown for the FN well alone, in operation since 1950 or earlier, shows that contamination associated with the area of the gasoline pipelines and the former IOL bulk plant and former IOL CN Rail tanker car offloading area are all located within the capture areas of the well. There was insufficient sampling and monitoring locations established, including deeper bedrock wells and other wells at the interface between the soil and completely to highly weather and fractured bedrock, to fully delineate the contamination and to also verify that no contamination was migrating to the marine environment. Given the above, and current investigations by ACER the area(s) originally assessed by the IOL consultant ARC is/are still considered to represent the apparent source of contamination with risk of concern to human health and the marine environment. Details are provided below that demonstrate that the historical sources continue to represent apparent sources of contamination to the study area.

For current ACER investigations reference is made to TPH contamination contours shown on Figures 4-1 and 4-2 (also in Appendix 97), contamination footprints shown on Figures 3-5, 3-6, 3-7 and 3-8 (also in Appendix 76) and groundwater flow shown on Figure 3-4 (also in Appendix 73). Also refer to Figure 3-2 (also provided in Appendix 72), showing a profile of the stratigraphy of the site with respect to a transect line extending directly from the IOL bulk plant to the wharf as shown on Figure 3-1. Photos taken during rehabilitation of underground services by the Town that show the overburden and bedrock conditions as well as petroleum sheening and staining in the soils, weathered/fractured bedrock and groundwater are provided in Photos 3-1 to 3-14 (also included in Appendix 72). Several downhole video stills showing the extensive and significant fracturing in the bedrock are provided in Photos 3-15 to 3-18 for 16MW20A located on the IOL bulk plant and adjacent to 14th St. and Photos 3-19 to 3-22 for 16MW 22B located about 140 metres down gradient of 16MW20A and are also included in Appendix 72. Monitoring well 16MW20B is located adjacent to the MEL building, about several metres from the IOL underground gasoline transfer line and about 18 metres from the FN water supply well that extends into the bedrock to a depth of about 120 feet. The well construction is shown on Figure 3-3 (also included in Appendix 72).

As indicted, an assessment of the zone of drawdown influence under existing Department of Environment approved pumping rates was carried out by Craig Hydrogeologic Inc. for MEL and FN properties, April, 2011, (Affidavit document A-662, Appendix 30). As can be seen in Figures 2, 3, 5, and 6 of the report, the groundwater capture area reflected by a pumping rate of 250 GPM for FN operations (operational range from 200 to 350 GPM) include the adjacent DFO and DNRE properties. Craig indicates that

"Any properties which are located within the groundwater capture areas of the pumping wells and which have sources of groundwater pollution/contamination pose a risk to the pumping wells."

This includes the IOL Bulk plant and former IOL CN Rail tanker car petroleum offloading area and the area of the IOL underground gasoline and fuel oil transfer lines that extend from the bulk plant to the end of the wharf, and it is expected that contamination was drawn into the overburden and bedrock zones by the operating well. Properties identified to be impacted by these sources would in turn fall within the capture zone of the well.

Although the IOL consultant and the DELG were knowledgeable that FN operations and ice production facilities were located in the area and had on site water supply wells for food grade operations, utilizing the brackish/saltwater aquifer, protection of the brackish/saltwater aquifer water supply in consideration of historical and ongoing existing use in accordance with requirements of the DELG Guideline for the Management of Contaminated Sites was not recognized (refer to Section 1.2.2 Groundwater Aquifer and Water Supply Use and Section 4.2.1 for Pumping Influence of FN Well for further details).

A downhole video was taken in 2000 and it is reported that oil like globules were evident in the water column (A-57, Appendix 32 is provided as a digital video included as a separate digital file that can be opened using the open source video program “VLC media player”). A still photo at time frame 14h18m17s247 from the aforementioned video and a photo of a water sample collected during purging of the well are provided in Appendix 99. The well construction is shown on Figure 3-3 (also included in Appendix 72).

Treatment of contamination in bedrock is considered extremely more difficult than soils and typically requires much longer time periods compared with soil remediation. Details are provided in Section 5.0 with key considerations provided below.

It is more difficult in recognition that a limited number of fractures usually dominate the flow is central to an assessment strategy and rock matrix diffusion, that may significantly retard contaminate migration, requires that the rock matrix porosity and the porosity resulting from weathering and alteration around fractures is recognized applicably. (FN A-2584 in Appendix 107).

Discrete fracture pathways and matrix diffusion for contaminant fate and transport are important aspects in the remediation of contamination. The direction and the rate of fracture-matrix exchange depend on the relative concentrations of the solute in the fracture and the matrix as well as the amount of surface area available for this process. Once a solute has diffused into the matrix, it may absorb onto pore surfaces, and the surface areas of the matrix pores are many times larger than the surfaces of fractures. The majority of the solute may be in the matrix pores. (FN A-2584 in Appendix 107). **The amount of solute that enters the matrix pores is expected to increase with longer periods of exposure to the solute/contamination, and would be expected to result in a longer time frame for remediation.**

Matrix diffusion is indicated to be important because, when contaminants are being diffused into the matrix, the rehabilitation and remediation of the aquifer is made increasingly more difficult with residence time of the contaminant. Matrix porosity may act as a persistent reservoir that can slowly release contaminates after a site appears to have been cleaned up. For similar reasons, matrix diffusion can cause pump and treat efforts to be misleading, where the water appears to be clean, only to be re-contaminated by diffusion back from the matrix, (FN A-2584 in Appendix 107), into the fractures. As such, spreading/migration of contamination could be expected to continue and result in re-contamination of properties.

Matrix diffusion is a significant mechanism by which contaminants may enter a rock matrix with appreciable pore space, such as sedimentary rocks, as present on the site. After the contaminant has diffused into the rock matrix, the process of diffusion works in reverse (which is called “backdiffusion”) and releases the contaminant stored

within the rock matrix back into the fracture. Back-diffusion is a dynamic phenomenon, causing the passing plume to persist at a point of observation, albeit at a relatively low concentration, longer than it would otherwise, **even if the contaminant is removed from the fluid within the fractures**. **This process increases effective plume longevity and, if not accommodated, can greatly delay remediation time frames.**

Several other keys factors such as preferential pathways afforded by underground services, fractured bedrock and tidal effects/loadings etc., in addition to pumping of commercial and Town wells and remedial wells, are important considerations for the migration and spreading of contamination and are discussed in detail in Section 4.2. It is important to note that with respect to the ARC reports, with specific reference to the figure identified as shallow groundwater flow May 2, 1998, groundwater flow was reported to occur in an east to west direction, as well as west to east and north-south in some areas (Affidavit A-116 in Appendix 25)." ACER also indicated that "The title of the ARC report was "Remediation System for DFO and DNRE Properties" and the only date provided on the report was the date of May 2, 1998 with May 1998 shown on most of the figures. The report was attached to an email dated June 9, 1998, from Raymond Morin of the DOE to Claude Burry of DFO." Figure 3 (shown as ACER Figure 1-8 in Appendix 24) contained in the ARC Phase II investigation report, A-332 in Appendix 22, (AG-438 better figures, Appendix 23)**,** included additional monitoring wells and also showed components of groundwater flow for July, 1998 to be in an east to west direction landward (rather than towards the shoreline), from the SCH property towards the area between the FN and MEL buildings. A strong component of groundwater flow is evident under the footprint of the FN building that was from north to south from areas of contamination identified on the DFO/SCH property.

ACER also noted that groundwater flow under the MEL building was south to east towards the area between the two buildings. Also of note is Figure 1 (shown as ACER Figure 1-9, also provided in Appendix 24) in the ARC May, 1999 monitoring report, A-321 in Appendix 26, that shows groundwater flow for May 1999, to be almost opposite to that shown in Figure 3 (shown as ACER Figure 1-8 in Appendix 24) for July, 1998. ACER further notes that the figures show a strong component of groundwater flow occurring from the highly contaminated area between the FN and MEL buildings into the area represented by the footprints of the two buildings. ACER also noted in the ARC Report A-321 in Appendix 26 that "the treatment system was not operating. The electric panel was checked and all switches were noted to be in the off position." Therefore, it is reasonable to make a comparison of the flow conditions given there would be no pumping influences. It is apparent from the figures that conditions exist that can cause contamination occurring on the DFO property to migrate onto the FN and MEL properties, and result in widespread contamination including the area of the building footprints, other adjacent properties and into the marine environment.

As indicated previously, groundwater flow contours are shown in Figure 3-4 (also in Appendix 73) for a monitoring event on May 18, 2017, for a high tide cycle represented by a lower end of the range for the high tide cycle. It is important to note that groundwater flow conditions are consistent with conditions previously reported by the IOL consultants for investigations for the area between 1989 and 2004. Groundwater flow occurs from the IOL bulk plant property in all directions;

- northerly onto the EFL property and residential properties;
- southerly onto 14th St. (Town property) and the Enterprise Shippagan Ltd. property;
- westerly onto several commercial and institutional properties;
- and easterly onto the FN and MEL properties and former CN Rail ROW (Town property that is also used as a driveway and contains the two IOL underground petroleum transfer pipelines), 15th St., (Town property) and SCH/DFO property, ultimately discharging to the harbour.

Monitoring carried out by ACER and the IOL consultants show groundwater flow gradients favour roadways with underground services including 14th St., and the former CN ROW located between the FN and MEL properties, and are representative of preferential flow pathways. Groundwater contours show flow occurring from the IOL bulk plant property toward 14th St., and continuing onto the former CN ROW/driveway area between the FN and MEL properties with flow components occurring onto the FN and MEL properties. Contamination identified in association with the two underground gasoline lines located within the former CN ROW, reported to be "suspected of having been leaking during their operating life" circa 1938 by an IOL consultant, would also spread across the FN and MEL properties as well as onto the SCH/DFO property, and ultimately discharge into the harbour.

Flow also occurs along the former CN ROW between the FN and MEL properties that is in a landward direction from the SCH/DFO property with flow components occurring northerly and southerly onto the FN and MEL properties, respectively. Water supply, storm and sewer lines as well as saltwater lines and effluent lines from FN fisheries and other operations extend under the buildings, thereby also providing for preferential flow and increased spreading of contamination under the buildings and across properties. This results in broad spreading of contaminated groundwater that is further exacerbated by historical water supply pumping operations associated with the FN operations as well as a Town municipal well, nearby wells for ice plant operations and IOL remedial pumping wells on the IOL bulk plant property and former CN ROW and SCH/DFO properties that also influence groundwater flow.

As indicated from the above, with additional details in Section 4.2, migration and spreading of contamination is critical both historically and currently for the study area with respect to contamination of properties and misleading information indicating an area is remediated but with recontamination occurring due to the factors discussed in Section 4.2.

The FN well is located about ten metres from the location identified as "pipeline break" where the greatest concentrations were reported for soils and groundwater for the ARC 1998 investigations. See Figure 4-2, also included in Appendix 97, with location of well identified as WS/FN WELL and "Pipeline Break". Maximum drawdown would occur in this area and given concentrations associated with the gasoline pipelines were extremely high in this area, it would not be unexpected to result in higher concentrations in the deeper bedrock in this area as determined from these investigations as indicated by the BTEX and TPH values shown for groundwater on the soil and bedrock profile Figure 3-3 (also included in Appendix 72), that also shows the zones of bedrock fracturing.

Video stills showing the highly fractured bedrock are provided in Photos 3-15 to 3-18 (also in Appendix 72) for 16MW20A located on the IOL bulk plant property, and Photos 3-19 to 3-22 (also in Appendix 72) for 16MW22B located on the MEL property opposite the FN industrial/commercial water supply well.

Photos 3-10 to 3-14 (also included in Appendix 72) show petroleum staining in the soils and completely to highly weathered and fractured bedrock during upgrading of underground services by the Town for 14th St. Photos 3-1 and 3-2 (also included in Appendix 72) shows petroleum staining and sheening on the 4 metre trench excavation for Town underground services upgrading that is essentially on the opposite side of 14th St., with Photo 3-3 (also included in Appendix 72) showing petroleum sheening on the water surface in this area.

With respect to contamination identified by ARC in the area of the gasoline pipeline on August 26, 1998 A-126 in Appendix 36, IOL requested approval to remove and treat 600 Metric Tonne of contaminated soil. MGI, 2001, A-298 (Appendix 37), reported that "hydrocarbon impacted soil was removed from the area between FN Fisheries Ltd. and Marine Extract Ltd. fish plants (refer to Figure 2 in Appendix 38). The work was completed by Jacques Whitford Environmental Limited on behalf of Irving Oil Ltd but the volume of contaminated soil removed from the site was not known." The area of excavation shown in Figure 2 of the MGI, 2001, A-298 report (Appendix 37),

was limited to only a portion of the contaminated area shown for soils between the FN and MEL buildings as shown on Figure 2 of the ARC, August 1998 report (AG-438 in Appendix 23). Excavation was terminated near the top of the pipes to avoid potentially damaging the pipes and therefore only a fraction of the contaminated soils was removed according to the contractor Sealand Construction Ltee. (Personal communication: Eric Smith, circa 2012).

It was indicated in a Phase I Environmental Site Assessment carried out by MGI on page 21, paragraph 2, sentence 1 that "hydrocarbon impacted soil and groundwater is known to exist as a result of leaks in the Irving Oil Ltd. underground pipes located on-site, and (page 13, paragraph 6) **under the NBDOE Remediation Sites Management Records that "an on-going assessment of the DFO wharf and Irving Oil Ltd. pipeline is being conducted by ARC Associates Ltd. on behalf of Irving Oil Ltd.** (MGI, May 2001 is A-298 in Appendix 37). It was indicated on page 21, paragraph 2, sentence 2 that "Groundwater monitoring in this area is currently being conducted by Irving Oil Ltd."

With respect to the remaining impacted soil between the FN and MEL buildings, on the DFO and DNRE properties only, the DFO consultant MGI (Maritime Groundwater Inc. subsequently acquired by Conestoga Rovers & Associates) July, 2003, A-308 (Appendix 39) indicates that "Residual hydrocarbon impacts were identified along the property boundary in the area between the FN Fisheries Ltd. fish plant and the Marine Extract Ltd. building. Benzene, toluene and/or xylene concentrations in excess of the applicable CCME or NBDELG Tier I guidelines (for a commercial site with non-potable water and sand soil) were identified in surface and subsurface soil samples." Sample locations 03MW-4 and 03MW-5 are located on DFO property. It was further indicated in the report that "The aerial extent of hydrocarbon impacted soil in this area is estimated to be 650 square metres with a volume of 2400 cubic metres." and "The source of hydrocarbon impact in this area is assumed to be related to the abandoned underground fuel lines….". This estimate represents the remaining portion of contaminated soil between the MEL and FN buildings. ACER notes that this ignores previous investigations that identified contamination to extend under the FN and MEL buildings including ARC, August 1998, A-332 in Appendix 22, (AG-438 better figures, Appendix 23)**,** sampling inside the MEL building, A-121 in Appendix 40, June 18, 1998. ACER, FN A-944 in Appendix 9, for sampling between 2011 and 2013 showed petroleum hydrocarbon contamination in the soil and groundwater to occur under the building footprint for the FN and MEL buildings. Refer to Figures 4-1 and 4-2 (also in Appendix 97) showing the TPH concentration contours for soil and groundwater, respectively, for the current ACER investigations with Figures 4-15 and 4-16 (also in Appendix 96) showing the ARC 1998 concentrations.

ACER noted that an area of petroleum contamination on the SCH property that MGI referred to as " Site is down gradient of former hydrocarbon impacts that were identified on the adjacent property" in the 2013 Final Phase III ESA (FN A-931 in Appendix 54), and referred to in the Phase II/III ESA dated February, 2002, A-307 in Appendix 42, by MGI as "Residual hydrocarbon impact was previously identified along the property boundary in the area between the FN Fisheries Ltd. fish plant and the Marine Extract Ltd. building." is included as part of the larger area identified in the previous "Additional" Phase III ESA 2003 report (A-308, in Appendix 39) by MGI as "Contaminated Site 4 – Abandoned Pipeline near F.N. Fisheries Ltd. Fish Plant".

For the purpose of further defining the area associated with Contaminated Site 4, refer to Figure 5 in A-308 in Appendix 39. The area of petroleum hydrocarbon impacts associated with Contaminated Site 4 as presented in the report is indicated to extend from the DFO property to the western end of the FN and MEL building footprints. With respect to Contaminated Site 4 it is indicated that concentrations of TPH in soil of 4,800 mg/kg were reported in the vicinity of the pipeline. Hydrocarbon contaminated soil was reportedly removed and the area is shown in Figure 5 of the report. As indicated, **contaminated soil below and adjacent to the pipe was not excavated to avoid any further damage to the pipe.**

ACER notes that it appears that recontamination or incomplete remediation occurred in this area. For the February 2002, Phase II/III ESA by MGI for DFO property, A-307 in Appendix 42, indicated in the "Conclusions" section of the report that "Residual hydrocarbon impact was previously identified along the property boundary in the area between the FN Fisheries Ltd. fish plant and the Marine Extract Ltd. building. Soil samples collected from monitor wells (01MW-1, 01MW-2 and 01MW-6) drilled in this area as part of the Phase II/III ESA were within applicable NBDELG (1999) and CCME guidelines."

Groundwater sampling conducted at three locations in November 2001 indicated concentrations to be within the NBDELG (1999) criteria applied for the assessment. It was further noted that analytical data from a July 2000 monitoring event by ASPEN Environmental associated with remediation of petroleum impacts on the DFO and DNRE properties showed concentrations to be within the NBDELG (1999) criteria. MGI applied non-potable conditions for the selection of NBDELG criteria, although FN and MEL and other users in the area were using potable water wells for food grade operations.

Although the Phase II/III ESA by MGI, Affidavit A-307 in Appendix 42, conducted in November 2001, indicated concentrations for petroleum hydrocarbons in the soil and groundwater samples collected for those investigations to be within the NBDELG (1999) criteria for the area along the property boundary in the area between the FN Fisheries Ltd. fish plant and the Marine Extract Ltd. building, results for the additional sampling locations installed as part of the "Additional Phase III Environmental Site Assessment" conducted in February 2003 by MGI, Affidavit A-308, in Appendix 39 showed concentrations in soil at two of the three additional locations, 03MW-4 and 03MW-5, exceeded NBDELG (1999) and federal CCME criteria.

However, for the "Additional Phase III Environmental Site Assessment" conducted in February 2003 by MGI, Affidavit A-308 in Appendix 39, it was noted that the soil samples submitted for locations 03MW-4 and 03MW-5 for Contaminated Site 4 that showed exceedences, were at depths between 0.61 and 1.83 metres. For the third location 03MW-6, analysis were for soil samples collected at depths between 2.44 and 5.49 metres that showed concentrations to be within the commercial criteria they applied for the assessment. Concentrations at depths between 2.44 and 5.49 m for 03MW-4 and 03MW-5 were also within NBDELG 1999 criteria.

On page 424 MGI, July 2003, A-308 in Appendix 39, it is indicated that "headspace vapour concentrations in soil samples collected during the Additional Phase III ESA ranged from 0 ppm to 85% LEL, with the highest concentrations occurring at 3MW-6." Based on vapour readings for samples, analysis of a sample between 0.6 to 1.83 metres at 03MW-6 would have been appropriate to confirm if concentrations were similar to those obtained at similar depths at 03MW-4 and 03MW-5 that exceeded NBDELG criteria.

ACER notes that for the Phase II/III ESA by MGI conducted in November 2001, Affidavit A-307 in Appendix 42, that with the exception of one sample, that analysis of samples on the SCH/DFO property for Contaminated Site 4 were for sampling depths between 2.4 and 6.0 metres. Similar to the results for the "Additional Phase III Environmental Site Assessment" conducted in February 2003 by MGI, Affidavit A-308 in Appendix 39, for samples analysed at similar depths, concentrations were within the NBDELG (1999) criteria. It appears that exceedences of the NBDELG (1999) criteria for soil is most prevalent at depths ranging from 0.6 to 1.83 m and the extent of contamination (laterally and vertically) in this area was not established in accordance with NDBELG or federal requirements. There was no excavation of impacted soils associated with this area on the SCH/DFO property.

With respect to concentrations of hydrocarbons in groundwater for Contaminated Site 4 for the MGI Phase II/III and Additional Phase III ESAs, it is indicated in the ACER letter to SCH/DFO dated April 17, 2016, FN A-1291 in Appendix 62, that the previous sampling for 01MW-6 was on November 28, 2001 when the monitoring well was initially installed. The concentrations for BTEX components as well as the TPH range hydrocarbons, with the

exception of petroleum hydrocarbons in the C6-C10 TPH range, were below quantification limits for the November 28, 2001 sampling event.

It was further noted by ACER that concentrations were higher for select BTEX and TPH components for the other monitoring well 01MW-1 located in the same general area for the same sampling event was higher. It was also noted that concentrations for monitoring wells 03MW-4 and 03MW-5 installed in 2003 (A-308 in Appendix 39) in the same area of concern showed select BTEX and TPH components to be relatively higher compared to the 2001 sampling event. Petroleum hydrocarbons at 03MW-4 exceeded the NBDELG 2003, 2012 and 2015 criteria for non-potable and potable water conditions.

Given the groundwater flow conditions assessed for the study area as shown on Figure 3-4 (also in Appendix 73) for ACER and ARC Figures 1-8 and 1-9 in Appendix 24, recontamination can be expected given conditions that contribute to the migration and spreading of contamination and the historically apparent sources for the study area, and in turn continue to represent a risk to the marine environment.

ACER noted that there are concentrations of petroleum hydrocarbons (including naphthalene) on the MEL and FN properties that represent a risk to the marine environment due to the transport of petroleum hydrocarbons to the marine environment via the groundwater to surface water pathway. Contamination as well as remedial activities associated with the SCH/DFO property related to the IOL pipeline assessment are also considered to be contributing sources/factors to the contamination issues on the FN and MEL properties.

There was no assessment of risks to the marine environment due to the transport of petroleum hydrocarbons (including naphthalene) to the marine environment via the groundwater to surface water pathway and remediation was only carried out to reduce concentrations to levels that satisfied the NBDELG human health criteria and did not include any assessment of risks to the marine receiving environment.

It was noted in DFO correspondence AGC-147 (Appendix 56) between Marcia Johannesen of Public Works and Government Services Canada (PWGSC) and Raymond Losier of DFO dated March 20, 2013 that it was indicated that “Groundwater sampled from Monitoring Well 01MW-6 (down gradient of the former hydrocarbon impacts on the adjacent property) is within acceptable hydrocarbon guidelines and no further assessment is recommended.” ACER also noted that in an email dated April 11, 2013 from Mario Theriault of Conestoga Rovers & Associates (CRA) to Marcia Johannesen (AGC-213, Appendix 57) the following was indicated:

“Hi Marcia, see attached site plan. A monitor well was located immediately north of 01MW-6 as shown on the plan. The monitor wells immediately south and northeast of 01MW-6 could not be located. However, we did notice other monitor wells which appeared to have recently been drilled (silica sand visible on asphalt around flush mount) in the vicinity of the FN Fisheries LTD Fish Plant (at least three monitor wells as shown in orange on the plan; approximate locations). I doubt very much that all other monitor wells (01MW-2, 01MW-3, 01MW- 4, 01MW-5 and 03-MW-1, 03-MW-2 and 03-MW-3 identified in green) are still in place as this area has been paved over the years. Sorry, no photos showing other monitor wells.”

It appears from the above that even though there was some interest in the collection of additional information, that it was determined that “no further assessment is recommended” based on concentrations of a single sample and no apparent regard for historical observations of groundwater flow conditions, underground services that provide for preferential flow pathways for movement of contamination from the IOL bulk plant and contaminated soils were known to have been left in place for remediation in the area of the pipeline. It was further noted by ACER that the previous sampling for 01MW-6 was on November 28, 2001 when the monitoring well was initially installed (A-307, Appendix 42). The concentrations for BTEX components as well as the TPH range hydrocarbons, with the exception of petroleum hydrocarbons in the C6-C10 TPH range, were below quantification limits for the November 28, 2001 sampling event. It was further noted that concentrations were higher for select BTEX and TPH

components for the other monitoring well 01MW-1 located in the same general area for the same sampling event was higher. It was also noted that concentrations for monitoring wells 03MW4 and 03MW5 installed in 2003 (A-308, Appendix 39) in the same area of concern showed select BTEX and TPH components to be relatively higher compared to the 2001 sampling event.

It was further noted that concentrations for 01MW-6 were for the most part below the quantification limits and results for 01MW-5 were comparatively higher, as well as other locations in the area of interest installed in 2003 that showed even higher concentrations for select BTEX and TPH range petroleum hydrocarbons than the original two monitoring wells. Given that 01MW-6 showed concentrations for BTEX and select TPH range petroleum hydrocarbons that were below the quantification limits and several other monitoring wells showed comparatively higher values, the decision that "no further assessment is recommended" would not be considered to be a good technically based assessment.

It is also indicated in the DFO request for property-based environmental information dated October 29, 2013 from the DOE regarding the site with respect to contamination and remedial work etc., that "Our records indicate that there has been contamination found at 1. Shippagan, DFO Wharf and Irving Pipeline (PID# 20704584)., as well as several other nearby properties (AGC-228, Appendix 58). This would indicate that there were still issues related to contamination on the DFO property (and presumably the DNRE property), contrary to the position of PWGSC (AGC-147, Appendix 56).

Further to the above, it is indicated in a letter dated March 25, 1997 from Tom Gallagher of Jacques Whitford Environmental Limited to Claude Burry of DFO (A-83, Appendix 20) that

"The testing revealed that these 2 abandoned pipelines did not pass testing and were suspected of having been leaking during their operating life." And further indicated that " DFO clean-up activities should be part of a joint effort which should include all impacted property owners.".

In addition, in correspondence dated August 7, 1997 (AGC-468, Appendix 59) Tom Gallagher, Jacques Whitford, states " Mike Sauerteig from Irving Oil called me today about the Shippagan clean-up. He said that he is awaiting a proposal from his consultant (Vic Nowicki-Arc Associates) which he expects to have in about a week. He said the IOL approach will be to dig test pits starting at the edge of IOL property, and progressing down the pipeline towards the wharf. IOL is going to go right across the DNRE property since they have the "go ahead". He also expects to go right into DFO property. I told him that shouldn't be a problem, and he would need to do that anyways to get the full picture."."

There was no information located in the documentation to indicate that this was done.

As indicated, in the summer of 1998 a secondary FN fish plant and fish meal plant waste water treatment system was installed at the eastern end of the FN property. Petroleum contamination was encountered and construction was halted. Photos and a drawing with locations are provided in A-33 a b c (Appendix 49). Given that the IOL underground petroleum pipeline was identified as a source of petroleum contamination on the adjacent DFO property with Irving Oil Limited having been identified as the responsible party, it was concluded that the pipeline was the apparent source of contamination and therefore, IOL was contacted regarding clean up. The impact area was referred to as the "pollution pit". An invoice dated October 8, 1998, A-37 (Appendix 50) shows that approximately 500 ton of contaminated soils were excavated from the "pollution pit" and transported to Belledune for treatment. In a fax to Sealand Construction Ltd. from Eric Smith dated July 31, 1998, A-36 (Appendix 51) it was indicated that since no one was on site qualified to evaluate the soils that a soil sample be collected in a 5 gal bucket. In a fax from Mike Sauerteig of IOL to Eric Smith dated August 21, 1998, A-38 (Appendix 52) Sauerteig indicates that "We have been informed through conversation with Sealand Constr. that approx. 500 tonnes soil was delivered to Envirem in Belledune, with instructions to send the bill to Irving Oil Limited. Please be advised

that we cannot accept responsibility for any costs associated with this work until such time that we have had the opportunity to inspect the soils and have the sample analyzed."

Irving inspected the site and took samples (5 gallon bucket) to their lab for analysis and the construction of the FN pollution pit was completed. About 3 times the required excavated soil had to be removed due to the sides caving in while we waited for the Irving inspection due to the high water level, continuous pumping to keep the pit dry and sandy soil. **There was no sampling carried out to confirm that all contaminated soils had been excavated**. Billing, A-39 (Appendix 53) shows IOL having paid the invoice associated with the transport of contaminated soils to Belledune, reflecting an admission that IOL was responsible for the contamination. ACER sampling indicates contamination is still present in this area.

It is also noted by ACER that MGI did not consider naphthalene contamination in this area although concentrations were identified in the historical documentation contained in their assessment report. It is indicated in the report that "No soil samples were submitted for PAH analysis from the Additional Phase III ESA work. No PAHs were detected during previous assessment work.". ACER noted in ARC, April 1998, A-344 (Appendix 34) that soil samples at MW2-98 and MW4-98 showed naphthalene concentrations of 42 and 32mg/kg compared with the CCME 2010 provisional guideline of 22 mg/kg for environmental health, but a value of 0.013 mg/kg to be applied if there is concern for potential impact to water bodies.

In a memo dated November 20, 2000 (A-318 in Appendix 41) regarding "IOL July 2000 Site Monitoring Report, Shippagan, NB" Tom Gallagher of JWEL indicates "It should be clear that the existing remedial approach appears to be geared toward containment and treatment of impacted groundwater, ·rather than remediation of soil. Soil contamination can act as a persistent ·source of groundwater contamination, and as such, groundwater remediation may be required over an extended time frame (greater than 5 years)." It was further indicated that

""The monitoring data presented in the report is from such a limited time period that it is not possible to meaningfully evaluate trends or progress. If additional monitoring data is available for prior sampling events (i.e. from site assessments) it would be useful to include these data.

Interpretation of groundwater elevation data in the form of groundwater contour maps should be considered and opinions provided on the effectiveness of the pumping system and overall progress toward achieving the management objectives. There did not seem to be sufficient information presented in the July report for Aspen's opinion that the dissolved groundwater plume is currently in a stable phase. We recommend that clarification be obtained on the basis for their opinion.

The existing monitoring report indicates that several wells could not be located or were inaccessible. As several of these wells appear to be located hydraulically down-gradient of the hydrocarbon source areas, consideration should be given to refurbishing or replacement of some of these wells. Monitoring of these wells will be necessary to delineate the dissolved hydrocarbon plume and to demonstrate hydraulic containment (i.e. no hydrocarbon discharge to the bay).""

The above comment by JWEL indicates that additional assessment was necessary to ensure remediation was adequate, recognizing as indicated in the JWEL report, (A-83 in Appendix 20) that **"The preliminary investigation revealed significant hydrocarbon impacts to DFO property, with the greatest impacts being closest to the DNRE property. The adjacent DNRE property has been confirmed as being contaminated by hydrocarbons (gasoline).", and further indicated that "JWEL recommends that the extent of the contamination (both on and off DFO property) be established prior to DFO initiating any remedial action. DFO clean-up activities should be part of a joint effort which should include all impacted property owners. <u>Premature clean up may result in recontamination of DFO property</u>"** No additional sampling was carried out for confirmation purposes. Subsequent sampling by MGI in in 2002 (A-307 in Appendix 42) on behalf of the DFO/SCH and as

discussed in this report ACER current investigations showing concentrations of petroleum hydrocarbons are present that represent a risk of concern for areas previously defined by ARC, in association with the area of the two OIL underground gasoline transfer lines and the IOL bulk plant that were identified as apparent sources.

ACER noted that migration of contaminated towards MW3 was frequently identified as an issue by the Department of Environment and the IOL consultant ARC. In a letter from ARC to Mr. Mike Sauerteig dated October 10, 1996, (A-586 in Appendix 125) ARC indicated that "MW3 has shown a steadily increasing level of dissolved hydrocarbons (e.g., 2,300 ppb in April 1996 to 6,100 ppb in August 1996). This well is located approximately 3.0 metres beyond the IOL property boundary. These concentrations would indicate the plume is moving off-site in a northerly direction at increasing concentrations. It would be advisable to establish the limits and direction of the plume."

ACER notes that ARC indicates plume is moving off-site in a "northerly direction" based on steadily increasing levels of dissolved hydrocarbons at MW3, but MW3 is located to the east on the CN ROW property towards the harbour. ACER believes the north arrow is incorrectly referred to in this instance. Refer to the Figure in the ARC monitoring report (ARC, 1997A, A-592 a,b in Appendix 21) that shows the north arrow in the title box and may be mistakenly used for referencing, when compared with ARC Figure 4 (in A-450 in Appendix 101) that shows the north arrow outside the title box and MW3 to the east of the IOL property. Also refer to Figure 1-5 of ACER report (is Figure from ARC A-481a in Appendix 24, with ACER Figure 1-5 also included in Appendix 24) that shows the north arrow outside the title box and context for groundwater flow off the IOL property (but did not include location MW3), with Figure 3-4 (also in Appendix 73) for the ACER investigations showing groundwater flow for the study area.

ACER also had the opportunity to collect samples and take photos during upgrading of the Town underground services adjacent to the IOL bulk plant property in the area of MW3 in 2002. Photos 3-6, 3-7 and 3-9 (also included in Appendix 72) show the two IOL underground gasoline lines uncovered during upgrading of the Town underground services in 2012. Petroleum staining is evident around the pipes with evidence of seepage. It is also evident from Photo 3-7 that there is petroleum discharge occurring from a nearby concrete pipe that originates from the IOL bulk plant property as indicated from Photo 3-6. It appears that the petroleum discharge is migrating through the soils with a portion of the flow following the gasoline pipeline as a preferential pathway.

Photos 3-10 to 3-14 (also included in Appendix 72) show petroleum staining in the soils and completely to highly weathered band fractured bedrock during upgrading of underground services by the Town for 14th St., Photos 3-1 and 3-2 (also included in Appendix 72) shows petroleum staining and sheening on the 4 metre trench excavation for Town underground services upgrading that is essentially on the opposite side of 14th St., with Photo 3-3 (also included in Appendix 72) showing petroleum sheening on the water surface in this area.

It was noted during air rotary drilling of the bedrock wells 16MW20A and 16MW20B, located adjacent to 14th St. and up gradient of MW3, in the highly weathered and highly fractured bedrock that petroleum product was observed in the groundwater discharged from the well and continued for about 30 minutes (see photos 4-1, 4-2 and 4-3 below) as the hole was pumped to clear up the water for the downhole video. Mobilization of the petroleum product is attributed to water pressure generated by air rotary drilling mobilizing contaminant in the weathered and fractured zone. This would indicate that contamination has been drawn into this zone with remedial pumping carried out on the IOL property expected to be a contributing factor, and would further support a significant amount of petroleum product having been released on the IOL bulk plant property, while also recognizing that this zone shows and other underlying zones show contamination above RBCA and CCME drinking water and marine aquatic life guidelines. Referring to Figure 3-2, it is shown that all three IOL recovery wells extend into the highly weathered and fractured bedrock zone that dips down as it extends to the shoreline.

In addition, municipal underground services are present that represent preferential pathways that would provide for faster transport of contaminated groundwater. See Photo from page 11 (A-1871 j) of FN A-1871 a,b,c,d,e,f,g,h,I,j,k, in Appendix 18 as Photo 1-1 in this report, located adjacent to 14th St., and up gradient of MW3.

During drilling of monitoring well 19MW150, located about 5 m from the corner of the wharf and adjacent to an underground storm discharge line, there was a loss of downhole water pressure at approximately 4 metres depth. Within several minutes, a cloud of dirty water was observed to be discharging from the storm line located at the corner of the wharf that spread across the inner harbour and persisted for several hours (see Photos in Appendix 100).

The above also supports that the underground lines provide a direct preferential pathway for release of contaminated groundwater to the harbour in addition to normal groundwater flow. It is important to recognize that contamination in the highly fractured bedrock also exceeds guidelines in recognition of the highly fractured nature of the bedrock and application of CCME guidelines that indicate that "If transport between the contaminant source and receptor (e.g. surface water body) is through fractures instead of unconsolidated soils, either a transport distance of zero should be assumed (i.e. the Canadian Water Quality Guidelines for the Protection of Aquatic Life should be applied to groundwater), or a site-specific risk assessment should be conducted." This would also apply to a water supply well used for food grade operations."

As indicated previously Monitoring carried out by ACER and the IOL consultants show groundwater flow gradients favour roadways with underground services including 14th St., and the former CN ROW located between the FN and MEL properties, and are representative of preferential flow pathways. Groundwater contours show flow occurring from the IOL bulk plant property toward 14th St. and continuing onto the former CN ROW/driveway area between the FN and MEL properties with flow components occurring onto the FN and MEL properties.

ACER further notes that the figures show a strong component of groundwater flow occurring from the highly contaminated area between the FN and MEL buildings into the area represented by the footprints of the two buildings. ACER also noted in the ARC Report A-321 in Appendix 26 that "the treatment system was not operating. The electric panel was checked and all switches were noted to be in the off position." Therefore, it is reasonable to make a comparison of the flow conditions given there would be no pumping influences. It is apparent from the figures that conditions exist that can cause contamination occurring on the DFO property to migrate onto the FN and MEL properties, and result in widespread contamination including the area of the building footprints, other adjacent properties and into the marine environment.

As indicated previously, groundwater flow contours are shown in Figure 3-4 (also in Appendix 73) for a monitoring event by ACER on May 18, 2017, for a high tide cycle represented by a lower end of the range for the high tide cycle. It is important to note that groundwater flow conditions are consistent with conditions previously reported by the IOL consultants for investigations for the area between 1989 and 2004. Groundwater flow occurs from the IOL bulk plant property in all directions, and ultimately to the harbour. Also refer to ACER Figures 3-7 and 3-8 in Appendix 76 that show the footprint of contamination in the soil, weathered/fractured bedrock and groundwater.

Based on groundwater flow established by the IOL consultant (Figures 1-8 and 1-9 in Appendix 24) and ACER Figure 3-4 (also in Appendix 73) in addition to the soil and groundwater TPH concentrations contours contaminated groundwater flows to the harbour (ACER Figures 3-7 and 3-8, also contained in Appendix 76) where sediments are known to be impacted (ACER Figure 3-8 in Appendix 76). Impacts to SCH/DFO inland properties is discussed in detail in Section 4.4.1 with harbour sediments discussed in detail in Section 4.4.2.

4.2 MIGRATION AND SPREADING OF CONTAMINATION

Spreading/migration of contamination over large areas is a major factor for the project area, with:

- overburden and bedrock conditions that provided preferential flow conditions;
- an extensive network of underground services providing preferential flow conditions;
- pumping of groundwater aquifers and remedial well pumping;
- and tidal influence;

that promoted the spreading/migration of contamination in combination with long term delays in cleanup efforts as well as no cleanup efforts having been implemented for contaminated soils, with respect to the IOL Bulk plant and in association with the pipeline including areas on the CN ROW and under the FN and MEL building footprints.

The extent of contamination identified by ACER based on information collected to 2019 for soil and groundwater respectively, shown in Figures 3-5 and 3-6, also in Appendix 76 is similar to what is shown in previous environmental reports prepared by Three-D GeoConsultants Ltd. (Document A-281 a in Appendix 4), shown in ACER Figure 1-3 and Figure 1-4, for soil and groundwater contamination, respectively. The Three-D GeoConsultants Ltd. report included findings from the 1998 investigations of the nearby Department of Natural Resources and Energy (DNRE) and Small Craft Harbours (SCH) properties that included the MEL and FN properties (ARC report as Document A-332 with AG-438 having better figures, referring to Figures 2 and 4 for soil and groundwater contamination, respectively, in Appendix 22, and Appendix 23),.

Three-D GeoConsultants Ltd., July 12, 2001, A-281 a (Appendix 4) identified a number of variables that influence the spread of contamination including but not limited to the following:

1) Geology

I) The type of materials involved from surface grade materials, overburden material and bedrock material. (Chemical compositions and Classifications) – silty sand and gravel to depths of 3 metres and sandstone that is highly weathered near the surface.

ACER note that Silty sand and gravel have a moderate to high permeability.

II) Dip of Stratigraphic Column - 3 degrees to 5 degrees East-North-East

Towards the shoreline.

III) The relatively high Porosity and Transmissivity of reservoir rock material - Transmissivities = 207 m3/day (13,895 g/d/ft.) from drawdown data.

*(High risk for rapid spread of contaminants throughout area)

IV) Fractures and Fissures of regional reservoir rock causing further diversion of contaminants throughout area. This also makes the "actual" groundwater flow very difficult to determine.

V) The presence of high levels of "salts" within the groundwater and sub-surface soils hinder the effectiveness of injection galleries of Phosphate and Nitrate thus slowing down the bacterial degradation of the hydrocarbon contaminants of the area.

2) Groundwater Influences

I) Aquifer Potential - groundwater velocity and Transmissivity of aquifer.

II) Aquifer Boundaries- Coastline of harbour on eastern-north eastern portion of aquifer.

III) Groundwater Elevations (i.e. Hydraulic Gradient is low = approx. 0.018)

- There is very little difference between groundwater elevations of the whole area (therefore area is very susceptible to frequent changes in groundwater flow direction(s)).

IV) Tidal Loading (i.e. Seawater Encroachment)

- This causes frequent fluctuations in groundwater elevation, therefore affecting the whole area with respect to groundwater flow direction during fluctuations of tide.

V) Recharge of Aquifer

- During recharge events (mainly in the Spring and Fall of year) there are fluctuations in groundwater elevations therefore causing changes in the direction of groundwater flow of whole area during these times.

*Reports containing conflicting groundwater flow designations of area could be due to points IV) and V) above.

VI) The boundary between the fresh water of the aquifer and the saltwater of the aquifer.

Saltwater-Freshwater interface determined to be between 25' and 50' below surface. (interface would differ with tidal loading and recharge of aquifer events).

3) Density of Each Individual Contaminant Involved

4) Influence of Existing Wells in Area

(i.e., Domestic and Remedial wells currently in use in the area.)

I) Operating wells within the area cause changes in groundwater flow due to a change in the potentiometric surface of the groundwater caused by drawdown of operating wells.

II) The number of operating wells in the contaminated area and around the contaminated area is very important in determining the path that these contaminants travel. Operating wells have a great influence on groundwater elevation, hence the direction of groundwater flow.

Three-D GeoConsultants Ltd., A-281 a, July 12, 2001 (Appendix 4) also commented concerning the “effectiveness of remedial action plan and remedial facilities in place at the present time”. Several potential concerns were identified:

Whether or not the efforts to remedy contamination of the area have been premature (Premature Remediation), and if so, this ultimately leads to re-contamination of the whole area due to the number of complex variables involved within the locality: and

If contamination has been proven to be depleted on a subsequent property, have the contaminants actually been removed from that site or have the contaminants simply been displaced from one site to another?

Recognition of land use as being sensitive or non-sensitive for affected properties (including source properties and adjacent properties that have been impacted by the source properties) and whether or not:

- a more effective remedial plan/design should be implemented for each contaminated site or;
- an alternative remedial action plan be implemented for “total decontamination of all contaminated properties”.

Assessments by ARC for the DNRE and DFO property indicate that “The dissolved hydrocarbons occur more widely, as would be expected due to groundwater movement and tidal fluctuation effects….” “The groundwater flow indicates a gradient of 0.0015 is operative to the west,”…..” “With such small elevation differences, tidal loading could easily cause localized flow to change direction. The orientation and occurrence of both the dissolved and residual plumes appear to indicate that changes in the direction of groundwater flow have taken place. These changes may occur due to high tides and/or high recharge events (spring and fall) or local well pumping. If these changes only occur at specific times of the year, and are only in force for short time spaces, then the spreading of the plume would be limited and may to some degree reverse itself at other times of the year.”

4.2.1 Extensive Network of Multiple Underground Services Providing Preferential Flow Pathways

Preferential Flow Pathways are defined in Provincial guidelines as “Means by which contaminants may migrate faster or easier than through soil leaching or bulk transport processes (*e.g.*, culverts, trenches, ditches, sewer lines, pipelines, swales, cabling *etc*.).” The presence of preferential flow pathways including but not necessarily limited to water supply, storm water and sewer lines as well as ocean discharge lines from the fisheries operations, gravel sub-base for street construction acting like a “French drain” (as indicated by an IOL consultant) and fractured bedrock zones are important factors to be assessed and if present, to consider the implications of this in the assessment with respect to movement of contaminates off site.

With respect to streets, the granular sub-base materials for the street and placement of piping combine to provide a very significant preferential flow pathway for contaminates, and this situation is very evident for this project. **The IOL consultant ARC January 9, 1993, A-481 in Appendix 24 indicated:**

“This street appears to act as a groundwater sink as the three monitoring wells to the southeast of 14th Street flow towards the northwest. The groundwater contour centred on MW13 also indicates that there is a groundwater sink between 14th Street. It is likely that the installation of services such as sewers and water mains and the ensuing backfill with coarse material may in fact act to provide a french drain effect along the pipeline. This could account for the apparent observed groundwater data."

The extensive network of multiple underground services in the project area extend across multiple properties and as such contribute to spreading of contamination throughout the project area including the marine environment (noting that petroleum hydrocarbons reported in sediments and surface water between 1975 and 2013). Underground services shown on the drawings demonstrate that there is an extensive network across the affected properties, but it should also be noted that other lines are present that are not shown that further add to the extensive nature of the network.

4.2.2 Pumping Influence of FN Well, Remedial Wells for IOL Bulk Plant and DFO/DNRE by IOL, and Town Well

As previously indicated, since 1950 or earlier, FN had a functioning 6 inch potable water supply well, that is approximately 120 feet deep **and substantial petroleum hydrocarbon contamination was reported for the shallow and deeper groundwater flow systems** (Affidavit document A-155, Appendix 31)**.** A downhole video was taken in 2000 and it is reported that oil like globules were evident in the water column (A-57, Appendix 32 is provided as a digital video included as a separate digital file that can be opened using the open source video program “VLC media player”). A still photo at time frame 14h18m17s247 from the aforementioned video and a photo of a water sample collected during purging of the well are provided in Appendix 99. The well construction is shown on Figure 3-3 (also included in Appendix 72). Sampling of the FN water supply well by ACER in 2011, A-292 (Appendix 8) showed concentrations of petroleum hydrocarbons (BTEX and TPH) exceeding the RBCA

commercial land use with potable and non-potable water criteria, and could no longer be used for food grade seafood operations.

An assessment of the zone of drawdown influence under existing Department of Environment approved pumping rates was carried out by Craig Hydrogeologic Inc. for the MEL and FN properties, April, 2011, (Affidavit document A-662, Appendix 30). As can be seen in Figures 2, 3, 5, and 6 of the report, the groundwater capture area reflected by a pumping rate of 250 GPM for FN operations (operational range from 200 to 350 GPM) include the adjacent DFO and DNRE properties. Craig indicates that

"Any properties which are located within the groundwater capture areas of the pumping wells and which have sources of groundwater pollution/contamination pose a risk to the pumping wells."

This includes the area of the IOL underground gasoline and fuel oil transfer lines that extend from the bulk plant to the end of the wharf, and it is expected that contamination was drawn into the overburden and bedrock zones by the operating well.

The additional investigations by ACER in 2016, 2018 and 2019 included additional intrusive investigations to further assess conditions near the DFO SCH property boundaries with FN and MEL. Additional soil and groundwater sampling was carried out in other areas and to greater depths that also included drilling into bedrock. Sampling carried out at new and previously existing locations also allowed for an assessment of current conditions. Sampling locations are shown in Figure 3-1 (also in Appendix 70).

The ACER 2016 intrusive sampling program showed that the bedrock has extensive vertical and horizontal fracturing with large fractures evident. Location 16MW24 was screened in the groundwater between 12.37 and 14.17 metres in fractured bedrock. Location 12MW88 was screened in the groundwater between 0.6 and 3.7 metres in sand and gravel and in the highly weathered sandstone. Location 12MW43 was screened in the groundwater between 0.3 and 2.2 metres in till and 0.3 m of the highly weathered sandstone. A cross section of the overburden and bedrock conditions is provided in Figure 3-2, (also included in Appendix 72) with the FN well identified as WS/FN WELL. The location of the well is shown on Figure 4-2, also included in Appendix 97. Photos taken during rehabilitation of underground services by the Town that show the overburden and bedrock conditions as well as petroleum sheening and staining in the soils and groundwater are provided in Photos 3-1 to 3-14 (also included in Appendix 72). Several downhole video stills showing the extensive and significant fracturing in the bedrock are provided in Photos 3-15 to 3-18 for 16MW20A located on the IOL bulk plant and adjacent to 14th St. and Photos 3-16 to 3-19 for 16MW 22B located about 140 metres down gradient of 16MW20A, are also included in Appendix 72.

Well 16MW22B is located near the northeast corner of the MEL building about 140 metres from 16MW20 located on the IOL bulk plant property, in the direction of the wharf and several metres from the IOL underground gasoline transfer line and the FN water supply well that is constructed to 120 foot depth. The cobble and cave fractures appear to represent zones of significant fracturing and vertical fractures are evident that extend several metres, providing an interconnection with the two highly fractured zones in the bedrock, that show a downward dip from the IOL site toward the FN/MEL properties and the wharf. **ACER noted that in the draft remediation plan for the two IOL gasoline pipelines, A-114 in Appendix 55 that the remedial collection pipes were shown to be 3.5 to 4.5 metres below grade with the depth of the pumps in the remedial collection wells for the collection galleries to be 0.6 metres below the collection pipe.**

It would be expected that this groundwater pumping arrangement and fracture conditions would likely result in contamination being drawn into the deeper groundwater zones associated with the weathered

and fractured bedrock. Migration of contamination into the bedrock would be expected to increase even more significantly due to drawdown associated with the FN water supply well, used for food grade operations. As previously indicated, an assessment of the zone of drawdown influence under existing Department of Environment approved pumping rates was carried out by Craig Hydrogeologic Inc., April, 2011, for the Marine Extract and Pecheries FN Fisheries Ltee properties, (Affidavit document A-662, Appendix 30). As can be seen in Figures 2, 3, 5, and 6 of the report the groundwater capture area for the Marine Extract and FN Fisheries pumping wells reflected by a pumping rate of 250 GPM for FN operations (operational range from 200 to 350 GPM) include the adjacent DFO and DNRE properties. Craig indicated that "Any properties which are located within the groundwater capture areas of the pumping wells and which have sources of groundwater pollution/contamination pose a risk to the pumping wells." This includes the SCH properties and areas extending to the edge of the wharf as well as the former IOL bulk plant and rail tanker car petroleum offloading facilities and former CN spur.

This would likely have been further influenced by the pumping of the Town Water Supply well. Document A-143 in Appendix 105 refers to Town potable water well located on 14 th., Street that is no longer in use as it "Would likely have influence on area and could possibly pull in contaminates." It appears that the potential risk of contamination was considered to be so high that the Town proceeded to replace this well. It is indicated by ARC, April, 1998, A-344 (Appendix 34) that "Near the shoreline, saltwater intrusion has taken place into the aquifer at shallow depths (<20 m). This intrusion has been caused in large part by historic extraction of fresh water by the Town of Shippagan and various commercial enterprises."

Given the behavior of groundwater flow due to groundwater pumping operations on the FN and MEL properties associated with food grade operations, pumping of wells for the Town Water Supply, pumping of remedial wells and return of treated groundwater to the recharge galleries for remediation on the DFO and DNRE properties, extensive underground services that provide for preferential flow conditions across the properties for the movement of contaminated groundwater, and tidal loading/influence in combination with the long term presence of petroleum hydrocarbons and PAHs in the soils, bedrock, groundwater and harbour sediments, it is reasonable to expect that contamination present on the FN and MEL properties and SCH property associated with the IOL underground gasoline transfer line represents an historical and ongoing source of contamination to the FN and MEL properties, and in turn to the marine environment.

It is also noted that there was an incident in December 1997 that required a lift station located on 16th St, one street over from 14th st for the IOL bulk plant, to be shut down **due to gasoline <u>infiltration into the sewer lines</u>** between 12th St., and 15th St., (FN A-1887 a in Appendix 64). Gaskets on the sewer line were reported to breakdown due to gasoline in the soils and groundwater in the area of 12th St., to 15th St., with IOL bulk plant and underground petroleum transfer lines being located between these streets. The deteriorated lines would provide an opportunity for contaminated groundwater to be "sucked in" to the sewer lines and draw contaminated groundwater down into the overburden soils and highly fractured bedrock. In addition, it would also contribute to the movement of contaminated groundwater from one area to another similar to a remedial well, thereby increasing the spreading of contamination.

<u>ACER, A-291 in Appendix 7 noted that it would appear that groundwater conditions show increases in concentrations without remedial operations being active for the IOL bulk plant area. **This would also indicate that it is likely that there is a persistent source, and in this instance the source would most likely be associated with residual contamination in the overburden soils and bedrock above and within the tidal zone, and possibly the movement of contamination deeper within the bedrock."**</u>

Although the highly weathered and fractured bedrock represents a long term persistent source, given that significant increases in petroleum concentrations occurred on multiple occasions between 1994 and 2000 and was accompanied by notable increases in thicknesses of free product, it would more likely be indicative of releases of a significant release of petroleum product at surface. However, there were no reports of any significant losses during this time frame.

Based on a review of monitoring reports in FN A-1804 (Appendix 27) available for the 56 months that the remedial system operated, July 7, 1999 to March 16, 2004, the system was non-operational at least 40 percent of the time. Given the system was non-operational at this frequency this provided opportunity for contamination to continue to migrate onto the adjacent FN and MEL properties including the area of the building footprints, other adjacent properties and to the marine environment.

It was noted during air rotary drilling of the bedrock wells 16MW20A and 16MW20B, in the highly weathered and highly fractured bedrock that petroleum product was observed in the groundwater discharged from the well and continued for about 30 minutes (see photos 4-1, 4-2 and 4-3 below) as the hole was pumped to clear up the water for the downhole video. Mobilization of the petroleum product is attributed to water pressure generated by air rotary drilling mobilizing contaminant in the weathered and fractured zone. This would indicate that contamination has been drawn into this zone with remedial pumping carried out on the IOL property expected to be a contributing factor, and would further support a significant amount of petroleum product having been released on the IOL bulk plant property, while also recognizing that this zone shows and other underlying zones show contamination above RBCA and CCME drinking water and marine aquatic life guidelines. Referring to Figure 3-2, it is shown that all three IOL recovery wells extend into the highly weathered and fractured bedrock zone that dips down as it extends to the shoreline.

For May 18 and 19th, 2017 water level and sample monitoring event there was a rainfall of 24.8 mm overnight (https://climate.weather.gc.ca/climate_data/daily_data_e.html) with data provided in Appendix 116. Water level measurements for monitoring wells inside and outside the diked areas showed the groundwater level had generally risen over 30cm, with maximum increases inside the dike showing 109 cm (16MW17) and outside of 71 cm at 12MW70. Given that free product measuring up to 37 cm thickness was reported by the IOL consultant, the soil overburden and the highly to completely weathered bedrock and highly fractured bedrock would become significantly impacted, resulting in long term persistent sources.

4.2.3 Tidal Influence on Groundwater Flow and Contaminate Migration and Spreading

With respect to contaminate migration in the project area, as indicated in the assessments undertaken by ACER, A-292 (Appendix 8), A-291 (Appendix 7) and FN A-944 (Appendix 9), and monitoring in May 2017 (see Figure 3-4 also in Appendix 73) groundwater monitoring indicates that tidal fluctuations appear to affect water levels and therefore, likely has an influence on the movement of groundwater. ACER observations were similar to historical ARC observations shown in Figures 1-8 and 1-9 in Appendix 24. Based on monitoring observations, changes in water level were most notable near the wharf, diminishing at the west end of the IOL property for monitoring carried out in December 2012 and 2017 and 2019. It should be noted that underground services would also have an influence on flow direction as well.

Groundwater flow contours for this study, based on groundwater level measurements for wells that typically extended to a depth of 5 metres plus or minus, with a number of wells penetrating into the upper highly fractured bedrock zone, are shown in Figure 3-4 (also in Appendix 73) for a monitoring event on May 18 for a high tide

Photo 4-1 Petroleum sheening during air rotary drilling of 16MW20A and 16MW20B located on the IOL bulk plant property adjacent to 14th St.

Photo 4-2 Petroleum sheening during air rotary drilling of 16MW20A and 16MW20B located on the IOL bulk plant property adjacent to 14th St. Evident for about 30 minutes of pumping to clear the well for downhole video.

Photo 4-3 Petroleum sheening during air rotary drilling of 16MW20A and 16MW20B located on the IOL bulk plant property adjacent to 14th St. Photo also shows relative location of MW to bulk plant fence line adjacent to 14th St.

event. However, it is noted that the high tide in this instance only represented a lower range for the high tide cycle. The site tide elevation was 0.4 metres, noting that the normal tidal range is (minus) - 0.5 m as low tide and 1.5 m as high tide, with mid tide being 0.5 m. Groundwater flow was somewhat variable across the properties, but with flow gradients favouring roadways with underground services including 14th St., and the driveway and former railway tracks located between the FN and MEL properties.

For this event the flow contours show flow occurring from the IOL bulk plant property toward 14th St., and continuing into the driveway area between the FN and MEL properties and former CN ROW. It then splits of onto the FN and MEL properties. Flow also occurs along the driveway between the FN and MEL properties that is in a landward direction from the DFO and FN property boundary that also splits north and south onto the FN and MEL properties, respectively.

It is also evident that draw down areas, also referred to as sinks, occur in several locations including the east end of the MEL property, the west side of the MEL building, the south east corner of the IOL bulk plant property (the IOL consultant ARC noted this as well), with a component also being toward the sink located at the west end of the MEL building. Flow in that direction is attributed to the driveway with underground services as well as the ditch located parallel to the driveway on the west end of the MEL property.

There is also a component of flow evident from the south side of the MEL building toward the harbour in the direction of the boat unloading facilities. There is also a component of flow from the south west corner of the IOL tank farm toward an ARC MW13 that ARC had identified as the location of a sink that would also act to draw contamination from the IOL bulk plant site in that direction.

For a monitoring event carried out on July 18, 2019 with a tide elevation of 0.11 metres, versus 0.4 m for the aforementioned tide event, similar areas showed draw down behaviour, but in the area of 18MW121 and 18MW125 a water level elevation of -0.28 metres was observed compared with the site general level of 0.6 m. This was more pronounced than the May 18, 2018 event, but noting that the tide level was transitioning from high to low and was also about 0.1 metres lower for the readings taken for this well. The draw down was not as evident during the May 19, 2017 event likely due to the higher tide level. This is an area that ARC also identified as being unusual in regards to groundwater flow behaviour as well as the area of MW13, near ACER well 12MW47 but also with 12MW59 being nearby that showed multi direction flow behaviour as well.

It was noted by ACER that on the south side of the MEL property that locations 12MW59, 12MW46 and 12MW57 showed multidirectional flow behaviour, attributed for the most part to 15th street and underground services but also due in part with the storm sewers also having a link to the wharf and probable leakage in and out of the pipes with tidal changes. During drilling of monitoring well 19MW150, located about 5 m from the corner of the wharf and adjacent to an underground storm discharge line, there was a loss of downhole water pressure at approximately 4 metres depth. Within several minutes, a cloud of dirty water was observed to be discharging from the storm line located at the corner of the wharf that spread across the inner harbour and persisted for several hours (see Photos in Appendix 100). It is also noted that there is a component of groundwater flow that occurs toward the boat storage area as well, with 15th St., likely having some influence.

Tidal loading effects were noted to be evident from the edge of the wharf to the west side of the IOL bulk plant property. Changes in flow direction were noted to be most prevalent within about 100 metres of the edge of the wharf, land ward, but still noticeable at about 150 metres and still evident at the west side of the IOL bulk plant property boundary at approximately 321 m.

Based on a review of reports by ARC Associates, with specific reference to the figure identified as “shallow groundwater flow May 2, 1998” (ACER Figure 1-8 also provided in Appendix 24) groundwater flow was reported to occur in an east to west direction, as well as west to east and north-south in some areas (Affidavit A-116 in

Appendix 25). The title of the ARC report was “Remediation System for DFO and DNRE Properties” and the only date provided on the report was the date of May 2, 1998 with May 1998 shown on most of the figures. The report was attached to a fax dated June 9, 1998, from Raymond Morin of the DOE to Claude Burry of DFO.

Figure 3 contained in the ARC Phase II investigation report, A-332 (AG-438 better figures in Appendix 23) in Appendix 22 (shown as ACER Figure 1-8 and also included in Appendix 24) included additional monitoring wells and also showed components of groundwater flow for July, 1998 to be in an east to west direction landward (rather than towards the shoreline), from the SCH property towards the area between the FN and MEL buildings. A strong component of groundwater flow is evident under the footprint of the FN building that was from north to south from areas of contamination identified on the DFO/SCH property.

Groundwater flow under the MEL building was south to east towards the area between the two buildings. Also of note is Figure 1 (shown as ACER Figure 1-9 and also included in Appendix 24) in the ARC May, 1999 monitoring report, A-321 in Appendix 26, that shows groundwater flow for May 1999, to be almost opposite to that shown in Figure 3 for July, 1998. The ARC monitoring report, A-321 (Appendix 26) that also included the additional monitoring wells and showed flow directions to be almost the opposite of that reported for the July 1998 investigations, prior to any remedial measures. There is a strong component of groundwater flow occurring from the highly contaminated area between the FN and MEL buildings into the area represented by the footprints of the two buildings. It was noted by ACER that it was indicated in the report that “the treatment system was not operating. The electric panel was checked and all switches were noted to be in the off position.” Therefore, it is reasonable to make a comparison of the flow conditions given there would be no pumping influences**. It is apparent from the figures that conditions exist that can cause contamination occurring on the DFO property to migrate onto the FN and MEL properties, and result in widespread contamination including the area of the building footprints, other adjacent properties and into the marine environment.**

The ARC monitoring report, A-321 (in Appendix 26) included additional monitoring wells. It was indicated that for the flow conditions shown in Figure 1 that “This groundwater configuration is due to a number of reasons. The main groundwater high is centred in an area of disturbed soil (due to recent excavation) and previously present more permeable soils (due to the installation of pipeline and railway tracks). Consequently, infiltration in this area will be higher than the adjacent areas, thus causing local and temporary rising of the water table. The small area of groundwater low is likely due to natural discharge at the shoreline during a period of low tidal stage. During high tide it is expected that the groundwater elevation will rise due to blockage of discharge to the sea. The rise in tidal water head will cause a subsequent rise in groundwater head and local changes in groundwater flow directions.”

It should be noted that groundwater flow conditions are likely to have remained relatively unchanged or unaffected during the operation phase of the remedial system. Based on a review of monitoring reports in FN A-1804 (in Appendix 27) available for the 56 months that the remedial system operated, July 7, 1999 to March 16, 2004, the system was non-operational at least 40 percent of the time. Given the system was non-operational at this frequency this provided additional opportunity for contamination to continue to migrate onto the adjacent FN and MEL properties including the area of the building footprints, other adjacent properties and to the marine environment.

The ARC, April 1998, report, A-117 (in Appendix 28), for investigations carried out on the DNRE property indicated:

““The dissolved hydrocarbons occur more widely, as would be expected due to groundwater movement and tidal fluctuation effects, FIGURE 3). Dissolved hydrocarbons occur in highest concentrations in the same zone as defined for the residual hydrocarbons.

The groundwater flow indicates a gradient of 0.0015 is operative to the west, (0.0015 between MW2 and MW1), (FIGURE 4). This groundwater flow direction may be influenced by the pumping of remedial wells on the IOL Bulk Plant site or alternatively, through the pumping of any local wells, which extract fresh or saltwater for processing.

The groundwater flow across the site must be considered as having potential to change due to the small differences between the water elevations in the wells. With such small elevation differences, tidal loading could easily cause localized flow to change direction. The orientation and occurrence of both the dissolved and residual plumes appear to indicate that changes in the direction of groundwater flow have taken place. These changes may occur due to high tides and/or high recharge events (spring and fall) or local well pumping. If these changes only occur at specific times of the year, and are only in force for short time spaces, then the spreading of the plume would be limited and may to some degree reverse itself at other times of the year.""

A similar statement was made for the ARC report, A-109 (in Appendix 25), for investigations carried out on the DFO property.

4.3 Current and Historical TPH Contamination Contours

Contamination contours based on TPH concentrations were determined for the more recent sampling carried out by ACER and for historical sampling to assist with the assessment of contaminant sourcing, migration and spreading. TPH concentration contour mapping was determined in recognition of intrusive sampling programs and timing got the implementation of remedial programs as follows.

- intrusive soil and groundwater for the IOL bulk plant and other areas investigated by ACER between 2009 and 2019 are shown in Figures 4-1 and 4-2 (also in Appendix 97) of Section 4.3.1, respectively, noting that remediation was apparently discontinued on the IOL property circa 2003 for spills on the bulk plant site, and the DFO/DNR properties associated with the underground gasoline and fuel oil pipelines.
- intrusive soil and groundwater investigations carried out for the IOL bulk plant area in 1989 are shown in Figures 4-3 and 4-4 (also as overlays on the original ARC drawings in Figure 4,5 and 4-6) of Section 4.3.2, respectively.
- additional intrusive soil and groundwater investigations for the IOL bulk plant area undertaken in August 1992 are shown in Figures 4-7 and 4-8 (also in Appendix 98) of Section 4.3.3, respectively, **prior to installation of the groundwater remedial system**, noting that free phase liquid petroleum product was detected in December 1990 and frequently reported at a number of wells to the end of 1992, measuring up to 37 cm thickness, and with additional monitoring wells having been installed by IOL in April and August 1992 on and beyond IOL property boundaries that allowed for additional delineation.
- groundwater for the IOL bulk plant area in June and September 1996 are shown in Figures 4-11 and 4-12 of Section 4.3.4 that demonstrate variability in concentrations but also noting that concentrations were generally showing increases over the previous 12 months.
- intrusive soil and groundwater investigations undertaken for the area of the two IOL underground gasoline transfer lines that included the FN, MEL and DFO/DNRE properties in August 1998 are shown in Figures 4-15 and 4-16 (also in Appendix 96) of Section 4.3.5, respectively, based on investigations carried out following pressure testing of the IOL underground gasoline transfer line and prior to any remedial systems being installed by IOL consultants.

Several basic premises were applied in the development of the contaminate contours for the IOL bulk plant area for 1989, 1992, 1998 and 2012. It is noted from the DELG correspondence (Affidavit document A-433, in Appendix 16) that it was reported that during test pit investigations for a spill event on the bulk plant property that “a lot of

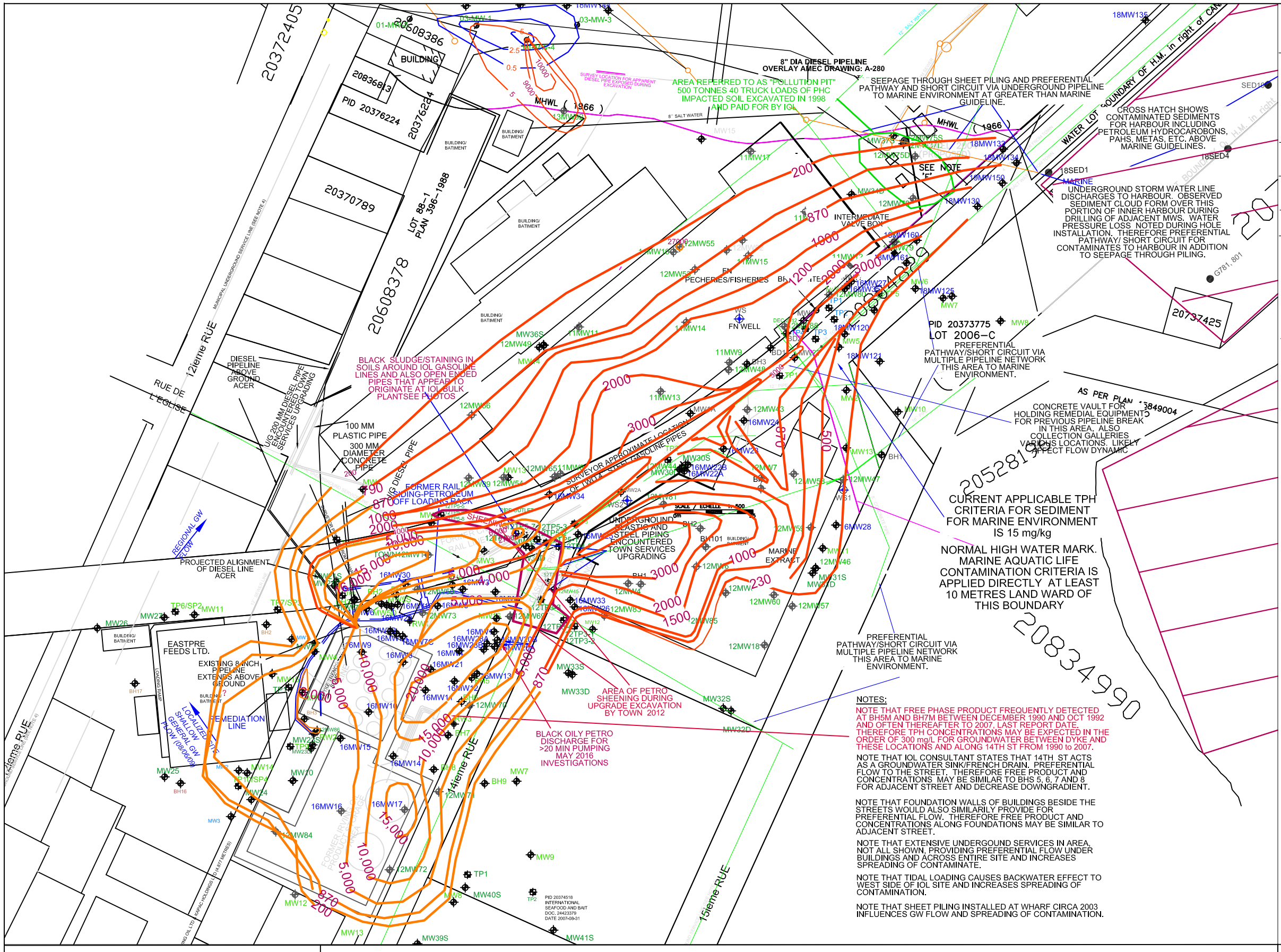
product was seeping into the excavated holes which indicated a rather large amount of product had been lost in the ground" and it was further indicated that based on the information a "rather large amount of free phase product and consequently contaminated soil still remains in the ground". The groundwater table was encountered at a depth of "approximately three feet" and product was "seen floating on the surface of the water". DOE instructed IOL to recuperate product from the surface of the groundwater that was stored in a large aboveground reservoir (20,000 gallon capacity) on site.

Nolan Davis & Associates Limited (NDA) carried out an assessment for the Bulk Storage Plant to evaluate the permeability of the floor and surrounding berms for the diked containment area of the tank farm (December 22, 1992- from MD Riley, Nolan Davis and Associates to Ian Mosher, IOL, site assessment of permeability of the floor and surrounding berms of the **diked containment area**, A-469 in Appendix 83). **The liner soils were described as a "silty sand and gravel".** Hydraulic conductivity testing indicated the soils to have a coefficient of permeability of 5x10-6 cm/sec. It was reported that The Province of New Brunswick Construction Standard for Petroleum Storage Systems specify "the walls and floors of the diked area and any interconnecting channel shall have an impermeable lining of a material designed and maintained to be liquid tight to a permeability of 1x10-7 cm/sec". The difference between the laboratory value and the Provincial requirement is 50 times different/higher. In general, the surface and shallow soils are described as either sand and gravel with varying amounts of silt or sand with varying amounts of silt for most areas outside and inside the dikes. The IOL consultant ARC described all sample locations investigated on the property in 1989 as "silty sand". ACER investigations indicated a layer of fill material consisting of brown sand and gravel with some silt and traces of clay was typically encountered at sample locations. This layer was generally in the order of 1.2 metres below grade in areas between the IOL bulk plant and the east end of the FN property with fill depths showing an increase to over 6m near the edge of the wharf. The fill is typically underlain by a layer of red/brown silty sand with some gravel approximately 0.5 metres in thickness for the bulk plant area and 1.0 m in the middle to eastern portion of the FN and MEL properties. A layer of sand ranging from about 2.0 metres in thickness at the edge of the wharf to 2.5 metres on the eastern portion of the FN/MEL properties with the sand being underlain by completely to highly weathered and fractured bedrock.

Given the higher permeability of the liner and that it was reported that during test pit investigations that "a lot of product was seeping into the excavated holes which indicated a rather large amount of product had been lost in the ground" and it was further indicated that based on the information a "rather large amount of free phase product and consequently contaminated soil still remains in the ground", concentrations inside the dike based on 1989 would be expected to show values significantly higher than the BH/MW locations established at the perimeter of the property at that time. Given that free phase liquid product was spilled inside the dike and concentrations for groundwater would be expected to be comparable to solubility concentrations, that are significantly greater than 100 mg/L, a conservative value of 100 mg/L was identified in the figures to reflect that concentrations inside the dike would be expected to be higher and visually demonstrates this to facilitate discussions. Given that free phase liquid product was spilled inside the dike and concentrations in the soil would be expected to be comparable to residual saturation concentrations, that are significantly greater than 20,000 mg/kg, a conservative value of 20,000 mg/kg was identified in the figures to reflect that concentrations inside the dike would be expected to be higher and visually demonstrates this to facilitate discussions. This reflects the basic approach applied, with other values applied for specific years based on additional supporting information/hypothesis.

4.3.1 Contamination Contours ACER 2012, 2016 and 2019

The contours shown in Figures 4-1 and 4-2 for soil and groundwater (also provided in Appendix 97), respectively, represents the culmination of the sampling programs carried out between 2009 and 2019. The extensive sampling



LEGEND

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- SEDIMENT 18SED1 & 19SED1 ACER 2018 & 2019
- SEDIMENT SED 1 & 12SED1 MGI 2001 & 2012
- 3.2 TPH CONCENTRATION CONTOUR

RBCA TIER I COMMERCIAL POTABLE LAND USE CRITERIA, COARSE SOIL

		Sample ID	SOIL (Depth) dd/mm/yy		
		RBCA			
		1999	2003 2007	2012	2015
B	Benzene	0.005 mg/L	0.03 mg/kg	0.042 mg/kg	0.005 mg/L
T	Toluene	0.024 mg/L	0.38 mg/kg	0.35 mg/kg	0.024 mg/L
E	Ethylben.	0.0016 mg/L	0.08 mg/kg	0.065 mg/kg	0.0016 mg/L
X	Xylene	2.4 mg/kg	11 mg/kg	11 mg/kg	0.02 mg/L
TPH	Total Petroleum Hydrocar.	80 mg/kg [1] 185 mg/kg [2] 10000mg/kg [3]	450 mg/kg[1] 7400 mg/kg[2] 10000mg/kg[3]	870 mg/kg[1] 1800 mg/kg[2] 10000mg/kg[3]	870 mg/kg[1] 1800 mg/kg[2] 10000mg/kg[3]

1 Guideline for Gasoline (G) 2 Diesel (D), Fuel oil (F) (APPLICABLE) 3 Lube Oil (L)

CONCENTRATIONS WITHIN GUIDELINES
CONCENTRATIONS EXCEEDING GUIDELINES
NOT SAMPLED ns NOT DETECTED nd
NOTE: nd INDICATES BELOW REPORTING LIMIT

PROBABLE GROUNDWATER FLOW DIRECTION FOR SHALLOW AQUIFER

TRACE OVERLAY OF IRVING OIL LIMITED SITE PLAN FOR AS BUILT REMEDIATION SYTEM AND FORMER RAIL LOADING RACK SHOWN IN IN BLUE. REFERENCE: CAMPBELL, OCTOBER 30, 1992, INTER-OFFICE MEMO.

Some BHs/MWs and Feature locations approximate. BH/MW locations extrapolated from ASPEN, MARCH 2000, AMEC, 2001 and ARC documents, and railway siding features from Cambell, 1992.

NOTES:

NOTE THAT FREE PHASE PRODUCT FREQUENTLY DETECTED AT BH5M AND BH7M BETWEEN DECEMBER 1990 AND OCT 1992 AND OFTEN THEREAFTER TO 2007. LAST REPORT DATE. THEREFORE TPH CONCENTRATIONS MAY BE EXPECTED IN THE ORDER OF 300 mg/L FOR GROUNDWATER BETWEEN DYKE AND THESE LOCATIONS AND ALONG 14TH ST FROM 1990 to 2007.

NOTE THAT IOL CONSULTANT STATES THAT 14TH ST ACTS AS A GROUNDWATER SINK/FRENCH DRAIN. PREFERENTIAL FLOW TO THE STREET. THEREFORE FREE PRODUCT AND CONCENTRATIONS MAY BE SIMILAR TO BHS 5, 6, 7 AND 8 FOR ADJACENT STREET AND DECREASE DOWNGRADIENT.

NOTE THAT FOUNDATION WALLS OF BUILDINGS BESIDE THE STREETS WOULD ALSO SIMILARILY PROVIDE FOR PREFERENTIAL FLOW. THEREFORE FREE PRODUCT AND CONCENTRATIONS ALONG FOUNDATIONS MAY BE SIMILAR TO ADJACENT STREET.

NOTE THAT EXTENSIVE UNDERGOUND SERVICES IN AREA, NOT ALL SHOWN, PROVIDING PREFERENTIAL FLOW UNDER BUILDINGS AND ACROSS ENTIRE SITE AND INCREASES SPREADING OF CONTAMINATE.

NOTE THAT TIDAL LOADING CAUSES BACKWATER EFFECT TO WEST SIDE OF IOL SITE AND INCREASES SPREADING OF CONTAMINATION.

NOTE THAT SHEET PILING INSTALLED AT WHARF CIRCA 2003 INFLUENCES GW FLOW AND SPREADING OF CONTAMINATION.

ACER
Environmental Services (2015) Ltd.

PHASE II & III ENVIRONMENTAL SITE ASSESSMENT
MEL, FN, EFL SHIPPAGAN, NB

FILE NAME: Fig 4-1 2019 TPH Iso Sol	JOB NO.: CBT 60-1	MADE: GP	CHKD: GP	DATE: Jan 29, 2020

FIGURE 4-1

TPH CONTAMINATE CONTOURS FOR SOIL FOR STUDY AREA INVESTIGATIONS BY ACER 2009 TO END SEPTEMBER 2019

SOURCES OTHER THAN
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EXISTANT AND WERE
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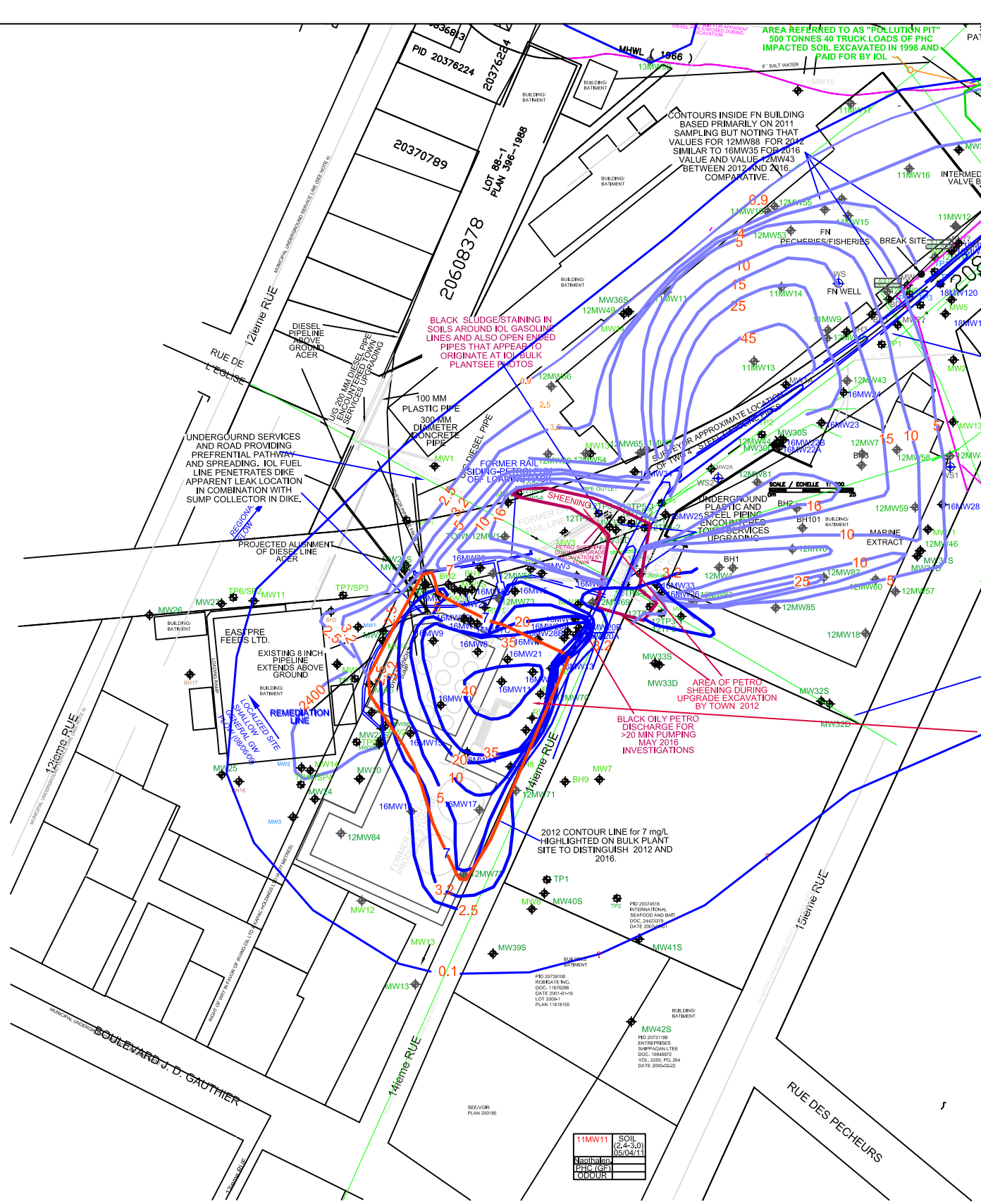

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- 3.2 TPH CONCENTRATION CONTOUR

RBCA TIER I COMMERCIAL POTABLE LAND USE CRITERIA, COARSE SOIL EXCEPT NOTED OTHERWISE

		Sample ID		GW dd/mm/yy		
		RBCA				
		1999	2003 2007 RES		2012	2015
B	Benzene	0.005 mg/L	0.005 mg/L		0.005 mg/L	0.042 mg/L
T	Toluene	0.024 mg/L	0.024 mg/L		0.024 mg/L	0.35 mg/L
E	Ethylben.	0.0024 mg/L	0.0024 mg/L		0.0024 mg/L	0.043 mg/L
X	Xylene	0.3 mg/L	0.3 mg/L		0.3 mg/L	0.73 mg/L
TPH	Total Petroleum Hydrocar.	2.8 mg/L 1 1.8 mg/L 2 8.4 mg/L 3	4.4 mg/L 1 3.2 mg/L 2 7.8 mg/L 3		4.4 mg/L 1 3.2 mg/L 2 7.8 mg/L 3	4.4 mg/L 1 3.2 mg/L 2 7.8 mg/L 3

1 Guideline for Gasoline (G) 2 Diesel (D), Fuel oil (F) (APPLICABLE) 3 Lube Oil (L)

CONCENTRATIONS WITHIN GUIDELINES
CONCENTRATIONS EXCEEDING GUIDELINES
NOT SAMPLED ns NOT DETECTED nd
NOTE: nd INDICATES BELOW REPORTING LIMIT

PROBABLE GROUNDWATER FLOW DIRECTION FOR SHALLOW AQUIFER

TRACE OVERLAY OF IRVING OIL LIMITED SITE PLAN FOR AS BUILT REMEDIATION SYTEM AND FORMER RAIL LOADING RACK SHOWN IN IN BLUE. REFERENCE: CAMPBELL, OCTOBER 30, 1992, INTER-OFFICE MEMO.

Some BHs/MWs and Feature locations approximate. BH/MW locations extrapolated from ASPEN, MARCH 2000, AMEC, 2001 and ARC documents, and railway siding features from Cambell, 1992.

ACER
Environmental Services (2015) Ltd.

PHASE II & III ENVIRONMENTAL SITE ASSESSMENT
MEL, FN, EFL SHIPPAGAN, NB.

FILE NAME: Fig 4-2 2019 GW Iso | JOB NO.: CBT 60-1 | MADE: GP | CHKD: GP | DATE: Nov 13, 2019

FIGURE 4-2

TPH CONTAMINATE CONTOURS FOR GROUNDWATER FOR STUDY AREA INVESTIGATIONS BY ACER 2009 TO END SEPTEMBER 2019

data obtained for specific years, obtained for adjacent and nearby properties immediately following approvals for investigations being acquired, have been applied for contouring assessment purposes. It is recognized that the concentrations for the extensive sampling carried out for the years, 2012 for FN, MEL and property boundaries for the IOL bulk plant, 2016 for the IOL Bulk plant and related operations, and the DFO property in 2018 are expected to show some variability. Samples were obtained from select locations for areas previously investigated to obtain an indication of relative concentrations for contouring evaluation purposes. For extensive investigations undertaken for specific years, groundwater sampling was also carried out at several locations on the adjacent properties for relative comparison of concentrations for the given year. Findings indicted good comparative values and contouring should reflect similar trends such as footprints/patterns having elevated concentrations typically indicative of sources of contamination and migration pathways that also show elevated concentrations.

It should be noted that over 1000 tonnes of contaminated soil was removed during excavation work adjacent to the IOL bulk plant and former tanker car unloading area in the September to October period in 2012 during upgrading of underground services by the Town of Shippagan. The consultant's report associated with the upgrading of the sewer line between 12th and 15th Street indicated petroleum hydrocarbons to be present in the area of the property boundary between IOL and the former IOL/CNR rail car tanker unloading facility, located on land currently

owned by the Town of Shippagan (A-353 a in Appendix 21). Soil analysis results for Monitoring Well MW-4 indicated petroleum hydrocarbon concentrations in soil of 15,000 mg/kg for TPH at a depth of 0.6 m compared with 2012 RBCA criteria of 74 mg/kg for a commercial site with coarse grain soils and non-potable water that would be applicable for food grade operations, with Benzene at 13 mg/kg exceeding the potable water criteria of 0.042 mg/kg. Removal of contaminated soils and placement of clean material would be expected to result in a relative reduction of concentrations in this area after 2012 with concentrations expected to show increases over time.

In addition to the basic premises noted in the introduction to Section 4.3 for the 2012 contouring, the following was also considered. The occurrence of free product reported for the perimeter monitoring wells between December 1990 and 2007, with 2007 being the last sampling data event would further indicate probable releases of additional product in addition to those reported. As indicated, free phase liquid petroleum product was detected in a number of monitoring wells, with BH6 to BH8 located adjacent to 14th St. being frequently reported to show free product. Therefore, for contouring purposes, concentrations in the groundwater for IOL would be expected to be in the order of 300 mg/L and higher given that free phase liquid product was being reported. The value of 300 mg/L was applied based on sampling results in July 1998 when sampling showed 300 mg/L in BH7 when at the same time, 1cm of free product was reported for BH6 and would be expected to be comparative of periods with free product being identified in this area.

In general, concentrations of PHCs in soils for the 2012 investigations that were limited to the boundary of the IOL bulk plant showed similar concentrations to adjacent locations inside the IOL property boundary for the 2016 investigations, with concentrations being orders of magnitude higher compared with the 1989 and 1992 investigations for perimeter wells in similar locations. This would indicate additional migration of contamination occurred after remedial measures were implemented between 1992 and 2012. Concentrations of PHCs in the groundwater show decreased values for perimeter wells between 1992 and 2012, with sampling at several locations between 2012 and 2019 showing similar concentrations for down gradient well locations.

The contamination contours for 2009 to 2019 indicated the following:

- footprints for areas with elevated TPH concentrations in the soil, indicative of a contaminate source, are similar to that for the groundwater as would typically be expected.

- footprints having elevated concentrations for TPH in the soil, indicative of source areas, occurred in the following areas:
  - the south side of the tank farm dike, where the underground pipe network for the tanker truck offloading facilities and underground gasoline transfer line that extends to the wharf penetrate the dike.
  - in the area of the former rail tanker car offloading facilities that may represent a source area, but with an apparent link to the fuel oil pipeline that is located underground adjacent to the dike and liquids collect for the IOL tank farm based on the concentration contours. The entire north side of the containment dike for this tank farm is a couple metres below the tank pads and liquids in the tank farm collect in this area (see Photo 4-4).
  - a location down gradient of the former IOL rail tanker car petroleum offloading facilities, where broken pipes that appear to be linked to the IOL bulk plant were identified during upgrading of Town underground services as well as the location of the two underground gasoline transfer lines that showed petroleum staining under the lines and indications of liquid migration.
- the underground gasoline transfer line that extends from the bulk plant to the end of the wharf within the former CN ROW now owned by the Town and adjacent to the driveway between the FN and MEL properties, given relative concentrations compared with adjacent areas.
- concentrations in the soil were more significant near 14th St., that the IOL consultant ARC indicated would provide a “french drain” effect and draw contamination from the IOL property towards the street.
- fundamentally the contour pattern for soils show elevated concentrations along the full length of the former CN ROW/driveway between the FN and MEL properties that connects to 14th St, and includes associated underground services and the two IOL underground petroleum transfer lines, with concentrations decreasing toward the opposite side of the FN/MEL properties. As such, the IOL property, former IOL/CN rail offloading facilities and IOL underground gasoline transfer lines represent apparent sources to FN/MEL, the former CN ROW/driveway and SCH/DFO properties and Town St. ROWs.
- the EFL property is located within the apparent source footprint of the soils for the bulk plant, with concentrations reflecting the edge of the plume for the IOL property and continuing to decrease towards the opposite side of the EFL property. The IOL property, former IOL/CN rail offloading facilities represent apparent sources.
- the higher concentrations at some locations near the edge of the FN and MEL properties and adjacent to the driveway are attributed to preferential flow pathways afforded by underground services and foundation walls, with pockets of higher contamination possibly occurring from tidal loading effects, as well as previous rainfall events and spring/fall recharge events that typically cause a rise in the water table and increased mobilization of contaminates. Sampling showed concentration increases in the groundwater on the IOL property in the spring following a rainfall event.
- the footprint of higher concentrations in the soil for the MEL property is located along an underground service pipe that would typically be expected to provide for preferential flow, linked to the driveway, in addition to other factors including tidal influence and spring recharge etc.

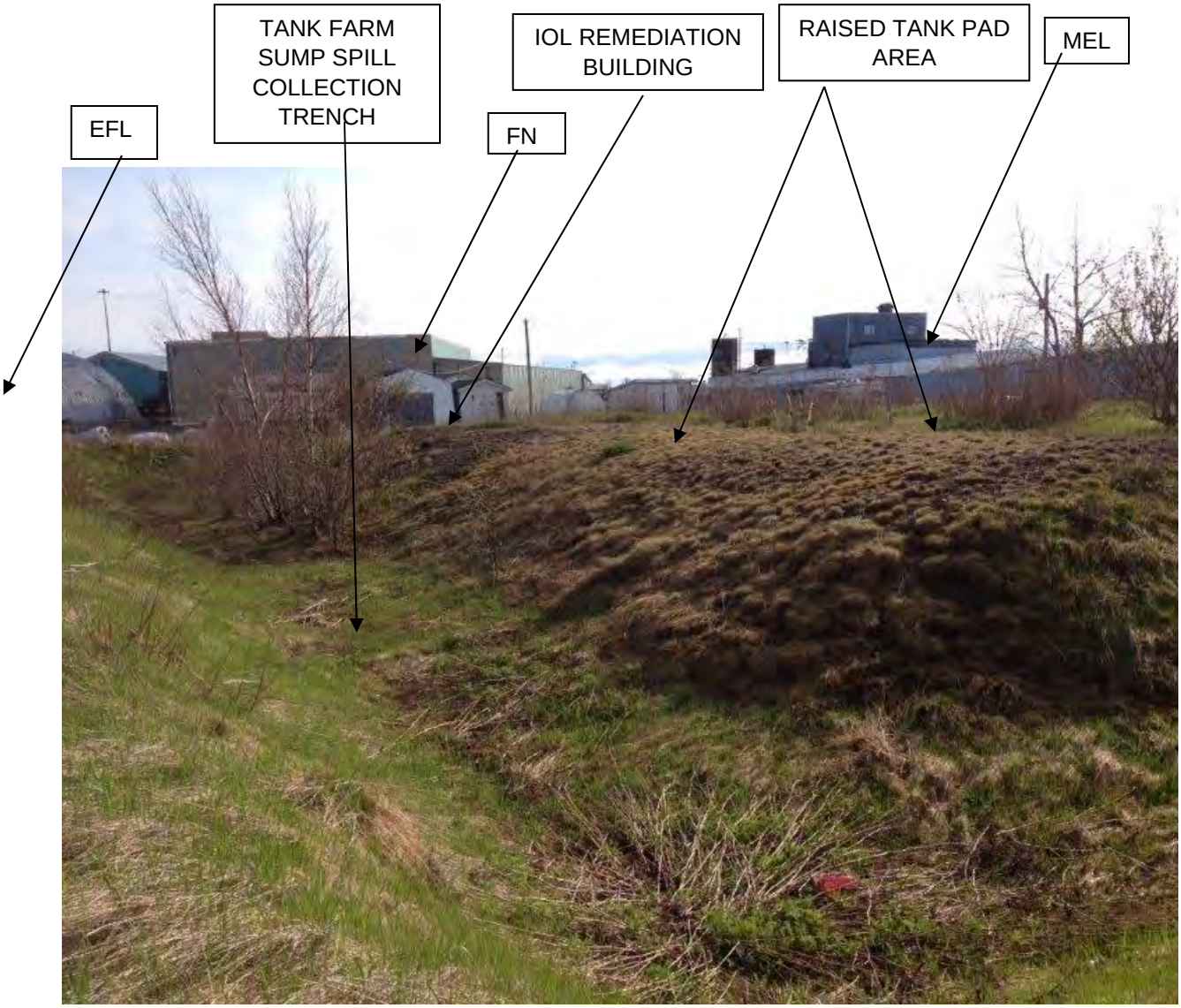


Photo 4-4 Sump area as low point for collection of liquids from the smaller tank farm diked area.

- a very localized pocket of contamination resembling weathered lube oil was identified at 12MW55 on the north side of the FN building footprint. Only gasoline and fuel oil were evident at monitoring wells located approximately 3 metres of this location, and showed less than 21mg/kg and 790 mg/kg compared with values of 60 mg/kg obtained at locations on the opposite side of the building. The concentration in the groundwater in area was only 1.2 mg/L compared with values of up to 65 mg/L on the opposite side of the building. Being of such a localized nature and in the weathered lube oil range at that concentration, it is most likely associated with a spillage of tar like foundation coating administered during construction or a similar incident.
- contaminate contouring for the groundwater supports the above based on contouring gradients/patterns identified for the soil.
- the contour pattern for groundwater fundamentally shows elevated concentrations along the full length of the driveway between the FN and MEL properties, with concentrations decreasing toward the opposite side of both properties.

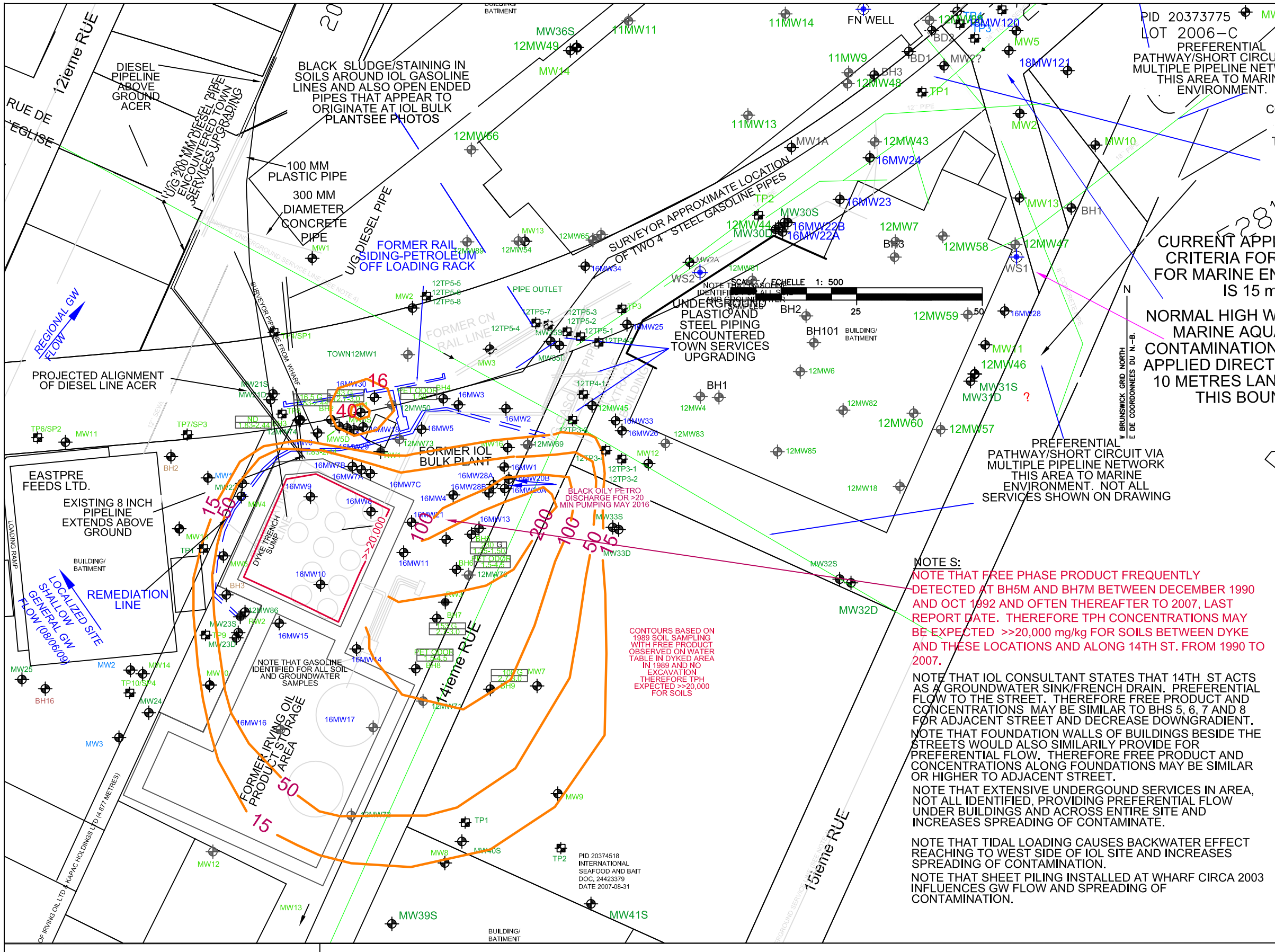
An area on the SCH/DFO property with sample location 01MW4 is identified, that shows petroleum hydrocarbon contamination to be present in the soil and groundwater. Concentrations in the soils and groundwater exceed RBCA and CCME criteria in consideration of human health and consideration of marine life for the ground water to surface water pathway. Concentration contours for this area indicate a localized source with soil and groundwater impacts that extend across the property boundary with FN. This area is considered to represent an apparent source of contamination contributing to the FN property. It is noted that the IOL underground diesel line is located in this area and previous sampling by MGI showed that location 01MW4 had the highest concentration. This sample location is located immediately adjacent to the diesel line and is considered to be the apparent source. Fuel oil range hydrocabons were identified for this area.

The above supports that the IOL property, former IOL/CN rail tanker car offloading facilities and IOL underground transfer lines represent apparent sources of contamination to the FN, MEL, EFL, former CN ROW/driveway, Town St. ROWs and SCH/DFO properties and other residential/commercial/institutional properties as well as and the marine environment.

4.3.2 Contamination Contours WMS 1989 Investigations

TPH concentration contours for soil and groundwater for the IOL bulk plant area in 1989 are shown in Figures 4-3 and 4-4, respectively, based on sampling data by the IOL consultant WMS (later became ARC) (A-450, in Appendix 101), following a spill of 3000 gallons of petroleum product. The concentration contours are also provided in Figures 4-5 and 4-6 as overlays on the original ARC drawing showing the footprint of contamination in the soil and groundwater, respectively. The basic premises noted in the introduction to Section 4.3 were applied for contouring purposes. The figures show conservative values of 100 mg/L for groundwater and 20,000 mg/kg for soils to reflect that concentrations inside the dike would be expected to be higher and visually demonstrates this to facilitate discussions.

The contamination contours for soil and groundwater shown on the ARC 1989 site drawing, Figures 4-5 and 4-6, respectively, illustrates the IOL bulk plant site to be the source of contamination and also further emphasizes that contamination appears to have migrated off site and could also be indicative of historical spills having occurred to give this result and/or that the liner in the tank farm does not provide adequate containment.



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- 3.2 TPH CONCENTRATION CONTOUR

16MW12 Sample ID
23000 F G Analysis Resembles Gas, Diesel, Fuel oil, Lube oil
Depth (m) Depth (m)

RBCA CRITERIA FOR SOIL				
COMMERCIAL SITE NON-POTABLE COARSE SOIL				
Publication year		1999	2003	2012 2015
TPH	Total Petroleum Hydrocarbons	80 mg/kg [1] 185 mg/kg [2] 10000 mg/kg [3]	450 mg/kg [1] 7400 mg/kg [2] 10000 mg/kg [3]	870 mg/kg [1] 1800 mg/kg [2] 10000 mg/kg [3]
Note: Gasoline, fuel oil and lube oil present at site				

1 Guideline for Gasoline (G) is APPLICABLE 2 Guideline for Diesel (D), Fuel oil (F)
3 Guideline for Lube Oil (L)

NOT SAMPLED ns
NOT DETECTED nd
NOTE: nd INDICATES BELOW REPORTING LIMIT

NOTE S:

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NOTE THAT FOUNDATION WALLS OF BUILDINGS BESIDE THE STREETS WOULD ALSO SIMILARILY PROVIDE FOR PREFERENTIAL FLOW. THEREFORE FREE PRODUCT AND CONCENTRATIONS ALONG FOUNDATIONS MAY BE SIMILAR OR HIGHER TO ADJACENT STREET.

NOTE THAT EXTENSIVE UNDERGOUND SERVICES IN AREA, NOT ALL IDENTIFIED, PROVIDING PREFERENTIAL FLOW UNDER BUILDINGS AND ACROSS ENTIRE SITE AND INCREASES SPREADING OF CONTAMINATE.

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PROBABLE GROUNDWATER FLOW DIRECTION FOR SHALLOW AQUIFER

TRACE OVERLAY OF IRVING OIL LIMITED SITE PLAN FOR AS BUILT REMEDIATION SYTEM AND FORMER RAIL LOADING RACK SHOWN IN IN BLUE. REFERENCE: CAMPBELL, OCTOBER 30, 1992, INTER-OFFICE MEMO.

Some BHs/MWs and Feature locations approximate.BH/MW locations extrapolated from ASPEN, MARCH 2000, AMEC, 2001 and ARC documents, and railway siding features from Cambell, 1992.

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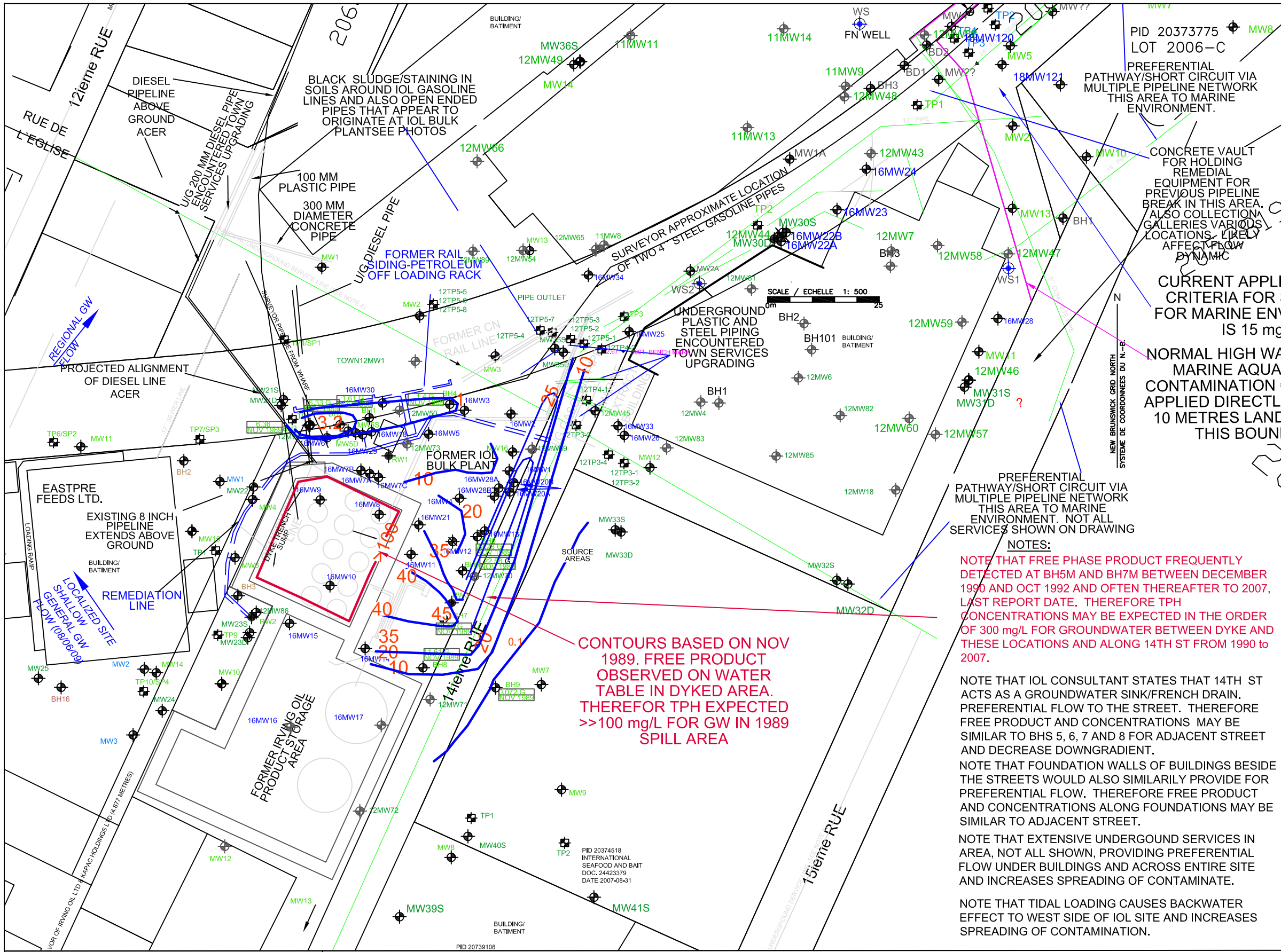
PHASE II & III ENVIRONMENTAL SITE ASSESSMENT
MEL, FN, EFL, SHIPPAGAN, NB.

FILE NAME: Fig 4-3 1989 So Iso	JOB NO.: CBI 60-1	MADE: GP	CHKD: GP	DATE: Nov 15 2019

FIGURE 4-3
TPH CONTAMINATE CONTOURS
FOR SOIL FOR IOL SITE
NOVEMBER1989
ALSO SHOWN IN FIGURE 4-5 AS OVERLAY
ON WMS DRAWING



LEGEND

- ACER BHs/MWs IN GREEN TEXT FOR MW21 TO MW42 FOR JUNE, 2010, 11MW8 TO 11MW17 APRIL 2011, MW30 TO MW42 JULY 2011, 12MW1 TO 12MW92 IN 2012 AND 13MW93 IN 2013, 16MW1 TO 16MW35 2016, 18MW120 TO 18MW162 AND 19MW150 IN BLUE TEXT.
- WMS/ARC BHs/MWs IN LIGHT GREEN TEXT BEGINNING 1989 RELATED TO IOL BULK PLANT
- JWEL BHs/MWs IN BLUE TEXT THREE D GEOCONSULT. IN BROWN EASTPRE FEEDS 1996
- BHs/MWs BY OTHERS UNKNOWN IN BLACK TEXT
- EXISTING RECOVERY WELL (RW) LOCATION (ASPEN, MARCH 2000)
- FN PECHERIES WATER SUPPLY (WS) WELL
- TEST PIT LOCATION IN BLUE TEXT BY JWEL 1995 DFO/DNR PROPERTY
- WMS/ARC TEST PITS IN LIGHT GREEN TEXT BEGINNING IN 1989 RELATED TO IOL BULK PLANT
- TEST PIT LOCATIONS IN GREEN TEXT BY ACER, SEPT, 2010
- SEDIMENT 18SED1 & 19SED1 ACER 2018 & 2019
- SEDIMENT SED 1 & 12SED1 MGI 2001 & 2012
- 3.2 TPH CONCENTRATION CONTOUR

16MW12 Sample ID
23000 F G Analysis Resembles Gas, Diesel, Fuel oil, Lube oil
Depth (m) Depth (m)

RBCA CRITERIA FOR POTABLE GROUNDWATER COARSE SOIL

COMMERCIAL SITE UNLESS NOTED OTHERWISE				
Publication year		1999	2003 RES	2012 2015
TPH	Total Petroleum Hydrocarbons	2.8 mg/L [1] 1.8 mg/L [2] 8.4 mg/L [3]	4.4 mg/L [1] 3.2 mg/L [2] 7.8 mg/L [3]	4.4 mg/L [1] 3.2 mg/L [2] 7.8 mg/L [3]
Note: Gasoline, fuel oil and lube oil present at site				

1 Guideline for Gasoline (G) is APPLICABLE
2 Guideline for Diesel (D), Fuel oil (F)
3 Guideline for Lube Oil (L)

NOT SAMPLED ns
NOT DETECTED nd

NOTE: nd INDICATES BELOW REPORTING LIMIT

PROBABLE GROUNDWATER FLOW DIRECTION FOR SHALLOW AQUIFER

TRACE OVERLAY OF IRVING OIL LIMITED SITE PLAN FOR AS BUILT REMEDIATION SYTEM AND FORMER RAIL LOADING RACK SHOWN IN IN BLUE. REFERENCE: CAMPBELL, OCTOBER 30, 1992, INTER-OFFICE MEMO.

Some BHs/MWs and Feature locations approximate.BH/MW locations extrapolated from ASPEN, MARCH 2000, AMEC, 2001 and ARC documents, and railway siding features from Cambell, 1992.

NOTES:

NOTE THAT FREE PHASE PRODUCT FREQUENTLY DETECTED AT BH5M AND BH7M BETWEEN DECEMBER 1990 AND OCT 1992 AND OFTEN THEREAFTER TO 2007, LAST REPORT DATE. THEREFORE TPH CONCENTRATIONS MAY BE EXPECTED IN THE ORDER OF 300 mg/L FOR GROUNDWATER BETWEEN DYKE AND THESE LOCATIONS AND ALONG 14TH ST FROM 1990 to 2007.

NOTE THAT IOL CONSULTANT STATES THAT 14TH ST ACTS AS A GROUNDWATER SINK/FRENCH DRAIN. PREFERENTIAL FLOW TO THE STREET. THEREFORE FREE PRODUCT AND CONCENTRATIONS MAY BE SIMILAR TO BHS 5, 6, 7 AND 8 FOR ADJACENT STREET AND DECREASE DOWNGRADIENT.

NOTE THAT FOUNDATION WALLS OF BUILDINGS BESIDE THE STREETS WOULD ALSO SIMILARILY PROVIDE FOR PREFERENTIAL FLOW. THEREFORE FREE PRODUCT AND CONCENTRATIONS ALONG FOUNDATIONS MAY BE SIMILAR TO ADJACENT STREET.

NOTE THAT EXTENSIVE UNDERGOUND SERVICES IN AREA, NOT ALL SHOWN, PROVIDING PREFERENTIAL FLOW UNDER BUILDINGS AND ACROSS ENTIRE SITE AND INCREASES SPREADING OF CONTAMINATE.

NOTE THAT TIDAL LOADING CAUSES BACKWATER EFFECT TO WEST SIDE OF IOL SITE AND INCREASES SPREADING OF CONTAMINATION.

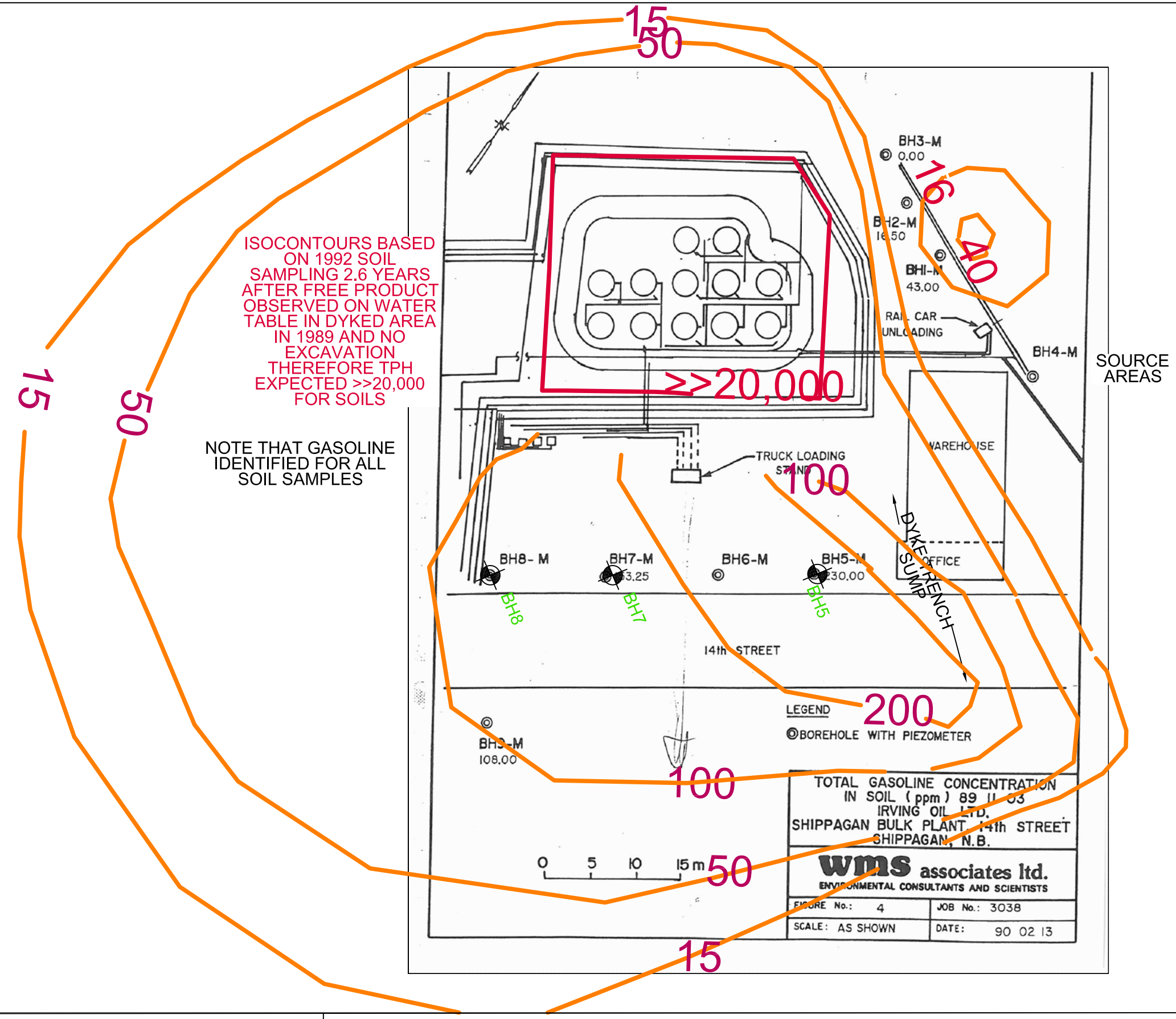
ACER Environmental Services (2015) Ltd.

PHASE II & III ENVIRONMENTAL SITE ASSESSMENT
MEL, FN, EFL, SHIPPAGAN, NB.

FILE NAME: Figure 4-4 1989 GW Iso	JOB NO.: CBI 60-1	MADE: GP	CHKD: GP	DATE: Nov 15 2019

FIGURE 4-4

TPH CONTAMINATE CONTOURS FOR GROUNDWATER FOR IOL SITE NOVEMBER 1989 ALSO SHOWN IN FIGURE 4-6 AS OVERLAY ON WMS DRAWING



LEGEND

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- 3.2 TPH CONCENTRATION CONTOUR

16MW12 Sample ID
23000 F G Analysis Resembles Gas, Diesel, Fuel oil, Lube oil
Depth (m) Depth (m)

RBCA CRITERIA FOR SOIL COMMERCIAL SITE NON-POTABLE COARSE SOIL				
Publication year		1999	2003	2012 2015
TPH	Total Petroleum Hydrocarbons	80 mg/kg [1] 185 mg/kg [2] 10000 mg/kg [3]	450 mg/kg [1] 7400 mg/kg [2] 10000 mg/kg [3]	870 mg/kg [1] 1800 mg/kg [2] 10000 mg/kg [3]
Note: Gasoline, fuel oil and lube oil present at site				

1 Guideline for Gasoline (G) is APPLICABLE 2 Guideline for Diesel (D), Fuel oil (F)
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ACER Environmental Services (2015) Ltd.

PHASEII & III ENVIRONMENTAL SITE ASSESSMENT
MEL, FN, EFL SHIPPAGAN, NB.

FILE NAME: Fig 4-5 ARC 1989 So Iso	JOB NO.: CBI 60-1	MADE: GP	CHKD: GP	DATE: Oct 10, 2016

FIGURE 4-5

TPH CONTAMINATE CONTOURS FOR SOIL FOR IOL SITE
NOVEMBER1989 FROM ACER FIGURE 4-3 AS OVERLAY ON WMS SITE DRAWING

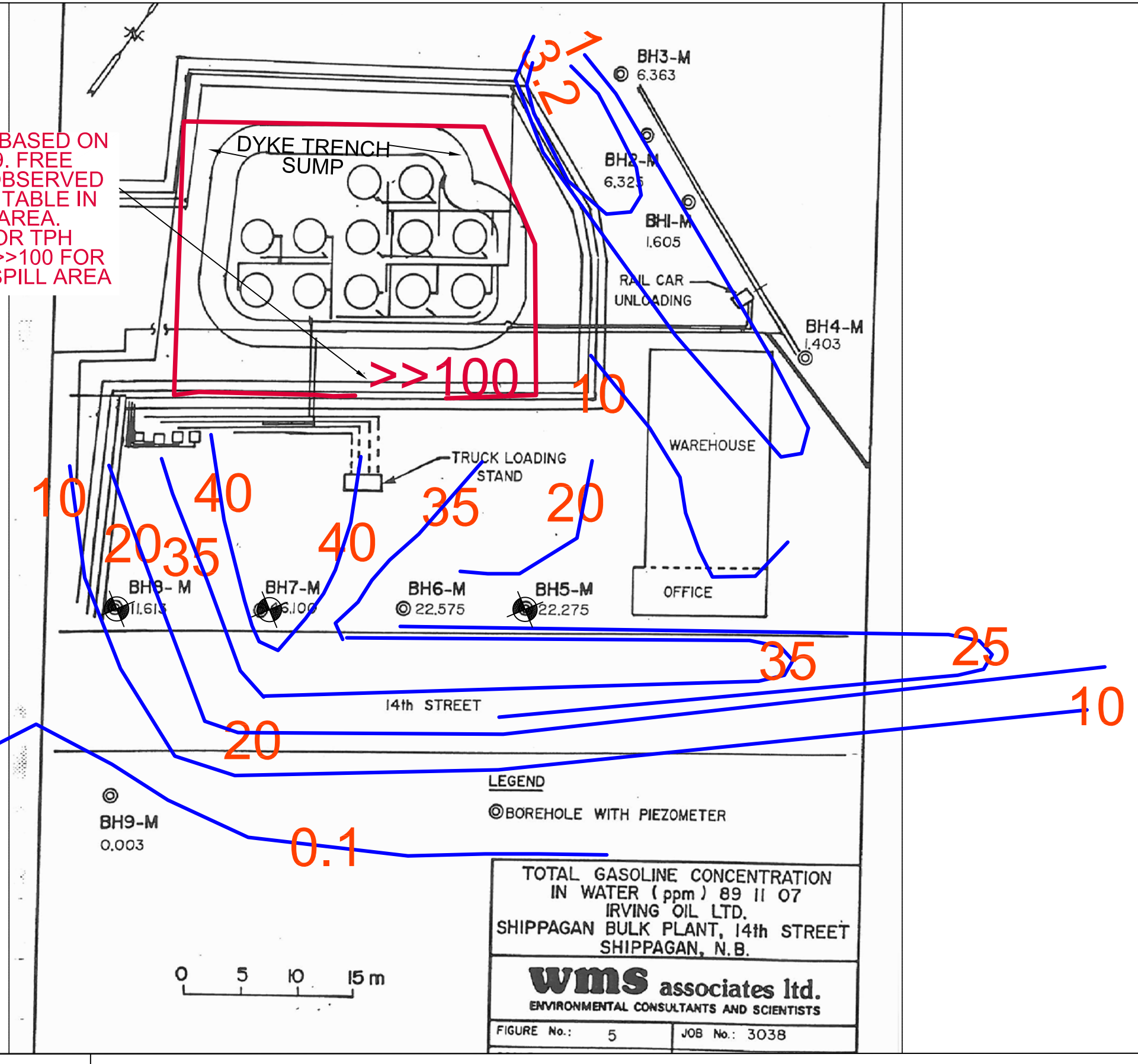
CONTOURS BASED ON NOV 1989. FREE PRODUCT OBSERVED ON WATER TABLE IN DYKED AREA. THEREFOR TPH EXPECTED >>100 FOR GW IN 1989 SPILL AREA

NOTE THAT GASOLINE IDENTIFIED FOR ALL SOIL SAMPLES AND GROUNDWATER SAMPLES ON IOL FOR NOVEMBER 1989, FUEL OIL ONLY FOR JULY 1990 SAMPLING, AND BOTH FUEL OIL AND AND GASOLINE FOR DECEMBER 1990.

GASOLINE AT EFL/IOL NORTHERN PROPERTY BOUNDARY FOR NEW LOCATIONS IN MARCH 1993 SAMPLING.

FUEL OIL ON EFL IN MARCH 1993.

ESSENTIALLY FUEL OIL AND GASOLINE BOTH PROPERTIES THEREAFTER



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16MW12 Sample ID
23000 F G Analysis Resembles Gas, Diesel, Fuel oil, Lube oil
Depth (m) Depth (m)

RBCA CRITERIA FOR POTABLE GROUNDWATER COMMERCIAL SITE NON-POTABLE COARSE SOIL			
Publication year		1999 2003	2012 2015
TPH	Total Petroleum Hydrocarbons	450 mg/kg [1] 7400 mg/kg [2] 10000mg/kg [3]	870 mg/kg [1] 4000 mg/kg [2] 10000mg/kg [3]
Note: Gasoline, fuel oil and lube oil present at site			

1 Guideline for Gasoline (G) is APPLICABLE
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Some BHs/MWs and Feature locations approximate.BH/MW locations extrapolated from ASPEN, MARCH 2000, AMEC, 2001 and ARC documents, and railway siding features from Cambell, 1992.

ACER Environmental Services (2015) Ltd.

PHASE II & III ENVIRONMENTAL SITE ASSESSMENT
MEL, FN, EFL, SHIPPAGAN, NB.

FILE NAME: Figure 4-6 ARC 1989 GW Iso	JOB NO.: CBI 60-1	MADE: GP	CHKD: GP	DATE: Nov 15 2019

FIGURE 4-6

TPH CONTAMINATE CONTOURS FOR GROUNDWATER FOR IOL SITE NOVEMBER 1989 FROM ACER FIGURE 4-4 AS OVERLAY ON WMS SITE DRAWING

A comparison of the 1989 sampling to the 2012 to 2019 TPH sampling by ACER indicates the following:

- footprints for areas with elevated TPH concentrations in the soil, indicative of a contaminate source, are similar to that for the soil for 1989 as would typically be expected for a common source area. The footprints for areas with elevated TPH concentrations in the soil and groundwater occurred for the former rail tanker car unloading facility for 1989. It is also indicated that there was an obvious second location with elevated concentrations in the area of the tanker off-loading station and truck loading rack for 1989. These two areas show elevated concentrations for 2016 as well, with ACER 2012 and Roy Consultants Ltee 2012 sampling (A-353 a in Appendix 21) also showing elevated concentrations in the area of the tanker car facility. Sampling was not permitted on the bulk plant property in 2012.
- concentrations for TPH in soil show maximum values of 23,000 mg/kg in the fuel oil and gasoline range for 2016 sampling compared with 230 mg/kg in the gasoline range in 1989. Concentrations are significantly higher for 2016, compared with locations previously sampled in 1989. Between the truck loading rack and 14th St. TPH concentrations in 2016 showed 16,000 mg/kg at 16MW13 compared with 230 mg/kg at BH5 (highest concentration recorded) in 1989 that was located within a metre or two of 16MW13 based on drawing locations. The highest concentrations recorded in the area of the former CN Rail tanker offloading area in 1989 was 43 mg/kg at BH1 compared with a 2016 value of 220 mg/kg at 16MW18, and with other sampling downgradient of the offloading area showing values up to 27,000 mg/kg.
- concentrations for TPH in the groundwater are similar for 2016 compared with locations previously sampled in 1989, with maximum values of 45 mg/L in the fuel oil and gasoline range in 2016 compared with 46.10 mg/kg in the gasoline range in 1989. **A sample was collected at MW7A in August 2016 for comparison with May 2016, thereby allowing about 4 months for the wells to acclimate (more pristine condition). A TPH value of 8.7 mg/L was obtained compared with the May 2016 value of 2.9 mg/L at 16MW7A, located adjacent to the eastern containment dike. Several water samples collected a year later in May 2017 on the IOL bulk plant showed higher concentrations than previous sampling in 2016, concentrations increasing from 8.6 mg/L to 21 mg/L at 16MW17, from 13 mg/L to 16 mg/L at 16MW13, from 5.4 mg/L to 8.7 mg/L at 12MW72, 2.5 mg/L to 3 mg/L at 16MW16. A concentration of 56 mg/L was obtained at 16MW13 compared with the adjacent 16MW11 that previously showed 45 mg/L. The maximum concentration for the drilling program in May 2016 for the bulk plant site was 45 mg/L compared with a value of 56 mg/L obtained a year later in May 2017.**
- concentrations were significant near 14th St., that the IOL consultant ARC indicated would provide a “french drain” effect and draw contamination from the IOL property towards the street. It is likely that leakage from the tanker truck offloading and bulk truck loading rack facilities contributed to the higher concentrations evident in that area. The contamination in the area of the former IOL rail tanker car petroleum unloading facilities/area is attributed to seepage from the tank farm, based on the contour gradients. The underground fuel oil transfer line appears to be a primary pathway and the Town underground services in the driveway on the west side of the FN property likely contributing with a french drain effect. Flow of contaminated groundwater to the down gradient FN, MEL, former CN ROW/driveway and SCH/DFO properties and marine waters is attributed to the street and underground services providing a preferential pathway and given that the underground services extend and network through these areas with storm drains discharging into the harbor. Free phase product was first detected in December 1990 and was frequently reported at a number of wells to the end of 1992 and thereafter but to a lesser degree until 2007 (last monitoring report), measuring up to 37 cm thickness. The IOL remediation system was not installed until circa October 1992, thereby providing an opportunity for free phase

product to flow down gradient via the preferential pathways afforded by the roads and underground services to the marine environment.

- elevated concentrations for TPH in soils and groundwater in 2016 were also noted in the area of the south east corner of the tank farm dike, where the underground pipe network for the tanker tuck offloading facilities and underground gasoline transfer line penetrate the dike boundaries, and in the area of the former IOL CN rail tanker car offloading facilities/area. The contours indicate that the IOL bulk plant property is a contaminate source to this area.
- elevated concentrations for TPH in soil in 2016 also occurred in the area of the south side of the tank farm dike, where the underground pipe network for the tanker tuck offloading facilities and underground gasoline transfer line that extends to the wharf penetrate the dike, and in the area of the former rail tanker car offloading facilities with origins linked to the fuel oil pipeline that is located underground adjacent to the dike. The entire north side of the containment dike for this tank farm is a couple metres below the tank pads and liquids in the tank farm collect in this area (see Photo 4-4). Given the relatively high permeability of the containment dike liners, increase in head, location of adjacent of remediation service trench line, and groundwater flow gradients, an increase in migration of contaminated groundwater from this area is expected.

Based on the above for 2016 and 1989, the IOL bulk plant and former IOL CN rail tanker car petroleum offloading facilities/area associated facilities and operations are an apparent source of contamination to the EFL, FN, MEL, former CN former OW/driveway, Town St. ROWs and SCH/DFO residential/commercial/institutional properties as well as and the marine environment. Given that:

- free phase product was first detected in December 1990 and was frequently reported at a number of wells to the end of 1992 before remedial wells were installed and thereafter but to a lesser degree until 2007, measuring up to 37 cm thickness, and continued to be reported to 2007 (no data after that period);
- the thickness of the free product layer was almost always greatest at the BHs adjacent to 14th St. but was also notable at BHs in the area of the rail tanker car offloading facilities;
- soils inside the dike for the spill area were saturated with petroleum product in 1989;
- temporary storage of 2600 gallons of product in the adjacent dike area would saturate soils in that area and the liner was not up to specifications and would allow infiltration of product into the soils and groundwater and represent a long term source of contamination; and
- no remedial wells were installed until circa October 1992;

the volume of free product available and contaminated groundwater that would also have an opportunity to flow to the street and driveway between the FN and MEL properties where liquids can travel much faster, would be expected to be significant and result in widespread contamination given the extensive network of underground services. This would be further exacerbated with water supply aquifer pumping operations occurring for FN operations drawing contaminates down gradient and thereby increasing movement of PHCs toward the wharf and discharging into the harbour as part of normal groundwater flow.

4.3.3 Contamination Contours IOL 1992 Additional Intrusive Sampling and Before Bulk Plant Remediation Wells Operational

Additional monitoring wells were installed by IOL in April and August 1992 on and beyond IOL property boundaries that allowed for additional delineation of contamination and remedial monitoring. Soil and groundwater

contamination contours for the IOL bulk plant area in August 1992 are shown in Figures 4-7 and 4-8, respectively (also in Appendix 98), based on sampling data by the IOL consultant ARC (A-450 in Appendix 101, A-493 a in Appendix 67 and A-494 Appendix 82). The concentration contours are also provided in Figures 4-9 and 4-10 as overlays on the original WMS site drawing showing the footprint of contamination in the soil and groundwater, respectively. **This represents conditions prior to installation of the groundwater remedial system**, and noting that free phase liquid petroleum product was detected in December 1990 and frequently reported at a number of wells to the end of 1992 before remedial wells were installed and thereafter but to a lesser degree until 2007, measuring up to 37 cm thickness, and continued to be reported to 2007 (no data after that period).

In addition to the basic premises noted in the introduction to Section 4.3, the following was also considered. The occurrence of free product reported for the perimeter monitoring wells between December 1990 and 2007, with 2007 being the last sampling data event in attributed to reported releases of product on site and given the thickness of measured product would further indicate probable releases of additional product to that reported. As indicated, free phase liquid petroleum product was detected in a number of monitoring wells, with BH6 to BH8 located adjacent to 14th St., being frequently reported to show free product. Therefore, for contouring purposes, concentrations in the groundwater for IOL would be expected to be in the order of 300 mg/L and higher given that free phase liquid product was being reported. The value of 300 mg/L is based on sampling results in July 1998 when sampling showed 300 mg/L in BH7 when at the same time 1cm of free product was reported for BH6 and would be expected to be comparative of periods with free product being identified in this area.

Given that free phase liquid product was spilled inside the dike and was noted between the tank farm and BH5 through BH8 between December 1990 and to 2007, concentrations in the soil would be expected to be comparable to residual saturation concentrations that are significantly greater than 20,000 mg/kg. However, a value of 20,000 mg/kg was identified in the figures for contouring purposes to reflect that concentrations inside the dike and the area between the tank farm and BH5 though BH8 would be reflective of a higher value and visually demonstrates this to facilitate discussions.

The contamination contours for soil and groundwater shown on the ARC 1992 site drawing, Figures 4-9 and 4-10 (ACER Figure 4-7 and 4-8 also in Appendix 98), respectively, shows the IOL bulk plant site to be the source of contamination, with ARC identifying a similar footprint for the extent of contamination that included the EFL and FN properties, former CN tanker car offloading area, 14th St and the driveway between the FN and MEL properties. The MEL site was not included in the ARC drawing.

Based on the additional intrusive sampling, a comparison of the 1992 and 1989 IOL sampling indicates the following:

- footprints with elevated concentrations in the soil, indicative of sources of contamination, in 1992 includes the tank farm and the tanker truck unloading facility, similar to 1989, but with the tanker car unloading facility no longer appearing to show a definable pattern based on soils as previously evident.
- the additional intrusive sampling locations show a larger footprint, indicating significant migration of contamination has occurred.
- concentrations for TPH in soil are significantly higher for 1992, compared with locations previously sampled in 1989. Values indicating possible free product presence in the soil, being much greater than 20,000mg/kg, identified in the fuel oil and gasoline range compared with a maximum value of 230 mg/kg in the gasoline range in 1989. Concentrations for TPH in the groundwater indicating possible free product, greater than 300,000 mg/L, as fuel oil and gasoline. Values are significantly higher for 1992 compared with locations previously

AREA REFERRED TO AS "POLLUTION PIT" 500 TONNES 40 TRUCK LOADS PHC IMPACTED SOIL EXCAVATED 1998 AND PAID FOR BY IOL

SEEPAGE THROUGH SHEET PILING AND PREFERENTIAL PATHWAY AND SHORT CIRCUIT VIA UNDERGROUND PIPELINE TO MARINE ENVIRONMENT AT GREATER THAN MARINE GUIDELINE.

CROSS HATCH SHOWS CONTAMINATED SEDIMENTS FOR HARBOUR INCLUDING PETROLEUM HYDROCARBONS, PAHS, METAS, ETC. ABOVE MARINE GUIDELINES.

UNDERGROUND STORM WATER LINE DISCHARGES TO HARBOUR. OBSERVED SEDIMENT CLOUD FORM OVER THIS PORTION OF INNER HARBOUR DURING DRILLING OF ADJACENT MWS. WATER PRESSURE LOSS NOTED DURING HOLE INSTALLATION. THEREFORE PREFERENTIAL PATHWAY/ SHORT CIRCUIT FOR CONTAMINATES TO HARBOUR IN ADDITION TO SEEPAGE THROUGH PILING.

PREFERENTIAL PATHWAY/SHORT CIRCUIT VIA MULTIPLE PIPELINE NETWORK THIS AREA TO MARINE ENVIRONMENT.

CONCRETE VAULT FOR HOLDING REMEDIAL EQUIPMENT FOR PREVIOUS PIPELINE BREAK IN THIS AREA. ALSO COLLECTION GALLERIES VARIOUS LOCATIONS. LIKELY AFFECT FLOW DYNAMIC

PREFERENTIAL PATHWAY/SHORT CIRCUIT VIA MULTIPLE PIPELINE NETWORK THIS AREA TO MARINE ENVIRONMENT. NOT ALL SERVICES SHOWN ON DRAWING

CURRENT APPLICABLE TPH CRITERIA FOR SEDIMENT FOR MARINE ENVIRONMENT IS 15 mg/kg

NORMAL HIGH WATER MARK. MARINE AQUATIC LIFE CONTAMINATION CRITERIA IS APPLIED DIRECTLY AT LEAST 10 METRES LAND WARD OF THIS BOUNDARY

FREE PRODUCT AT THESE LOCATIONS >> 20,000

CONTOURS BASED ON 1992 SOIL SAMPLING 2.6 YEARS AFTER FREE PRODUCT OBSERVED ON WATER TABLE IN DYKED AREA FOR 1989 SPILL AND NO EXCAVATION THEREFORE TPH EXPECTED >>20,000 FOR SOILS

NOTE S:

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NOTE THAT TIDAL LOADING CAUSES BACKWATER EFFECT REACHING TO WEST SIDE OF IOL SITE AND INCREASES SPREADING OF CONTAMINATION.

NOTE THAT SHEET PILING INSTALLED AT WHARF CIRCA 2003 INFLUENCES GW FLOW AND SPREADING OF CONTAMINATION.

LEGEND

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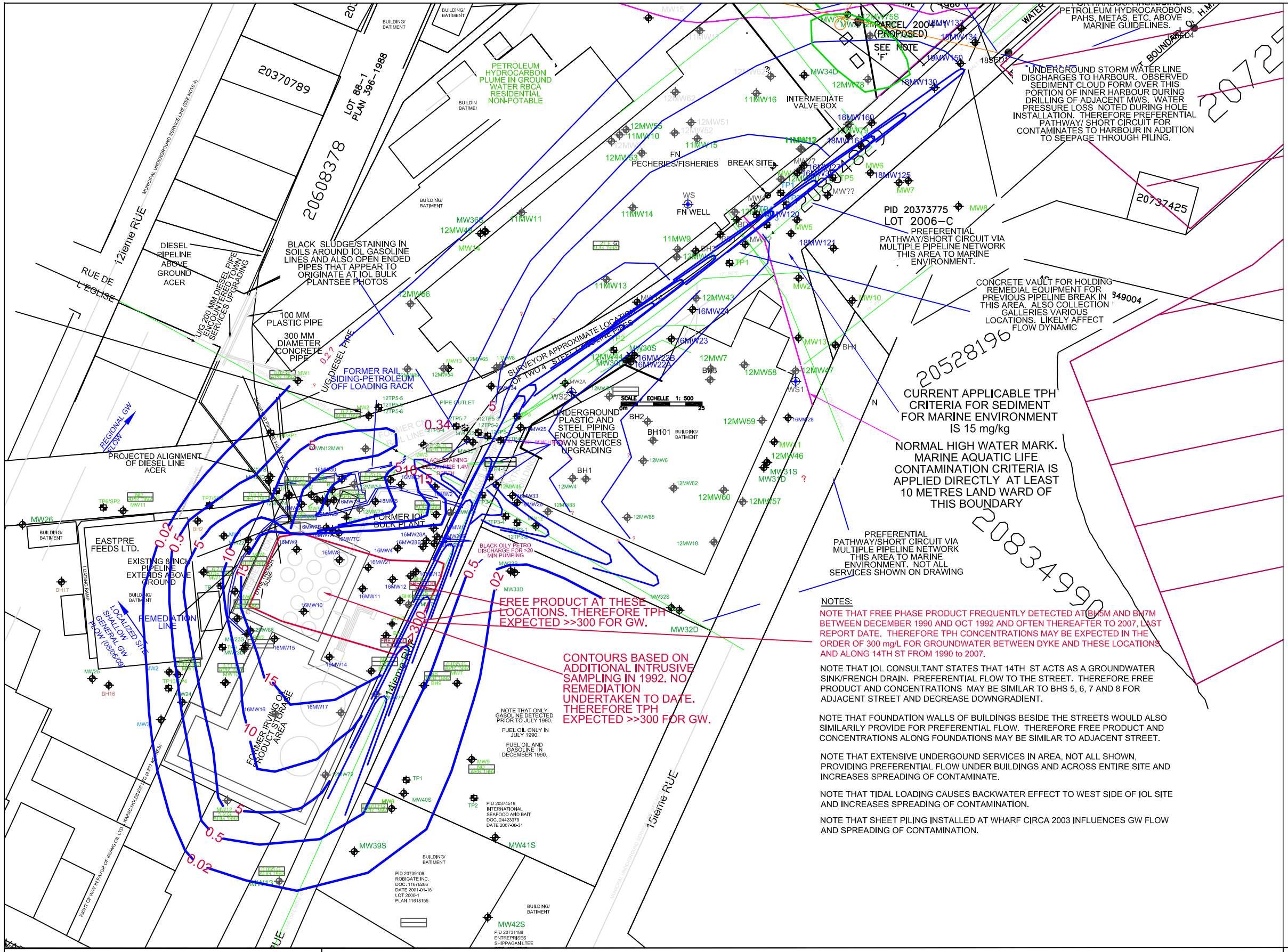
MEL, FN, EFL, SHIPPAGAN, NB.

FIGURE 4-7
TPH CONTAMINATE CONTOURS FOR SOIL FOR IOL SITE AUGUST1992
ALSO SHOWN IN FIGURE 4-9 AS OVERLAY ON WMS DRAWING

FILE NAME: Fig 4-7 1992 So Iso	JOB NO.: CBI 60-1	MADE: GP	CHKD: GP	DATE: Nov 15 2019



LEGEND

- ACER BHs/MWs IN GREEN TEXT FOR MW21 TO MW42 FOR JUNE, 2010, 11MW8 TO 11MW17 APRIL 2011, MW30 TO MW42 JULY 2011, 12MW1 TO 12MW92 IN 2012 AND 13MW93 IN 2013, 16MW1 TO 16MW35 2016, 18MW120 TO 18MW162 AND 19MW150 IN BLUE TEXT.
- WMS/ARC BHs/MWs IN LIGHT GREEN TEXT BEGINNING 1989 RELATED TO IOL BULK PLANT
- JWEL BHs/MWs IN BLUE TEXT THREE D GEOCONSULT. IN BROWN EASTPRE FEEDS 1996
- BHs/MWs BY OTHERS UNKNOWN IN BLACK TEXT
- EXISTING RECOVERY WELL (RW) LOCATION (ASPEN, MARCH 2000)
- FN PECHERIES WATER SUPPLY (WS) WELL
- TEST PIT LOCATION IN BLUE TEXT BY JWEL 1995 DFO/DNR PROPERTY
- WMS/ARC TEST PITS IN LIGHT GREEN TEXT BEGINNING IN 1989 RELATED TO IOL BULK PLANT
- TEST PIT LOCATIONS IN GREEN TEXT BY ACER, SEPT, 2010
- SEDIMENT 18SED1 & 19SED1 ACER 2018 & 2019
- SEDIMENT SED 1 & 12SED1 MGI 2001 & 2012
- 3.2 TPH CONCENTRATION CONTOUR

16MW12 Sample ID
23000 F G Analysis Resembles Gas, Diesel, Fuel oil, Lube oil
Depth (m) Depth (m)

RBCA CRITERIA FOR POTABLE GROUNDWATER COARSE SOIL

COMMERCIAL SITE UNLESS NOTED OTHERWISE				
Publication year		1999	2003 RES	2012 2015
TPH	Total Petroleum Hydrocarbons	2.8 mg/L [1] 1.8 mg/L [2] 8.4 mg/L [3]	4.4 mg/L [1] 3.2 mg/L [2] 7.8 mg/L [3]	4.4 mg/L [1] 3.2 mg/L [2] 7.8 mg/L [3]
Note: Gasoline, fuel oil and lube oil present at site				

1 Guideline for Gasoline (G) is APPLICABLE
2 Guideline for Diesel (D), Fuel oil (F)
3 Guideline for Lube Oil (L)

NOT SAMPLED ns
NOT DETECTED nd

NOTE: nd INDICATES BELOW REPORTING LIMIT

PROBABLE GROUNDWATER FLOW DIRECTION FOR SHALLOW AQUIFER

TRACE OVERLAY OF IRVING OIL LIMITED SITE PLAN FOR AS BUILT REMEDIATION SYTEM AND FORMER RAIL LOADING RACK SHOWN IN IN BLUE. REFERENCE: CAMPBELL, OCTOBER 30, 1992, INTER-OFFICE MEMO.

Some BHs/MWs and Feature locations approximate.BH/MW locations extrapolated from ASPEN, MARCH 2000, AMEC, 2001 and ARC documents, and railway siding features from Cambell, 1992.

ACER
Environmental Services (2015) Ltd.

PHASE II & III ENVIRONMENTAL SITE ASSESSMENT
MEL, FN, EFL, SHIPPAGAN, NB.

FILE NAME: Figure 4-4 1989 GW Iso	JOB NO.: CBI 60-1	MADE: GP	CHKD: GP	DATE: Nov 15 2019

FIGURE 4-8

TPH CONTAMINATE CONTOURS FOR GROUNDWATER FOR IOL SITE AUGUST 1992 ALSO SHOWN IN FIGURE 4-10 AS OVERLAY ON WMS DRAWING

CONTOURS BASED ON 1992 SOIL SAMPLING 2.6 YEARS AFTER FREE PRODUCT OBSERVED ON WATER TABLE IN DYKED AREA FOR 1989 SPILL AND NO EXCAVATION THEREFORE TPH EXPECTED >>20,000 FOR SOILS

APPROX. RESIDUAL HYDROCARBON PLUME IN SOIL

BUILDING

ROBICHAUD LINGERIE LTD

IRVING OIL LIMITED

DOMED STEEL BUILDING

F. N. FISH LTD.

OFFICE

STORAGE SHED

1st ST. STREET

FREE PRODUCT AT THESE LOCATIONS >> 20,000

FREE PROD >20000

FREE PROD >20000

MW 11 ND ND

MW 1 ND

MW 2 ND

MW 3 ND

MW 4 1200 260

MW 5D 5.3 45

MW 5S

MW 6 200 791

MW 7 ND ND

MW 8 55 ND

MW 9 26 ND

MW 10 22 6.2

EH8 8

BH5 5

3 ND

2 16.5

7 153

6 230

9 103

15

50

100

1200

3200

>20000

40

LEGEND

MW 10 = MONITORING WELL

MW 5D = DEEP MONITORING WELL
MW 5S = SHALLOW MONITORING WELL

ND = NOT DETECTED
3200 = HYDROCARBONS ppm
5 = WMS MONITORING WELL

RESIDUAL HYDROCARBON PLUME
IRVING BULK PLANT
SHIPPAGAN, NB

ARC Associates Ltd.
Job No: A91-134 Date: March 17, 1992
Figure: 3 Scale: As shown

IRV000218

LEGEND

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- TEST PIT LOCATIONS IN GREEN TEXT BY ACER, SEPT, 2010
- SEDIMENT 18SED1 & 19SED1 ACER 2018 & 2019
- SEDIMENT SED 1 & 12SED1 MGI 2001 & 2012
- 3.2 TPH CONCENTRATION CONTOUR

16MW12 Sample ID
23000 F G Analysis Resembles Gas, Diesel, Fuel oil, Lube oil
Depth (m) Depth (m)

RBCA CRITERIA FOR SOIL				
COMMERCIAL SITE NON-POTABLE COARSE SOIL				
Publication year		1999	2003	2012 2015
TPH	Total Petroleum Hydrocarbons	80 mg/kg [1] 185 mg/kg [2] 10000 mg/kg [3]	450 mg/kg [1] 7400 mg/kg [2] 10000 mg/kg [3]	870 mg/kg [1] 1800 mg/kg [2] 10000 mg/kg [3]
Note: Gasoline, fuel oil and lube oil present at site				

1 Guideline for Gasoline (G) is APPLICABLE 2 Guideline for Diesel (D), Fuel oil (F)
3 Guideline for Lube Oil (L)

NOT SAMPLED ns
NOT DETECTED nd
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Some BHs/MWs and Feature locations approximate.BH/MW locations extrapolated from ASPEN, MARCH 2000, AMEC, 2001 and ARC documents, and railway siding features from Cambell, 1992.

ACER
Environmental Services (2015) Ltd.

PHASE II & III ENVIRONMENTAL SITE ASSESSMENT
MEL, FN, EFL, SHIPPAGAN, NB.

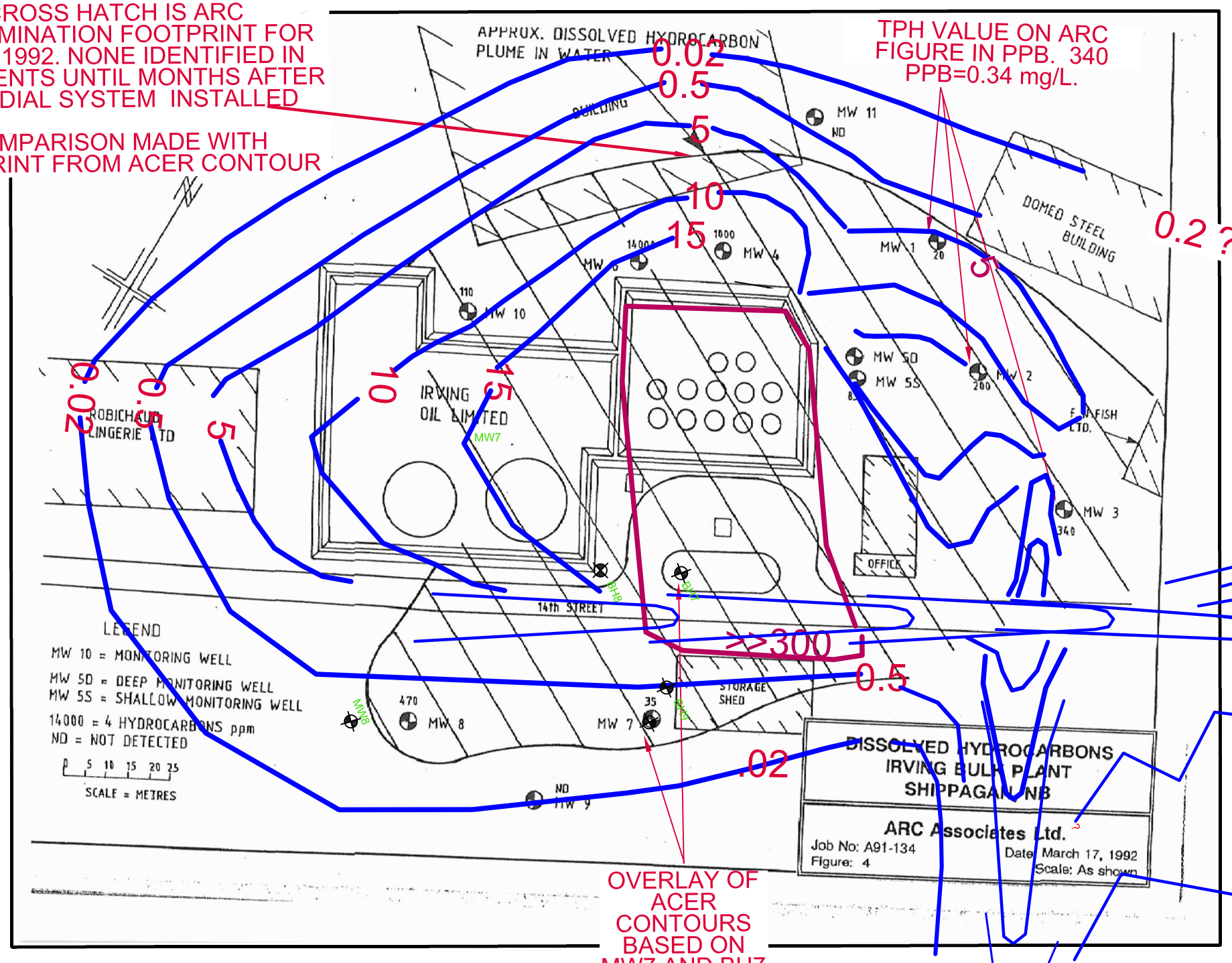
FIGURE 4-9
TPH CONTAMINATE CONTOURS FOR SOIL
FOR IOL SITE
AUGUST 1992
FROM ACER FIGURE 4-7 AS AN OVERLAY
ON WMS SITE DRAWING

FILE NAME: Fig 4-9 ARC 1992 So Iso	JOB NO.: CBI 60-1	MADE: GP	CHKD: GP	DATE: Nov 16, 2019

CROSS HATCH IS ARC CONTAMINATION FOOTPRINT FOR APRIL 1992. NONE IDENTIFIED IN DOCUMENTS UNTIL MONTHS AFTER REMEDIAL SYSTEM INSTALLED

COMPARISON MADE WITH FOOTPRINT FROM ACER CONTOUR

TPH VALUE ON ARC FIGURE IN PPB. 340 PPB=0.34 mg/L.



OVERLAY OF ACER CONTOURS BASED ON MW7 AND BH7

LEGEND

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- SEDIMENT SED 1 & 12SED1 MGI 2001 & 2012
- 3.2 TPH CONCENTRATION CONTOUR

16MW12 Sample ID
23000 F G Analysis Resembles Gas, Diesel, Fuel oil, Lube oil
Depth (m) Depth (m)

RBCA CRITERIA FOR POTABLE GROUNDWATER COMMERCIAL SITE NON-POTABLE COARSE SOIL			
Publication year		1999 2003	2012 2015
TPH	Total Petroleum Hydrocarbons	450 mg/kg [1] 7400 mg/kg [2] 10000mg/kg [3]	870 mg/kg [1] 4000 mg/kg [2] 10000mg/kg [3]
Note: Gasoline, fuel oil and lube oil present at site			

1 Guideline for Gasoline (G) is APPLICABLE
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3 Guideline for Lube Oil (L)

NOT SAMPLED ns
NOT DETECTED nd

NOTE: nd INDICATES BELOW REPORTING LIMIT

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TRACE OVERLAY OF IRVING OIL LIMITED SITE PLAN FOR AS BUILT REMEDIATION SYTEM AND FORMER RAIL LOADING RACK SHOWN IN IN BLUE. REFERENCE: CAMPBELL, OCTOBER 30, 1992, INTER-OFFICE MEMO.

Some BHs/MWs and Feature locations approximate.BH/MW locations extrapolated from ASPEN, MARCH 2000, AMEC, 2001 and ARC documents, and railway siding features from Cambell, 1992.

ACER
Environmental Services (2015) Ltd.

PHASE II & III ENVIRONMENTAL SITE ASSESSMENT
MEL, FN, EFL, SHIPPAGAN, NB.

FIGURE 4-10

TPH CONTAMINATE CONTOURS FOR GROUNDWATER FOR IOL SITE AUGUST 1992 FROM FIGURE 4-8 AS AN OVERLAY ON WMS SITE DRAWING

FILE NAME: Figure 4-10 ARC 1992 GW Iso	JOB NO.: CBI 60-1	MADE: GP	CHKD: GP	DATE: Nov 16 2019

sampled in 1989, with a maximum value of 46.10 mg/L in the gasoline range in 1989. As indicated previously, the IOL consultant ARC indicated the street would provide a "french drain" effect and draw contamination from the IOL property towards the street. The IOL remediation system was not installed until circa October 1992 thereby providing an opportunity for free phase product to flow down gradient via the preferential pathways afforded by the streets CN ROW/driveway and underground services to the marine environment.

A comparison of the 1992 IOL sampling and 2009 to 2019 sampling by ACER indicates the following:

- the IOL bulk plant and former CN tanker car offloading area and underground gasoline pipeline represent apparent sources of contamination to the EFL, FN and MEL properties, with contamination shown to extend onto these and other properties.
- as indicated previously, concentrations of PHCs in soils for the 2012 investigations that were limited to the boundary of the IOL bulk plant, showed similar concentrations as adjacent locations inside the IOL property boundary for the 2016 investigations. However, concentrations in soils were orders of magnitude higher for 2012 compared with the 1989 and 1992 investigations for perimeter wells. This would be indicative of additional migration of contamination having occurred after remedial measures were implemented between 1992 and 2012. Concentrations of PHCs in the groundwater show decreased values for perimeter wells between 1992 and 2012, with sampling at several locations between 2012 and 2019 showing similar concentrations for down gradient wells.
- contamination in the soil and groundwater for 2016 on the IOL bulk plant property show exceedences for provincial and federal criteria in consideration of human health and aquatic environment considerations, similar to investigations carried out in 1989 and 1992.

4.3.4 Contamination Contours IOL June and November, 1996

Contamination contours for groundwater for the IOL bulk plant area for June and November 28 1996 are shown in Figures 4-11 and 4-12, respectively, to demonstrate conditions 4 years after the remediation system was installed and the variability of concentrations. The concentration contours are also provided in Figures 4-13 and 4-14 as overlays on the original ARC drawings showing the footprint of contamination in the soil and groundwater, respectively.

A comparison of the June and November sampling for 1996 with 1992 (ACER Figures 4-7 and 4-8 also in Appendix 98), four years after the remediation system was installed indicates the following:

- the footprint with elevated concentrations in the groundwater, indicative of a source of contamination, in 1996 includes the IOL bulk plant tank farm and the tanker truck unloading facility and loading rack, similar to 1992.
- the groundwater contours showed elevated levels in the tank farm and truck offloading areas as well as the former tanker car unloading facility, with contours indicating a link from the tank farm.
- as per the ARC figure (ARC, 1997A in A-592 a,b in Appendix 21) groundwater contamination does not extend as far to the west and south with a general decrease in all areas except the area adjacent to 14th St. that shows
- free product presence. Contamination contours continue to indicate migration onto the Eastpre Feeds Ltd. property to the north, as well as the former railway line and FN Fisheries to the east, and 14th St. ROW and Enterprise Shippagan Ltee to the south.

AREA REFERRED TO AS "POLLUTION PIT" 500 TONNES 40 TRUCK LOADS PHC IMPACTED SOIL EXCAVATED 1998 AND PAID FOR BY IOL

SEEPAGE THROUGH SHEET PILING AND PREFERENTIAL PATHWAY AND SHORT CIRCUIT VIA UNDERGROUND PIPELINE TO MARINE ENVIRONMENT AT GREATER THAN MARINE GUIDELINE.

CROSS HATCH SHOWS CONTAMINATED SEDIMENTS FOR HARBOUR INCLUDING PETROLEUM HYDROCARBONS, PAHS, METAS, ETC. ABOVE MARINE GUIDELINES.

UNDERGROUND STORM WATER LINE DISCHARGES TO HARBOUR. OBSERVED SEDIMENT CLOUD FORM OVER THIS PORTION OF INNER HARBOUR DURING DRILLING OF ADJACENT MWS. WATER PRESSURE LOSS NOTED DURING HOLE INSTALLATION. THEREFORE PREFERENTIAL PATHWAY/ SHORT CIRCUIT FOR CONTAMINATES TO HARBOUR IN ADDITION TO SEEPAGE THROUGH PILING.

PETROLEUM HYDROCARBON PLUME IN GROUND WATER RBCA RESIDENTIAL NON-POTABLE

BLACK SLUDGE/STAINING IN SOILS AROUND IOL GASOLINE LINES AND ALSO OPEN ENDED PIPES THAT APPEAR TO ORIGINATE AT IOL BULK PLANTSEE PHOTOS

DIESEL PIPELINE ABOVE GROUND ACER

U/G 200 MM DIESEL PIPE ENCOUNTERED DURING SERVICES UPGRADING

100 MM PLASTIC PIPE

300 MM DIAMETER CONCRETE PIPE

U/G DIESEL PIPE

FORMER RAIL SIDING / PETROLEUM OFF LOADING RACK

SURVEYOR APPROXIMATE LOCATION OF TWO 4" STEEL PRODUCT PIPES

UNDERGROUND PLASTIC AND STEEL PIPING ENCOUNTERED TOWN SERVICES UPGRADING

PROJECTED ALIGNMENT OF DIESEL LINE ACER FROM PREVIOUS MIGRATION FROM IOL SITE AND RECOVERY WELLS HAVING LIMITED RECOVERY EFFECT

FORMER IOL BULK PLANT

EASTPRE FEEDS LTD.

EXISTING 8 INCH PIPELINE EXTENDS ABOVE GROUND

CONTOURS BASED ON JUNE1996 GW SAMPLING FREE PRODUCT BH6 >300 mg/L

4 CM PRODUCT

REMEDIATION LINE

LOCALIZED SITE SHALLOW GENERALLY FLOW (080809)

FORMER IRVING OIL PRODUCT STORAGE AREA

CONCENTRATIONS SIMILAR IN THESE AREAS COMPARED WITH 1992 BUT INCREASES FOR NOVEMBER 28, 1996 SAMPLE EVENT

CONCENTRATIONS SHOW REDUCTION IN EXTENT OF CONTAMINATION TO THE WEST OF BULK PLANT SITE IN 1996 BASED ON 5 mg/L CONTOUR COMPARED WITH 1992 SHOWN IN FIGURE 4-8. BUT INCREASES FOR NOVEMBER 28, 1996 SAMPLE EVENT SHOWN IN FIGURE 4-12

FN PECHERIES/FISHERIES

BREAK SITE

FN WELL

PID 20373775 LOT 2006-C PREFERENTIAL PATHWAY/SHORT CIRCUIT VIA MULTIPLE PIPELINE NETWORK THIS AREA TO MARINE ENVIRONMENT.

CONCRETE VAULT FOR HOLDING REMEDIAL EQUIPMENT FOR PREVIOUS PIPELINE BREAK IN THIS AREA. ALSO COLLECTION GALLERIES VARIOUS LOCATIONS. LIKELY AFFECT FLOW DYNAMIC

CURRENT APPLICABLE TPH CRITERIA FOR SEDIMENT FOR MARINE ENVIRONMENT IS 15 mg/kg

NORMAL HIGH WATER MARK. MARINE AQUATIC LIFE CONTAMINATION CRITERIA IS APPLIED DIRECTLY AT LEAST 10 METRES LAND WARD OF THIS BOUNDARY

PREFERENTIAL PATHWAY/SHORT CIRCUIT VIA MULTIPLE PIPELINE NETWORK THIS AREA TO MARINE ENVIRONMENT. NOT ALL SERVICES SHOWN ON DRAWING

PARCEL 2004 (PROPOSED)

SEE NOTE "F"

WATER LOT BOUNDARY OF

H.M. in right

12ieme RUE

RUE DE L'EGLISE

15ieme RUE

14ieme RUE

MUNICIPAL UNDERGROUND SERVICE LINE (SEE NOTE 4)

REGIONAL GW FLOW

SCALE ECHELLE 1: 500

PID 20836813

PID 20376224

20608378

20370789

LOT 88-1 PLAN 396-1988

20737425

20528196

20834898

349004

PID 20374518 INTERNATIONAL SEAFOOD AND BAIT DOC. 2442379 DATE 2007-06-31

NOTES:

NOTE THAT FREE PHASE PRODUCT FREQUENTLY DETECTED AT BH5M AND BH7M BETWEEN DECEMBER 1990 AND OCT 1992 AND OFTEN THEREAFTER TO 2007, LAST REPORT DATE. THEREFORE TPH CONCENTRATIONS MAY BE EXPECTED IN THE ORDER OF 300 mg/L FOR GROUNDWATER BETWEEN DYKE AND THESE LOCATIONS AND ALONG 14TH ST FROM 1990 to 2007.

NOTE THAT IOL CONSULTANT STATES THAT 14TH ST ACTS AS A GROUNDWATER SINK/FRENCH DRAIN. PREFERENTIAL FLOW TO THE STREET. THEREFORE FREE PRODUCT AND CONCENTRATIONS MAY BE SIMILAR TO BHS 5, 6, 7 AND 8 FOR ADJACENT STREET AND DECREASE DOWNGRADIENT.

NOTE THAT FOUNDATION WALLS OF BUILDINGS BESIDE THE STREETS WOULD ALSO SIMILARILY PROVIDE FOR PREFERENTIAL FLOW. THEREFORE FREE PRODUCT AND CONCENTRATIONS ALONG FOUNDATIONS MAY BE SIMILAR TO ADJACENT STREET.

NOTE THAT EXTENSIVE UNDERGOUND SERVICES IN AREA, NOT ALL SHOWN, PROVIDING PREFERENTIAL FLOW UNDER BUILDINGS AND ACROSS ENTIRE SITE AND INCREASES SPREADING OF CONTAMINATE.

NOTE THAT TIDAL LOADING CAUSES BACKWATER EFFECT TO WEST SIDE OF IOL SITE AND INCREASES SPREADING OF CONTAMINATION.

NOTE THAT SHEET PILING INSTALLED AT WHARF CIRCA 2003 INFLUENCES GW FLOW AND SPREADING OF CONTAMINATION.

LEGEND

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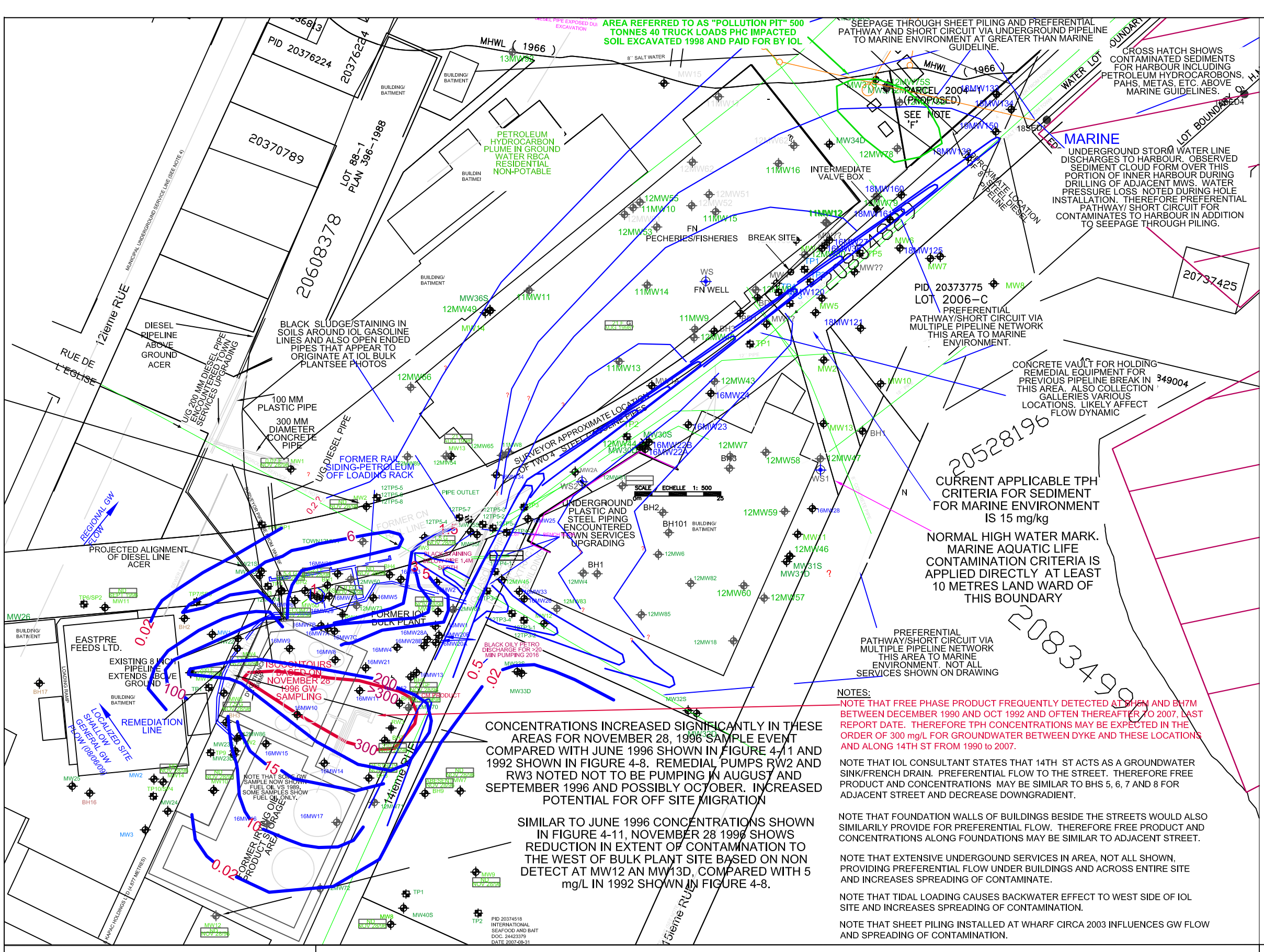
PHASE II & III ENVIRONMENTAL SITE ASSESSMENT
MEL, FN, EFL, SHIPPAGAN, NB.

FILE NAME: Figure 4-11 Jun 1996 GW Iso | JOB NO.: CBI 60-1 | MADE: GP | CHKD: GP | DATE: Nov 17 2019

FIGURE 4-11
TPH CONTAMINATE CONTOURS FOR GROUNDWATER FOR IOL SITE JUNE 1996 SHOWING REDUCED CONTAMINATION FOOTPRINT TO THE WEST OF BULK PLANT ALSO SHOWN IN FIGURE 4-13 AS OVERLAY ON ARC DRAWING



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TRACE OVERLAY OF IRVING OIL LIMITED SITE PLAN FOR AS BUILT REMEDIATION SYTEM AND FORMER RAIL LOADING RACK SHOWN IN IN BLUE. REFERENCE: CAMPBELL, OCTOBER 30, 1992, INTER-OFFICE MEMO.

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NOTES:

NOTE THAT FREE PHASE PRODUCT FREQUENTLY DETECTED AT BH6M AND BH7M BETWEEN DECEMBER 1990 AND OCT 1992 AND OFTEN THEREAFTER TO 2007, LAST REPORT DATE. THEREFORE TPH CONCENTRATIONS MAY BE EXPECTED IN THE ORDER OF 300 mg/L FOR GROUNDWATER BETWEEN DYKE AND THESE LOCATIONS AND ALONG 14TH ST FROM 1990 to 2007.

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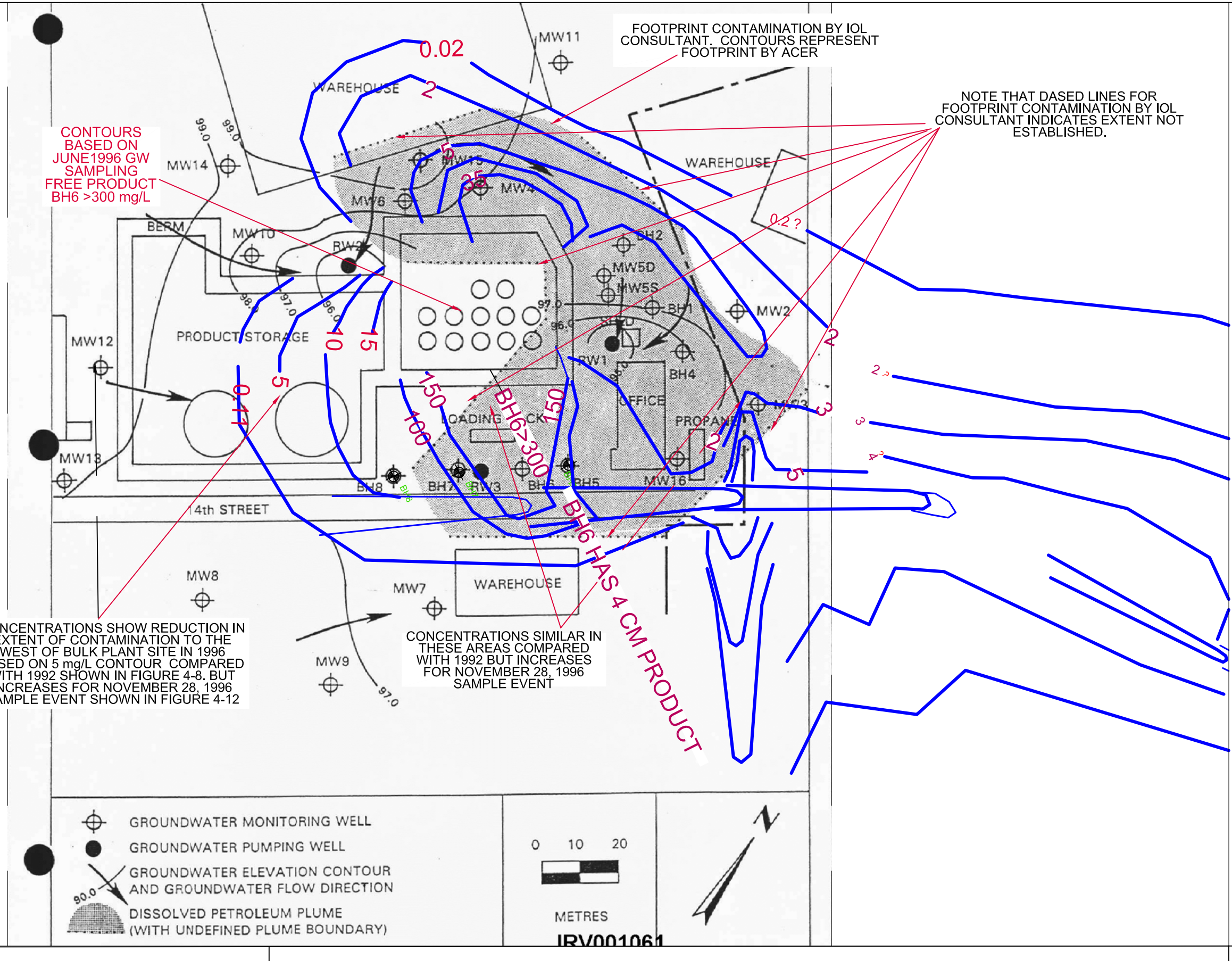
NOTE THAT SHEET PILING INSTALLED AT WHARF CIRCA 2003 INFLUENCES GW FLOW AND SPREADING OF CONTAMINATION.

ACER
Environmental Services (2015) Ltd.

PHASE II & III ENVIRONMENTAL SITE ASSESSMENT
MEL, FN, EFL, SHIPPAGAN, NB.

FILE NAME: Figure 4-12 Nov 1996 GW Iso	JOB NO.: CBI 60-1	MADE: GP	CHKD: GP	DATE: Nov 17 2019

FIGURE 4-12
TPH CONTAMINATE CONTOURS FOR GROUNDWATER FOR IOL SITE NOVEMBER 1996 SHOWING INCREASED CONCENTRATIONS BUT REDUCED CONTAMINATION FOOTPRINT ALSO SHOWN IN FIGURE 4-14 AS OVERLAY ON ARC SITE DRAWING



LEGEND

- ACER BHs/MWs IN GREEN TEXT FOR MW21 TO MW42 FOR JUNE, 2010, 11MW8 TO 11MW17 APRIL 2011, MW30 TO MW42 JULY 2011, 12MW1 TO 12MW92 IN 2012 AND 13MW93 IN 2013, 16MW1 TO 16MW35 2016, 18MW120 TO 18MW162 AND 19MW150 IN BLUE TEXT.
- WMS/ARC BHs/MWs IN LIGHT GREEN TEXT BEGINNING 1989 RELATED TO IOL BULK PLANT
- JWEL BHs/MWs IN BLUE TEXT THREE D GEOCONSULT. IN BROWN EASTPRE FEEDS 1996
- BHs/MWs BY OTHERS UNKNOWN IN BLACK TEXT
- EXISTING RECOVERY WELL (RW) LOCATION (ASPEN, MARCH 2000)
- FN PECHERIES WATER SUPPLY (WS) WELL
- TEST PIT LOCATION IN BLUE TEXT BY JWEL 1995 DFO/DNR PROPERTY
- WMS/ARC TEST PITS IN LIGHT GREEN TEXT BEGINNING IN 1989 RELATED TO IOL BULK PLANT
- TEST PIT LOCATIONS IN GREEN TEXT BY ACER, SEPT, 2010
- SEDIMENT 18SED1 & 19SED1 ACER 2018 & 2019
- SEDIMENT SED 1 & 12SED1 MGI 2001 & 2012
- 3.2 TPH CONCENTRATION CONTOUR

16MW12 Sample ID
23000 F G Analysis Resembles Gas, Diesel, Fuel oil, Lube oil
Depth (m) Depth (m)

RBCA CRITERIA FOR POTABLE GROUNDWATER COARSE SOIL

COMMERCIAL SITE UNLESS NOTED OTHERWISE				
Publication year		1999	2003 RES	2012 2015
TPH	Total Petroleum Hydrocarbons	2.8 mg/L [1] 1.8 mg/L [2] 8.4 mg/L [3]	4.4 mg/L [1] 3.2 mg/L [2] 7.8 mg/L [3]	4.4 mg/L [1] 3.2 mg/L [2] 7.8 mg/L [3]
Note: Gasoline, fuel oil and lube oil present at site				

1 Guideline for Gasoline (G) is APPLICABLE
2 Guideline for Diesel (D), Fuel oil (F)
3 Guideline for Lube Oil (L)

NOT SAMPLED ns
NOT DETECTED nd

NOTE: nd INDICATES BELOW REPORTING LIMIT

PROBABLE GROUNDWATER FLOW DIRECTION FOR SHALLOW AQUIFER

TRACE OVERLAY OF IRVING OIL LIMITED SITE PLAN FOR AS BUILT REMEDIATION SYTEM AND FORMER RAIL LOADING RACK SHOWN IN IN BLUE. REFERENCE: CAMPBELL, OCTOBER 30, 1992, INTER-OFFICE MEMO.

Some BHs/MWs and Feature locations approximate.BH/MW locations extrapolated from ASPEN, MARCH 2000, AMEC, 2001 and ARC documents, and railway siding features from Cambell, 1992.

ACER Environmental Services (2015) Ltd.

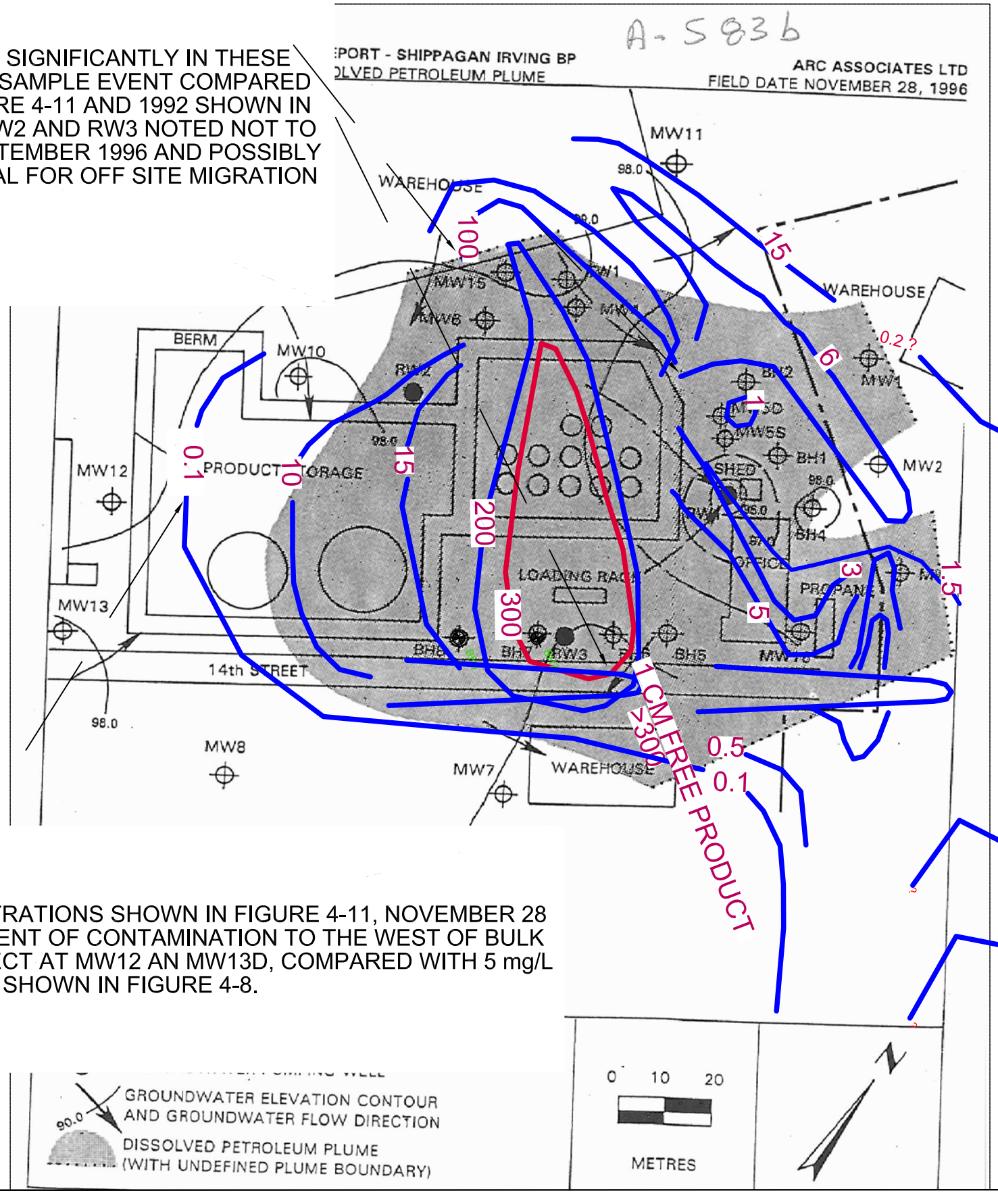
PHASE II & III ENVIRONMENTAL SITE ASSESSMENT
MEL, FN, EFL, SHIPPAGAN, NB.

FILE NAME: Figure 4-11 Jun 1996 GW Iso | JOB NO.: CBI 60-1 | MADE: GP | CHKD: GP | DATE: Nov 17 2019

FIGURE 4-13
TPH CONTAMINATE CONTOURS FOR GROUNDWATER FOR IOL SITE JUNE 1996 SHOWING REDUCED CONCENTRATION AND CONTAMINATION FOOTPRINT TO 1992 FROM ACER FIGURE 4-11 AS OVERLAY ON ARC SITE DRAWING

CONCENTRATIONS INCREASED SIGNIFICANTLY IN THESE AREAS FOR NOVEMBER 28, 1996 SAMPLE EVENT COMPARED WITH JUNE 1996 SHOWN IN FIGURE 4-11 AND 1992 SHOWN IN FIGURE 4-8. REMEDIAL PUMPS RW2 AND RW3 NOTED NOT TO BE PUMPING IN AUGUST AND SEPTEMBER 1996 AND POSSIBLY OCTOBER. INCREASED POTENTIAL FOR OFF SITE MIGRATION

SIMILAR TO JUNE 1996 CONCENTRATIONS SHOWN IN FIGURE 4-11, NOVEMBER 28 1996 SHOWS REDUCTION IN EXTENT OF CONTAMINATION TO THE WEST OF BULK PLANT SITE BASED ON NON DETECT AT MW12 AN MW13D, COMPARED WITH 5 mg/L IN 1992 SHOWN IN FIGURE 4-8.



LEGEND

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- WMS/ARC BHs/MWs IN LIGHT GREEN TEXT BEGINNING 1989 RELATED TO IOL BULK PLANT
- JWEL BHs/MWs IN BLUE TEXT THREE D GEOCONSULT. IN BROWN EASTPRE FEEDS 1996
- BHs/MWs BY OTHERS UNKNOWN IN BLACK TEXT
- EXISTING RECOVERY WELL (RW) LOCATION (ASPEN, MARCH 2000)
- FN PECHERIES WATER SUPPLY (WS) WELL
- TEST PIT LOCATION IN BLUE TEXT BY JWEL 1995 DFO/DNR PROPERTY
- WMS/ARC TEST PITS IN LIGHT GREEN TEXT BEGINNING IN 1989 RELATED TO IOL BULK PLANT
- TEST PIT LOCATIONS IN GREEN TEXT BY ACER, SEPT, 2010
- SEDIMENT 18SED1 & 19SED1 ACER 2018 & 2019
- SEDIMENT SED 1 & 12SED1 MGI 2001 & 2012
- 3.2 TPH CONCENTRATION CONTOUR

16MW12 Sample ID
23000 F G Analysis Resembles Gas, Diesel, Fuel oil, Lube oil
Depth (m) Depth (m)

RBCA CRITERIA FOR POTABLE GROUNDWATER COARSE SOIL

COMMERCIAL SITE UNLESS NOTED OTHERWISE				
Publication year		1999	2003 RES	2012 2015
TPH	Total Petroleum Hydrocarbons	2.8 mg/L [1] 1.8 mg/L [2] 8.4 mg/L [3]	4.4 mg/L [1] 3.2 mg/L [2] 7.8 mg/L [3]	4.4 mg/L [1] 3.2 mg/L [2] 7.8 mg/L [3]
Note: Gasoline, fuel oil and lube oil present at site				

1 Guideline for Gasoline (G) is APPLICABLE
2 Guideline for Diesel (D), Fuel oil (F)
3 Guideline for Lube Oil (L)

NOT SAMPLED ns
NOT DETECTED nd

NOTE: nd INDICATES BELOW REPORTING LIMIT

PROBABLE GROUNDWATER FLOW DIRECTION FOR SHALLOW AQUIFER

TRACE OVERLAY OF IRVING OIL LIMITED SITE PLAN FOR AS BUILT REMEDIATION SYTEM AND FORMER RAIL LOADING RACK SHOWN IN IN BLUE. REFERENCE: CAMPBELL, OCTOBER 30, 1992, INTER-OFFICE MEMO.

Some BHs/MWs and Feature locations approximate.BH/MW locations extrapolated from ASPEN, MARCH 2000, AMEC, 2001 and ARC documents, and railway siding features from Cambell, 1992.

ACER Environmental Services (2015) Ltd.

PHASE II & III ENVIRONMENTAL SITE ASSESSMENT
MEL, FN, EFL, SHIPPAGAN, NB.

FILE NAME: Figure 4-14 ARC Nov 1996 GW Iso	JOB NO.: CBI 60-1	MADE: GP	CHKD: GP	DATE: Nov 19 2019

FIGURE 4-14
TPH CONTAMINATE CONTOURS FOR GROUNDWATER FOR IOL SITE NOVEMBER 28, 1996 SHOWING HIGHER CONCENTRATIONS TO JUNE BUT REDUCED CONTAMINATION FOOTPRINT TO 1992 FROM ACER FIGURE 4-12 ALSO AS OVERLAY ON ARC DRAWING

- concentrations on the EFL property continue to show lower concentrations compared with the bulk plant site, with the exception of occasional occurrences of free product and elevated concentrations at MW14 that may be attributed to “Event” whereby there is an increase in mobilization of product such as spring recharge, heavy rainfall, pump failure or stoppage with elevated concentrations moving onto the EFL property with normal groundwater flow.
- concentrations in the groundwater being similar to 1992 in the tank farm and the tanker truck offloading and truck loading rack areas are indicative of ineffective treatment and/or additional spill incidents and/or a long term persistent source or combination of the above. concentrations in groundwater highest near 14th St., with free product still being reported frequently, but attributed in part to the effect of remedial well pumping in addition to the “french drain” effect of 14th St.

A comparison of the June and November sampling for 1996 indicated the following:

- concentrations in groundwater increased in general for the November sampling with an increase towards the EFL property being most notable indicating flow/migration to be more evident in that direction. This would support the opinion that events resulting in an increase in concentrations on the site may result in episodic increases in concentrations on the EFL property and supports the belief that the containment dike sump trench provides for increased migration of contamination for an event showing significant increases in concentrations and mobilization as indicated from the contour gradients for November.
- the increase in the extent of concentration gradients is highest near 14th St., with free product still being reported frequently, but attributed in part to the “french drain” effect of 14th St.

As indicated previously, ACER reported in the Phase II ESA for EFL, A-291 in Appendix 7, that there were increases in hydrocarbon concentrations observed at a number of monitoring wells in 1994, 1995, 1996, 1997, 1998 and 2000 that appeared to reflect “EVENTS” or an “EVENT” associated with the IOL property, also recognizing that fuel oil, gasoline and Naphthalene were detected at significant concentrations on the IOL and Eastpre Feeds Ltd. property, with increases observed for 1998,1999 and 2000 being primarily limited to the IOL property. A possible “EVENT(s)” may have also occurred in the fall to spring periods in 2000 based on the significant increase in TPH concentrations on the IOL property compared with 1999 values. ACER defined an “Event” as being reflective of pumps being inoperative, an accidental release of petroleum product, physical site alteration to overburden conditions or affecting groundwater flow, or a significant rise in water table due to environmental factors that may cause a significant change to concentrations of contaminates.

With the exception of BH5 through BH8 adjacent to 14th St., concentrations were commonly in the 2,000 to 8,000 mg/L range for a number of the perimeter wells as shown on Figure 4-11 for June 1996. However, increases from 40,000 to 90, 000 mg/L could occur often with spiked increases of 100,000 mg/L not being uncommon. However, major increases were also noted periodically but with results for November 28, 1996 being unusually notable. Free product was reported for BH6 between June and November 1996, with adjacent BH7 ranging from 119,000 mg/L in June to a low of 57,000 mg/L for September 4th sampling and then spiked to 310,000 mg/L on November 28, 1996. Spikes also occurred for the November 28, 1996 sampling with values at MW15 showing 200,000 mg/L compared with a value of 4mg/L in June and MW4 spiking from 43 to 130 mg/L.

It is recognized that a heavy rain fall may occur in late November resulting in a recharge type event that could mobilize contaminates in the soils. However, increases of this magnitude indicates an unusually significant increase in concentrations that would be considered representative of a likely spill event, versus a recharge event, but there was no documentation indicating an event had occurred. There was no information other than analysis

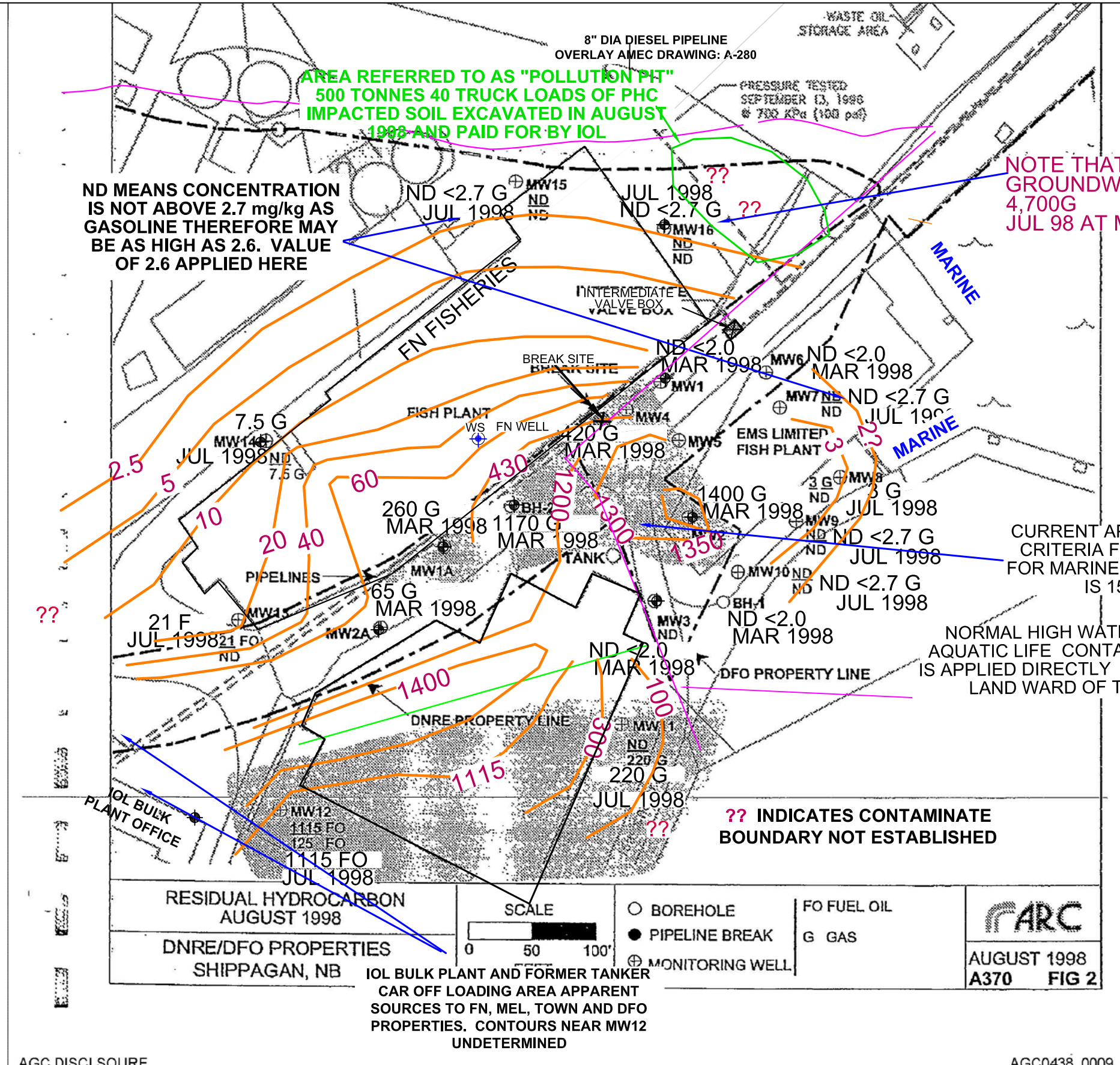
reports to review in an effort to determine why the increase may have occurred and there were no reported incidents of spills. It was noted that recovery wells RW2 and RW3 were not operating in August and September and this would allow for the migration of contamination into adjacent areas including the EFL property. It is possible that stoppage of RWs allowed the water table to rise and mobilize contaminates in the soils and completely to highly weathered and fractured bedrock.

4.3.5 Contamination Contours 1998 Investigations Area of IOL Underground Gasoline Transfer Pipeline Bulk Plant to Wharf

Investigations were undertaken to assess contamination in the area of the two IOL underground gasoline transfer pipelines that extend from the IOL bulk plant to the end of the SCH/DFO wharf. Concentration contours are based on sampling results prior to any remedial operations being implemented by IOL on the DFO/DNRE properties in association with investigations on properties pipeline contamination (A-353a in Appendix 21 for October 1997, A-117 in Appendix 28 April 1998 and AG-438 in Appendix 23 for August 1998 being pipeline related and A-609a in Appendix 21 for July 1998 monitoring for the IOL Bulk Plant). The concentration contours for soil and groundwater **include the IOL bulk plant area, former IOL CN Rail tanker car petroleum offloading facilities/area, former CN ROW, and the EFL, FN, MEL and DFO/DNRE properties in August 1998** are shown in Figures 4-15 and 4-16 (also provided in Appendix 96), respectively, as an overlay on an ARC drawing.

A comparison of the August 1998 contours with investigations for other years, prior to remedial systems being implemented on the DFO/DNR property, indicates the following:

- sources of contamination continue to be indicated by the truck tanker offloading and truck loading rack area and the IOL CN Rail tanker car offloading facility/area as per previous years with PHC concentrations in the soil on the DFO/DNR, former CN ROW now owned by the Town and FN and MEL properties generally being similar to values reported for the IOL bulk plant and rail tanker car unloading facility. However, TPH concentrations in the soil generally showed higher values along the IOL underground gasoline pipeline, with elevated concentrations indicative of a source as indicated in Figure 4-16, occurring near a valve location reported to have been leaking over the life of the pipeline.
- the pattern of contamination shown for soil in 1998 is very similar to that by ACER for 2012 (shown in Figure 4-1, also in Appendix 97)) for the FN and MEL properties but with higher concentrations in ACER 2012 to 2019. A maximum TPH concentration of 1400 mg/kg was indicated in 1998 near the FN/MEL and DFO property boundary, noting that this is in a down gradient area and a value of 1115 mg/kg was recorded at the IOL and FN/MEL property boundary, compared with a maximum value of 27,000 mg/L in 2012 about 20 metres down gradient of the IOL bulk plant property boundary. Concentrations on the IOL bulk plant property were recorded at over 50,000 mg/kg for ACER investigations in 2016.
- the pattern of contamination shown for groundwater in 1998 shows similarities to that by ACER for 2012 for the FN and MEL properties, shown in Figure 4-2 (also in Appendix 97), but with higher concentrations noted in the central portion of the properties, in the area of the FN water supply well, attributed to the IOL underground petroleum transfer line given the high concentrations occurring in the vicinity of the pipeline and as such represents a contributing source.
- as indicated on Figure 4-16, a maximum concentration of 230,000 mg/L was reported adjacent to the pipeline with a peak value of 80,000 mg/L reported for the IOL bulk plant site for the same month, but noting that free product and concentrations of 310,000 mg/L was reported near 14th St. for the IOL bulk plant in the previous.



LEGEND

- ACER BHs/MWs IN GREEN TEXT FOR MW21 TO MW42 FOR JUNE, 2010, 11MW8 TO 11MW17 APRIL 2011, MW30 TO MW42 JULY 2011, 12MW1 TO 12MW92 IN 2012 AND 13MW93 IN 2013, 16MW1 TO 16MW35 2016, 18MW120 TO 18MW162 AND 19MW150 IN BLUE TEXT.
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- JWEL BHs/MWs IN BLUE TEXT THREE D GEOCONSULT. IN BROWN EASTPRE FEEDS 1996
- BHs/MWs BY OTHERS UNKNOWN IN BLACK TEXT
- EXISTING RECOVERY WELL (RW) LOCATION (ASPEN, MARCH 2000)
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- TEST PIT LOCATION IN BLUE TEXT BY JWEL 1995 DFO/DNR PROPERTY
- WMS/ARC TEST PITS IN LIGHT GREEN TEXT BEGINNING IN 1989 RELATED TO IOL BULK PLANT
- TEST PIT LOCATIONS IN GREEN TEXT BY ACER, SEPT, 2010
- SEDIMENT 18SED1 & 19SED1 ACER 2018 & 2019
- SEDIMENT SED 1 & 12SED1 MGI 2001 & 2012
- 3.2 TPH CONCENTRATION CONTOUR

16MW12 Sample ID
23000 F G Analysis Resembles Gas, Diesel, Fuel oil, Lube oil
Depth (m) Depth (m)

RBCA CRITERIA FOR POTABLE GROUNDWATER COARSE SOIL

COMMERCIAL SITE UNLESS NOTED OTHERWISE				
Publication year		1999	2003 RES	2012 2015
TPH	Total Petroleum Hydrocarbons	2.8 mg/L [1] 1.8 mg/L [2] 8.4 mg/L [3]	4.4 mg/L [1] 3.2 mg/L [2] 7.8 mg/L [3]	4.4 mg/L [1] 3.2 mg/L [2] 7.8 mg/L [3]
Note: Gasoline, fuel oil and lube oil present at site				

1 Guideline for Gasoline (G) is APPLICABLE
2 Guideline for Diesel (D), Fuel oil (F)
3 Guideline for Lube Oil (L)

NOT SAMPLED ns
NOT DETECTED nd

NOTE: nd INDICATES BELOW REPORTING LIMIT

PROBABLE GROUNDWATER FLOW DIRECTION FOR SHALLOW AQUIFER

TRACE OVERLAY OF IRVING OIL LIMITED SITE PLAN FOR AS BUILT REMEDIATION SYTEM AND FORMER RAIL LOADING RACK SHOWN IN IN BLUE. REFERENCE: CAMPBELL, OCTOBER 30, 1992, INTER-OFFICE MEMO.

Some BHs/MWs and Feature locations approximate.BH/MW locations extrapolated from ASPEN, MARCH 2000, AMEC, 2001 and ARC documents, and railway siding features from Cambell, 1992.

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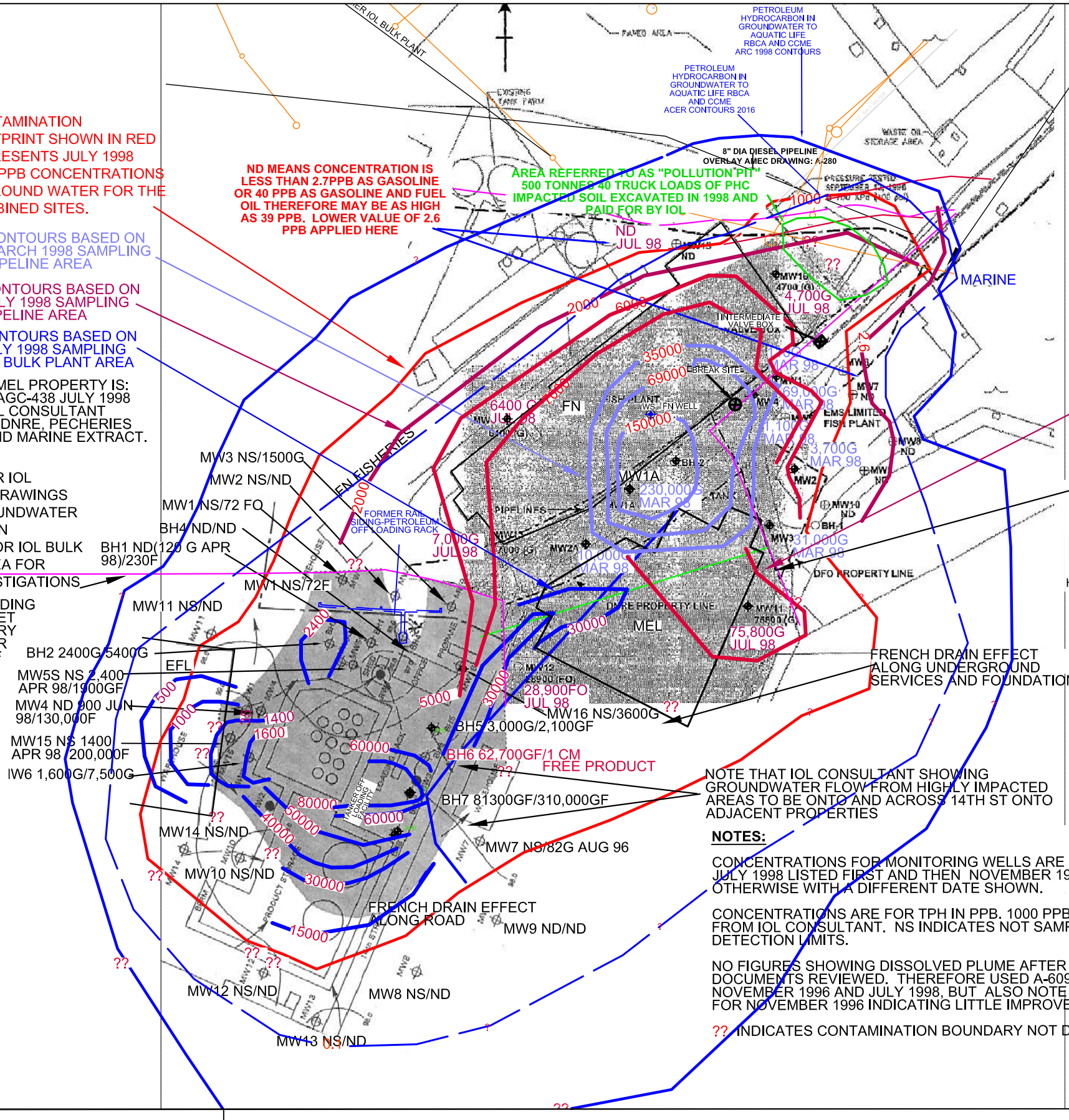
PHASE II & III ENVIRONMENTAL SITE ASSESSMENT
MEL, FN, EFL, SHIPPAGAN, NB.

FIGURE 4-15

TPH CONTAMINATE CONTOURS FOR SOIL FOR 1998 INVESTIGATIONS FOR IOL UNDERGROUND GASOLINE TRANSFER PIPELINE

FILE NAME: Figure 4-15 1998 So Iso	JOB NO.: CBI 60-1	MADE: GP	CHKD: GP	DATE: Nov 21 2019



WATER DISCHARGE FROM CATCH BASIN BECAME CLOUDY DURING INSTALATION OF 19MW150 USING WIRE LINE METHOD INVOLVING PUMPING OF WATER DOWNHOLE. INDICATES GROUNDWATER TO BE ENTERING THE DISCHARGE LINE INTO MARINE ENVIRONMENT AS A PREFERENTIAL PATHWAY TO THE MARINE ENVIRONMENT.

COMMENTS

IOL APPEARED TO MAINTAIN DIFFERENTIATION BETWEEN THE BULK PLANT SITE CONTAMINATION AND INVESTIGATIONS FOR THE IOL UNDERRGROUND GASOLINE PIPELINE THAT EXTENDS FROM THE BULK PLANT TO THE END OF THE WHARF AND WAS LOCATED ON DFO/DNRE PROPERTIES. CONTOURS FOR PIPELINE RELATED INVESTIGATIONS SHOWN IN BURGANDY. IOL BULK PLANT SITE SHOWN IN BLUE BASED. JULY 1998 SAMPLING USED FOR BOTH AREAS, WITH MARCH 1998 DATA ALSO RECOGNIZED.

NORMAL HIGH WATER MARK. MARINE AQUATIC LIFE CONTAMINATION CRITERIA IS APPLIED DIRECTLY AT LEAST 10 METRES LAND WARD OF THIS BOUNDARY AND IF PREFERENTIAL PATHWAYS EXIST SUCH AS UNDERGOUND SERVICES OR FRACTURED BEDROCK THE TIER I CRITERIA IS TO BE APPLIED AT THE SOURCE AS THE CASE IS HERE. APPPLICABLE TPH CRITERIA 0.10 mg/L

NOTES:

CONCENTRATIONS FOR MONITORING WELLS ARE PRESENTED WITH VALUES FOR JULY 1998 LISTED FIRST AND THEN NOVEMBER 1998, UNLESS INDICATED OTHERWISE WITH A DIFFERENT DATE SHOWN.

CONCENTRATIONS ARE FOR TPH IN PPB. 1000 PPB IS 1 MG/L. ALL VALUES ARE FROM IOL CONSULTANT. NS INDICATES NOT SAMPLED, ND INDICATES ABOVE DETECTION LIMITS.

NO FIGURES SHOWING DISSOLVED PLUME AFTER NOVEMBER 1996 EVIDENT IN DOCUMENTS REVIEWED. THEREFORE USED A-609A. FOOTPRINT SIMILAR FOR NOVEMBER 1996 AND JULY 1998, BUT ALSO NOTE THAT CONCENTRATIONS HIGHER FOR NOVEMBER 1996 INDICATING LITTLE IMPROVEMENT BETWEEN 1996 AND 1998.

?? INDICATES CONTAMINATION BOUNDARY NOT DELINEATED

LEGEND

- ACER BHs/MWs IN GREEN TEXT FOR MW21 TO MW42 FOR JUNE, 2010, 11MW8 TO 11MW17 APRIL 2011, MW30 TO MW42 JULY 2011, 12MW1 TO 12MW92 IN 2012 AND 13MW93 IN 2013, 16MW1 TO 16MW35 2016, 18MW120 TO 18MW162 AND 19MW150 IN BLUE TEXT.
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- 3.2 TPH CONCENTRATION CONTOUR

16MW12 Sample ID
23000 F G Analysis Resembles Gas, Diesel, Fuel oil, Lube oil
Depth (m) Depth (m)

RBCA CRITERIA FOR POTABLE GROUNDWATER			
COMMERCIAL SITE NON-POTABLE COARSE SOIL			
Publication year		1999 2003	2012 2015
TPH	Total Petroleum Hydrocarbons	450 mg/kg [1] 7400 mg/kg [2] 10000mg/kg [3]	870 mg/kg [1] 4000 mg/kg [2] 10000mg/kg [3]
Note: Gasoline, fuel oil and lube oil present at site			

1 Guideline for Gasoline (G) is APPLICABLE
2 Guideline for Diesel (D), Fuel oil (F)
3 Guideline for Lube Oil (L)

NOT SAMPLED ns
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NOTE: nd INDICATES BELOW REPORTING LIMIT
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Some BHs/MWs and Feature locations approximate.BH/MW locations extrapolated from ASPEN, MARCH 2000, AMEC, 2001 and ARC documents, and railway siding features from Cambell, 1992.

ACER
Environmental Services (2015) Ltd.

PHASE II & III ENVIRONMENTAL SITE ASSESSMENT
MEL, FN, EFL, SHIPPAGAN, NB.

FILE NAME: Figure 4-16 ARC 1998 GW Iso	JOB NO.: CBI 60-1	MADE: GP	CHKD: GP	DATE: Jan 29 2020

FIGURE 4-16

TPH CONTAMINATE CONTOURS FOR GROUNDWATER FOR 1998 INVESTIGATIONS FOR IOL UNDERGROUND GASOLINE TRANSFER PIPELINE

- two years with 110,000 mg/L as gasoline reported as recently as February 1998 (A-609 a in Appendix 30). Contours in the area of the IOL bulk plant show elevated concentrations and is also considered to be an apparent source.

Sources of Contamination to EFL

As indicated from the concentration contours the IOL bulk plant and associated facilities including the former CN rail tanker car unloading facilities/area have represented apparent sources of contamination to the EFL property. Also refer to the contamination footprints for soil and groundwater in Figures 3-5, 3-7, 3-7 and 3-8 that show concentrations of concern for human health and consideration of the marine environment. Key details regarding this conclusion are presented below, and noting that the contamination contour drawings presented in Section 4.3 show that the IOL bulk plant former CN rail tanker car unloading facilities/area have represented a long term persistent source of contamination to surrounding areas.

1. Sampling carried out by ACER in 2016 on the IOL bulk plant property and IOL former rail tanker car unloading facilities showed concentrations in the overburden soils to depths of over 3 metres and it was of particular note that petroleum hydrocarbons were detected in the shallow surface soils with TPH concentrations of 17,000 mg/kg being obtained at a depth of 0.3 metres below surface grade. The presence and relative concentrations of petroleum hydrocarbon contaminated soil near the surface at several sampling locations established at and/or adjacent to the property boundaries of the IOL property in 2012, and the presence of petroleum hydrocarbons in the groundwater at locations on/adjacent to the property boundaries, support the assertion that the IOL property and historical operations represent an apparent source of petroleum hydrocarbon contaminants detected on the Eastpre Feeds Ltd. and other nearby/surrounding properties. The only apparent source of contamination are the IOL property and IOL former rail tanker car unloading facilities.

2. The IOL environmental consultant initially carried out intrusive BH/MW investigations on the Eastpre Feeds Ltd. property in March 1992 (ARC,1992, Affidavit document A-450, in Appendix 101), including soil and groundwater reporting for April 1992 as part of supplemental investigations carried out by the IOL consultant **"in order to further define the extent of hydrocarbon plume" (see Page 1, paragraph 3, first line), following a gasoline spill that occurred on September 24, 1989** (Affidavit document A-433, in Appendix 16), **two and a half years after the reported spill**. **Impacts in the soil for Eastpre Feeds Ltd. typically occurs at depths greater than 1 metre below existing grade, as similarly reported for sample locations near the northern boundary of the IOL site** (ARC, 1992, Affidavit document A-450 in Appendix 101, and in ACER 2012, Affidavit document A-291 in Appendix 7). **Sampling carried out by WMS in November 1989 (Affidavit document A-435 a in Appendix 102) showed petroleum hydrocarbon concentrations to be about five times higher for soil samples located near the southern property boundary immediately south of the Truck Loading Stand (between loading stand and southern property boundary for IOL), with concentrations for the groundwater being 4 to 8 times higher for groundwater samples in this area compared to sampling on the IOL property near the property boundary with Eastpre Feeds Ltd. and former rail siding petroleum offloading rack**. **Contamination in the soil was also greatest in the shallow soils, 1.2 to 1.5 metres below existing grade, south of the Truck Loading Stand.**

3. **Free phase (floating) petroleum product was first detected/reported on the IOL property in December 1990 (WMS letter report dated February 25, 1991 to IOL, Affidavit document A-445 a in Appendix 103) after initial sampling in November 1989 (Affidavit document A-435 a in Appendix 102) showed gasoline at all locations, with free phase product thicknesses in the order of 35 cm subsequently being reported**

frequently at locations immediately south of the former Truck Loading Stand. Free product was not observed at any of the other boreholes on the IOL site including those located on the EFL/IOL property boundary (MW4 and MW6). Free product was detected on the IOL property until February 1999 (see Table 1-1A through 1-1D, in A-291 in Appendix 7**), with reports provided at a latter date showing free product in 2007 (FN A-1027, FN A-1028, FN A-1029 and FN A-1030, in Appendix 17).**

4. **Only gasoline PHCs were initially detected on the Eastpre Feeds Ltd. property in 1992** (ARC,1992, Affidavit document A-450 in Appendix 101) **with gasoline only, being initially reported in November 1989 at all sampling locations on the IOL property** (Affidavit document 435 a, in Appendix 102)**, but fuel oil range hydrocarbons were reported for the third sampling event in December 1990, with free phase fuel oil product reported in the area of BH5M and BH7M between the former truck loading stand for the IOL property and 14th St.. In May 1993 free phase product was measured at 37 cm near the former Truck Loading Stand, with only a petroleum sheen being reported for MW6 and MW4, with locations being immediately adjacent to the property boundary with IOL (see Table 1-1A to 1-1D**, **from ACER 2012,** Affidavit document A-291 in Appendix7)**. Free phase product thicknesses and concentrations are typically greater for source areas and therefore supports the assertion that the IOL property and associated operations represents a source for PHCs to surrounding properties.** Gasoline and fuel oil range hydrocarbons were reported for the second, fourth and fifth events, with resemblance not reported for the third event for the Eastpre Feeds Ltd. property, and concentrations were significantly lower for the Eastpre Feeds Ltd. property for all reporting events between 1992 and 2004, compared with the IOL property that showed significant increases in concentrations and thicknesses of free phase product. IOL and EFL showing gasoline initially and then IOL changing over to fuel oil with EFL in turn subsequently changing to fuel oil would indicate contamination is moving from the IOL property onto the EFL property. As indicated previously, the **higher concentrations are typically representative of a source property and sampling results and further supports the assertion that the IOL property and associated operations represents the apparent source for PHCs.**

5. Reporting and correspondence by IOL representatives and their environmental consultants indicating that containment of petroleum hydrocarbon impacted groundwater was not adequate and migration off site was a concern with frequent reference to MW3 in particular. However, as indicated from the ACER groundwater monitoring flow paths shown in Figure 3-4 (also in Appendix 73), flow occurs radially from the bulk plant property including onto the EFL and several other commercial/residential/institutional properties. Given the groundwater remediation system on the IOL property was not operational until October 1992, (Campbell Inter-Office Correspondence dated October 30, 1992, Affidavit document A-462a in Appendix 104) three years after the reported spill in September, 1989 this provided long term opportunity for migration of contamination onto the EFL property. There are admissions by IOL representatives and their environmental consultants that remedial measures were not implemented for impacted soils as proposed and approved by the New Brunswick Department of Environment (DOE). A soil treatment system was not installed until the fall of 1994 (ARC, 1995A, Affidavit document A-550 a in Appendix 69) that did not reflect the originally approved soil remedial approach and in our opinion was considered very inadequate. **There was no documentation found to indicate soils were remediated to satisfy appropriate remedial guidelines.** See Appendix 101 for ARC Figure 3 depicting the extent of **soil contamination in 1992** (ARC, 1992, Affidavit document A-450). ACER sampling on the IOL property in 2016 Therefore, soils and the weathered/fractured bedrock represent a long term persistent source. The IOL site appears to have been subject to frequent releases of petroleum product, unreported and reported (over 5,000,000 identified in Section 1.3), with a reported spill as recent as July 2003

in the area of the off-loading and loading rack, with impacted soils left in place below the underground piping network and no specific remediation of groundwater.

6. It is likely that overburden soils in the tank farm, having a permeability 50 times higher than required by the Province of NB, were significantly impacted during storage of recovered product in the reservoir for the 1989 spill, as well as other spills, with free phase floating product detected until 2007 (last reported monitoring event) with the thickness measuring over 35 cm for long periods of time. Given remedial measures for impacted soils were very limited and localized, the **residual contamination in the overburden soils and bedrock above and within the tidal zone, and deeper within the bedrock would represent a long term persistent source of contamination.**

7. Admission of IOL representatives that they considered IOL only responsible for remediation of contamination within the IOL property boundaries, even though it was indicated in the Order to delineate the extent of contaminate migration and remediation was required for any contamination "resulting from the discharge of petroleum product", as mandated in the Ministerial Order (Discovery Court File No. M/C/0793/02, March 2004 in Appendix 88). On February 15, 2019 a Ministerial Order was signed and to be served on IOL but was withheld after discussions with IOL legal counsel and IOL council inquiring what could be done to avoid the order being served (A-2734 in Appendix 126). DELG indicated "that the properties associated with the former Shippagan Bulk Plant and Pipeline must be assessed and remediated in accordance with the NB Brunswick Guideline for the Management of Contaminated Sites." IOL indicated that they had information that they would be willing to submit to the DELG to demonstrate that they have been conducting assessment work on the site. It is indicated that given the voluntary compliance by IOL, it was decided that the Order would not be served. **The ministerial order indicates that Irving Oil Company, Limited "Conduct an Environmental Site Assessment (ESA) in accordance with CSA Standard Z769-00 (R2013) on the source properties, third party properties, and all other contaminated properties identified during the ESA" and "The Remedial Action Plan shall be implemented immediately upon approval by the DELG".**

8. Absence of other potential sources of contamination as determined by the IOL environmental consultants, with the "Historical Review of the Irving Oil Bulk Plant and Surrounding Properties Shippagan, NB" report by AMEC dated September 2001 (AMEC 2001, Affidavit A-280 in Appendix 78) being particularly relevant, as well as investigations carried out by ARC (A-353 a, December 1997 in Appendix 21, A-117 in Appendix 28, A-330 in Appendix 81 and A-332, August 1998 in Appendix 22) and ACER.

9. In a letter from Service NB taxing authority to Eric Smith dated June 1, 1999 regarding the Eastpre Feeds Ltd (FN A-923 in Appendix 124) it is indicated that "After consulting with the Department of Environment and verifying the report on the property it was concluded that the property under referral" ….."The responsibility for clean up belongs to Irving Oil Ltd.".

FN, MEL, SCH/DFO, DNRE/Former CN ROW, Town St. ROWs

As indicated from the concentration contours the IOL bulk plant and associated facilities including the former CN rail tanker car unloading facilities/area and area of the two IOL underground gasoline transfer lines have represented apparent sources of contamination to the FN, MEL, Former CN ROW/driveway, Town of Shippagan St. ROWs, SCH/DFO property and other residential/commercial/institutional properties as well as the marine environment. The information provided in Sections 4.1.3 "ARC Investigations, DNRE/Former CN ROW, DFO, Area of Two IOL Underground Gasoline Pipelines" and Section 4.4.1 "SCH/DFO Inland Areas" is applicable to this Section in its entirety in consideration of contributing sources, with long term persistent sources in the soil and bedrock over a large area being problematical.

4.4 SCH and Shippagan Harbour

Historical sampling by others and current sampling by ACER shows that contamination has been associated with the SCH/DFO inland areas and the harbour sediments.

4.4.1 SCH Inland Areas

As indicated from the concentration contours the IOL bulk plant and associated facilities including the former CN rail tanker car unloading facilities/area and area of the two IOL underground gasoline transfer lines have represented apparent sources of contamination to the FN, MEL, Former CN ROW/driveway, Town of Shippagan St. ROWs, SCH/DFO property and other residential/commercial/institutional properties as well as the marine environment.

The information provided in Section 4.1.3 “ARC Investigations, DNRE/Former CN ROW, DFO, Area of Two IOL Underground Gasoline Pipelines” is applicable to this Section in its entirety in consideration of contributing sources, with long term persistent sources in the soil and bedrock over a large area being problematical. Section 4.1.3 provides additional specific discussions regarding:

- Identification of IOL as the responsible party upon determination that petroleum product identified to be discharging into the harbour, sheening that was identified as heavier than usual and coming from the area of the pipeline; and
- Investigations carried out by IOL to delineate the contamination in the soils and groundwater (not completed under the footprint of the Fn and MEL buildings) associated with the two gasoline pipelines, with the FN, MEL, former CN ROW that the gasoline lines were located on, Town ROWs and SCH/DFO being identified.

The information provided in Section 4.4.1 “SCH/DFO Inland Areas” is also applicable to this Section in its entirety, in consideration of contributing sources, with long term persistent sources in the soil and bedrock over a large area being problematical. Section 4.4.1 provides additional specific discussions regarding:

- partial excavation of impacted soils by IOL in the area of the gasoline pipelines and recontamination in this same area with the footprint increasing in the former CN ROW;
- excavation at the east end of the FN property that IOL accepted responsibility for and was likely incomplete with no confirmatory sampling;
- absence of sampling under the footprint of the MEL and FN buildings identified to be impacted as part of IOL investigations associated with the assessment of contamination associated with the two IOL underground gasoline lines. Petroleum sheening that was identified as heavier than usual was noted in the harbour and linked to the pipelines with subsequent investigations indicating that the gasoline lines were suspected of having been leaking over their entire life;
- absence of sampling for the FN and MEL properties, including the footprint of the buildings, for confirm that remediation of contaminated areas identified in association with the IOL gasoline pipelines was complete;
- recontamination; and
- presence of contamination in the soil, completely to highly weathered and fractured bedrock and groundwater represent a risk of concern for human health and the marine receiving environment.

Additional comments are provided below regarding issues of incomplete assessment and remediation, recontamination, migration and spreading of contamination and risks to the marine environment.

With specific reference to the SCH and DNRE properties that border the eastern portion of the FN and MEL properties and the 2010 to 2013 investigations, it is indicated in FN A-944 in Appendix 9 that “Also of note were the findings of investigations by ACER on the FN and MEL properties near the DNRE and SCH properties. Locations 12MW37D, 12MW43, 12MW75, 12MW78, 12MW46, 12MW47, 12MW53, 12MW58, 12MW74, 12MW75S and 12MW57, 12MW88, showed concentrations for petroleum hydrocarbons and PAHs that exceeded environmental guidelines/criteria. On the Wharf side of MEL, TPH concentrations of up to 6,500 mg/kg were detected in the soil. On the Wharf side of FN, TPH concentrations of 1,800 mg/kg were obtained in the soil. Concentrations of PAHs obtained in consideration of the groundwater to surface water pathway exceeded Federal guidelines at all sample locations analysed with the exception of one location.”

A sediment sample (split spoon sample obtained in the highly weathered sandstone) obtained off the edge of the wharf showed a TPH concentration in the lube oil range of 550 mg/kg (location 12SS1).

Access to information request to DFO and DFO defence affidavit documents obtained in August 2012 (ACER receipt date) uncovered several sources of petroleum contamination on DFO land that appears to have never been remediated or otherwise addressed (Maritime Groundwater Inc. – MGI – February 2002 as A-307 in Appendix 42).

As indicated in FN A-944 in Appendix 9, "Supplemental sampling was also carried out in June 2013 to assess other possible contamination sources including the SCH property. Based on reports prepared by Maritime Groundwater Inc. (MGI) on behalf of the DFO, petroleum hydrocarbon contamination was identified on the SCH property in several areas adjacent to and/or neighbouring the FN and MEL properties.

May 2, 1997, A-87, (Appendix 43) NBDELG occurrence report on wharf oil spill indicates there may be pipeline contamination reaching the harbour. See Section 4.1.1 for details.

DFO Affidavit for MEL CA-357 May 27, 2003, (Appendix 44) is a picture of repairs to the old north wharf showing contamination in crib work. DFO affidavit for MEL CA-359 May 29, 2003, (Appendix 45) is a picture showing trucks hauling away contaminated soil. August 20, 2014 AG-611 (Appendix 46) is an email from Rita Mroz to Maria Dober of Environment Canada, regarding historical reference to the Bulk plant, Rita Mroz, Environment Canada, indicates that in a previous email dated November 13, 2002 she indicated that “From the 1950s until the 1980s, Irving has a pipeline that ran from the water over DFO’s property, to the bulk storage tanks. DFO’s property, near the fuel tanks, is now very contaminated, likely caused by the pipeline leak (they did a stress test using seawater a few years ago and the pipe was “like swiss cheese”)”. Tom Gallagher’s letter to Claude Burry of DFO dated November 13, 1996 A-81 a, (Appendix 19) it is indicated on page 2 “Both lines were badly corroded and perforations were evident in the 150 mm diesel line on that section of piping exposed in the cribbing.”. ACER note: It is incorrectly indicated in this quotation that it is a 150 mm diesel line, and should have read 150 mm gas line.

March 16, 2011, A-304, (Appendix 47) e-mails from Garth Holder, Public Works, to Raymond Losier, DFO, re removal and disposal of fuel supply lines and soil disposal. Clean-up and disposal of petroleum pipelines and surrounding soils on Shippagan old north wharf during 2002-2003 renovations have no record of contamination testing, even though consultant reports showing petroleum contamination were shown to the wharf committee manager and excavating crew workers noted strong petroleum odours. March 16, 2001, A-304, (Appendix 47) Roland of Comeau Savoie (wharf contractor) states “What I can remember of that project, the whole area of the old north wharf has been excavated to elevation +1.2 in order to install the new tie rods. The old existing fuel supply pipes were remove and disposed of into the abandoned town sewage lagoon. I do not remember if there was any soil testing done at that time.” In an email from Garth Holder to Raymond Losier dated March 17, 2011, AG-199, (Appendix 48) it is indicated that “When we did the Old North Wharf, we did hit some underground contamination in front of the FN Fisheries, approximately 3 trucks load. This was when we were putting underground services. ”No

soil testing was carried out on the middle wharf where the IOL pipelines extend along the length of the wharf to the ocean end of the wharf, even though the information discussed above demonstrates that there were issues of concern.

As indicated previously, in the summer of 1998 a secondary FN fish plant and fish meal plant waste water treatment system was installed at the eastern end of the FN property. Petroleum contamination was encountered and construction was halted. Photos and a drawing with locations are provided in A-33 a b c (Appendix 49). Given that the IOL underground petroleum pipeline was identified as a source of petroleum contamination on the adjacent DFO property with Irving Oil Limited having been identified as the responsible party, it was concluded that the pipeline was the apparent source of contamination and therefore, IOL was contacted regarding clean up. The impact area was referred to as the “pollution pit”. An invoice dated October 8, 1998, A-37 (Appendix 50) shows that approximately 500 ton of contaminated soils were excavated from the “pollution pit” and transported to Belledune for treatment. In a fax to Sealand Construction Ltd. from Eric Smith dated July 31, 1998, A-36 (Appendix 51) it was indicated that since no one was on site qualified to evaluate the soils that a soil sample be collected in a 5 gal bucket. In a fax from Mike Sauerteig of IOL to Eric Smith dated August 21, 1998, A-38 (Appendix 52) Sauerteig indicates that “We have been informed through conversation with Sealand Constr. that approx. 500 tonnes soil was delivered to Envirem in Belledune, with instructions to send the bill to Irving Oil Limited. Please be advised that we cannot accept responsibility for any costs associated with this work until such time that we have had the opportunity to inspect the soils and have the sample analyzed.”

Irving inspected the site and took samples (the 5 gallon bucket) to their lab for analysis and the construction of the FN “pollution pit” was completed. About 3 times the required excavated soil had to be removed due to the sides caving in while we waited for the Irving inspection due to the high water level, continuous pumping to keep the pit dry and sandy soil. Billing, A-39 (Appendix 53) shows IOL having paid the invoice associated with the transport of contaminated soils to Belledune, reflecting an admission that IOL was responsible for the contamination. As indicated, no sampling was carried out to confirm all contaminated soils had been removed.

Sample location 01MW-4 installed by MGI, February 2002 (A-307 in Appendix 42) showed petroleum hydrocarbon contamination in this area. On Page 436 of the MGI report dated July 2003, A-308 in Appendix 39 in the Section identified as “Contaminated Site 3 - Fish Waste Storage Tanks” The area of contamination and volume are identified as 315 m2 and 1100 m3, respectively. However, it is noted that sampling was not carried out in the direction of or on the FN property to the south of 01MW-4, where the highest concentrations were reported. Additional sampling would have been appropriate to determine if concentrations were higher or lower. If higher than that obtained at 01MW-4 then the footprint of contamination and volume would be expected to be higher than the values recorded at that time.

Sampling by ACER in 2013 showed a TPH concentration of 9,500 mg/kg for location 13MW92, established on the FN property opposite to the MGI sample location 01-MW-4. Both sample locations showed fuel oil range petroleum hydrocarbons and the samples were obtained at similar depths. It should be noted that the results of sampling near the FN/SCH property boundary showed concentrations to be higher on the SCH property. A TPH value of 11,000 mg/kg is reported for the SCH soil sample at 01MW-4 (MGI, report dated February 2002, A-307 in Appendix 42).

This area was not investigated further by MGI, based on our review of the MGI report dated February 27, 2013, entitled FINAL PHASE lll ENVIRONMENTAL ASSESSMENT DFO SMALL CRAFT HARBOUR, SHIPPAGAN, GLOUCHESTER COUNTY NEW BRUNSWICK. PUBLIC WORKS AND GOVERNMENT SERVICES CANADA FOR FISHERIES AND OCEANS CANADA, as FN A-931 in Appendix 54. Therefore, the extent of contamination was not fully delineated, and it appears that no action has been taken to date to remediate or otherwise address

this issue, although MGI reported “a site classification of class 1 indicating that there is a high risk potential and action is required.”. Given that the concentrations were higher on the SCH property compared with the FN property, the SCH property would represent a potential source of petroleum hydrocarbon impacts to the FN property and possibly the MEL property given the preferential pathways afforded by underground services and tidal loading effects. Underground services and saltwater lines also extend to the edge of the wharf that would increase the opportunity for contaminate migration to the marine environment. Petroleum hydrocarbon concentrations in the soil and groundwater were below the CCME and RBCA guidelines for human health (Tables 2 and 3 in Appendix 29 and Figures 3-7 and 3-8 also in Appendix 76). However, the OHWM includes this area and direct application of the guidelines is considered applicable. It should be noted however, that the Total Organic Carbon (TOC) value for sediment samples obtained by AMEC In 2010 (Affidavit A-2712a in Appendix 117) from a nearby area with non-detectable petroleum hydrocarbon concentrations had a value of 2.2 g/kg which is 5 times lower than the TOC value used to establish the RBCA criteria of 25 mg/kg. As such, the RBCA criteria would have to be adjusted from 25 to 5 mg/kg. On this basis, current sampling show TPH concentrations in the soil were exceeded at one of the sample locations, with detection limits of 12 mg/kg not being sufficiently low to make a determination (Table 17 in Appendix 29 and Figure 3-5 in Appendix 76).

Current sampling show select BTEX and TPH concentrations in the groundwater exceeded RBCA criteria (indicated to be adopted for application for assessments of Federal properties) in consideration of the groundwater to surface water pathway (Tables 15 and 16 in Appendix 77 and Figure 3-7 also contained in Appendix 76). ACER 2016 investigations for this area indicated the contamination to be sourced to the SCH/DFO property as shown from the contamination contours on Figures 4-1 and 4-2 in Appendix 97 for soil and groundwater, respectively. Based on the concentration contours there is some potential for overlapping of contamination for the groundwater at a point short distance from the DFO/SCH property, with concentrations indicating contamination from the area of the two IOL underground gasoline pipelines and IOL bulk plant and former CN Rail tanker car offloading area likely represent an apparent source contributing to contamination on the SCH/DFO property in this area as well. This area is not considered to be a source contributing to contamination in the area of the FN and MEL properties. It is noted that the IOL 8 inch diesel pipeline is located in this area.

Of further note historically and chronologically with respect to inland contamination sources, in the JWEL report, November 1996, A-83 in Appendix 20, for investigations on the DFO property associated with the IOL underground petroleum transfer pipeline, it is indicated “total residual petroleum hydrocarbons in the soil ranged from non-detectable to 4800 ppm total petroleum hydrocarbons.”. Follow up investigations in 1998 to delineate contamination associated with the DFO property identified contamination to extend under almost the entire footprint for the FN and MEL buildings, including ARC, August 1998, A-332 in Appendix 22 (AG-438 figures better in Appendix 23) investigations in July 1998 and also sampling inside MEL building , A-121 in Appendix 40, June 18, 1998. ACER, FN A-944 in Appendix 9 for sampling between 2011 and 2013 showed petroleum hydrocarbon contamination in the soil to occur under almost the entire building footprint for the FN and MEL buildings.

Historical ARC MW5 and CRA location 03MW4 were both discussed above in the context of soil contamination issues as well as ARC location MW4. For the DFO property, concentrations of TPH were, 17 mg/L as gasoline at 03MW4 and 5.4 mg/L as possible gasoline at 03MW5 in 2003, with ARC location MW4 showing 69 mg/L as gasoline (highest and adjacent to the FN foundation wall) and 1.1 at MW5 in 1998. Other ARC locations showed significant concentrations of 31 mg/L at MW3, 3.7 mg/L at MW2, 0.1 at MW1 and .062 at MW6 in 1998.

Concentrations for TPH in groundwater obtained by ARC for the DNRE parcel adjacent to the DFO parcel, that was jointly remediated with the DFO parcel in association with the IOL underground petroleum transfer pipeline, were 230 mg/L at MW1A and 10 mg/L at MW2A in 1998 in A-117 in Appendix 28. ACER in 2011 obtained a

value of 60 mg/L at 11MW13 located in the area where a concentration was reported by ARC at 230 mg/L in 1998 at MW1A, noting that the 2015 RBCA criteria for potable water is 3.2 mg/L . Concentrations obtained by ARC in 1998 for the MEL property were 75.8 mg/L at MW11 and 28.9 mg/L at MW12 with concentrations at MW11, located in the area of groundwater flow from the DFO property due to “backwater” groundwater flow, being comparable to those obtained at MW4 on the DFO property and concentrations obtained by ARC at the far west end of the FN property in the direction of “backwater” groundwater flow from the DFO and DNRE properties were 7 mg/L at MW13, 6.4mg/L at MW14 and 4.7 mg/L at MW16.

MGI did not consider PAH contamination in this area although concentrations were identified in the historical documentation contained in their assessment report. It is indicated in the report that “No soil samples were submitted for PAH analysis from the Additional Phase III ESA work. No PAHs were detected during previous assessment work.”. ACER noted in ARC, April 1998, A-344 that soil samples at MW2-98 and MW4-98 showed naphthalene/PAH concentrations of 42 and 32mg/kg compared with the CCME 2010 provisional guideline of 22 mg/kg for environmental health, but a value of 0.013 mg/kg to be applied if there is concern for potential impact to water bodies. ACER A-292, ACER 291, and ACER 944 all show concentrations of naphthalene/PAHs in the groundwater to be present that exceed the marine guideline value in consideration of the groundwater to surface water pathway.

It was noted that an area of petroleum contamination on the SCH property that MGI referred to as “ Site is down gradient of former hydrocarbon impacts that were identified on the adjacent property” in the 2013 Final Phase III ESA, and referred to in the Phase II/III ESA dated February, 2002, A-307in Appendix 42, by MGI as “Residual hydrocarbon in impact was previously identified along the property boundary in the area between the FN Fisheries Ltd. fish plant and the Marine Extract Ltd. building.”, is included as part of the larger area identified in the previous “Additional” Phase III ESA 2003 report (A-308, in Appendix 39) by MGI as “Contaminated Site 4 – Abandoned Pipeline near F.N. Fisheries Ltd. Fish Plant”.

For the purpose of further defining the area associated with Contaminated Site 4, refer to Figure 5 in A-308 in Appendix 39. The area of petroleum hydrocarbon impacts associated with Contaminated Site 4 as presented in the MGI 2003 report is indicated to extend from the DFO property to the western end of the FN and MEL building footprints. With respect to Contaminated Site 4 it is indicated that concentrations of TPH in soil of 4,800 mg/kg were reported in the vicinity of the pipeline. Hydrocarbon contaminated soil was reportedly removed and the area is shown in Figure 5 of the report. Contaminated soil below and adjacent to the pipe was not excavated to avoid any further damage to the pipe.

A-308 in Appendix 39, July 2003, Additional Phase III ESA by MGI, it is indicated in the report that “Residual hydrocarbon impacts were identified along the property boundary in the area between the FN Fisheries Ltd. fish plant and the Marine Extract Ltd. building. Benzene, toluene and/or xylene concentrations in excess of the applicable CCME or NBDELG Tier I guidelines (for a commercial site with non-potable water and sand soil) were identified in surface and subsurface soil samples.”. Sample locations 03MW-4 and 03MW-5 are located on DFO property. It was further indicated in the report that “The aerial extent of hydrocarbon impacted soil in this area is estimated to be 650 square metres with a volume of 2400 cubic metres.” and “The source of hydrocarbon impact in this area is assumed to be related to the abandoned underground fuel lines….”.”

As indicated, excavation was terminated near the top of the pipes to avoid potentially damaging the pipes and therefore only a fraction of the contaminated soils was removed according to the contractor Sealand Construction Ltee. (Personal communication: Eric Smith, circa 2012). ACER noted that “With respect to the remaining impacted soil between the FN and MEL buildings, on the DFO and DNRE properties only, the DFO consultant indicates on

Page 405 “the volume of hydrocarbon impacted soil in this area is estimated to be 2400 cubic metres” in the vicinity of the area between FN and MEL building, contaminated site 4.” ACER also noted that “This estimate represents the remaining portion of contaminated soil between the MEL and FN buildings. ACER notes that this ignores previous investigations that identified contamination to extend under a large portion of the FN and MEL building footprints including ARC, August 1998, A-332 in Appendix 22, (AG-438 better figures, Appendix 23) investigations in July 1998 and also sampling inside MEL building , A-121 in Appendix 40, June 18, 1998. ACER, FN A-944 in Appendix 9 for sampling between 2011 and 2013 showed petroleum hydrocarbon contamination in the soil to occur under the building footprint for the FN and MEL buildings.

ACER notes that in DFO correspondence AGC-147 (Appendix 56) between Marcia Johannesen of Public Works and Government Services Canada (PWGSC) and Raymond Losier of DFO dated March 20, 2013 that it was indicated that “Groundwater sampled from Monitoring Well 01MW-6 (down gradient of the former hydrocarbon impacts on the adjacent property) is within acceptable hydrocarbon guidelines and no further assessment is recommended.””

ACER also noted that “In an email dated April 11, 2013 from Mario Theriault of Conestoga Rovers & Associates (CRA) to Marcia Johannesen (AGC-213, Appendix 57) the following was indicated:

“Hi Marcia, see attached site plan. A monitor well was located immediately north of 01MW-6 as shown on the plan. The monitor wells immediately south and northeast of 01MW-6 could not be located. However, we did notice other monitor wells which appeared to have recently been drilled (silica sand visible on asphalt around flush mount) in the vicinity of the FN Fisheries LTD Fish Plant (at least three monitor wells as shown in orange on the plan; approximate locations). I doubt very much that all other monitor wells (01MW-2, 01MW-3, 01MW- 4, 01MW-5 and 03-MW-1, 03-MW-2 and 03-MW-3 identified in green) are still in place as this area has been paved over the years. Sorry, no photos showing other monitor wells.”

It appears from the above that even though there was some interest in the collection of additional information, that it was determined that “no further assessment is recommended” based on concentrations of a single sample and no apparent regard for historical observations of groundwater flow conditions, underground services that provide for preferential flow pathways for movement of contamination.”

The previous sampling for 01MW-6 was on November 28, 2001 when the monitoring well was initially installed (A-307, Appendix 42). The concentrations for BTEX components as well as the TPH range hydrocarbons, with the exception of petroleum hydrocarbons in the C6-C10 TPH range, were below quantification limits for the November 28, 2001 sampling event. It was further noted that concentrations were higher for select BTEX and TPH components for the other monitoring well 01MW-1 located in the same general area for the same sampling event was higher. It was also noted that concentrations for monitoring wells 03MW4 and 03MW5 installed in 2003 (A-308, Appendix 39) in the same area of concern showed select BTEX and TPH components to be relatively higher compared to the 2001 sampling event.”

Concentrations for 01MW-6 were for the most part below the quantification limits and results for 01MW-5 were comparatively higher, as well as other locations in the area of interest installed in 2003 that showed even higher concentrations for select BTEX and TPH range petroleum hydrocarbons than the original two monitoring wells.

Given that 01MW-6 showed concentrations for BTEX and select TPH range petroleum hydrocarbons that were below the quantification limits and several other monitoring wells showed comparatively higher values, the decision that no further assessment is recommended” would not be considered to be a good technically based assessment.”

It is also indicated in the DFO request for property-based environmental information dated October 29, 2013 from the DOE regarding the site with respect to contamination and remedial work etc., it is indicated that "Our records indicate that there has been contamination found at 1. Shippagan, DFO Wharf and Irving Pipeline (PID# 20704584)." , as well as several other nearby properties (AGC-228, Appendix 58). This would indicate that there were still issues related to contamination on the DFO property (and presumably the DNRE property), contrary to the position of PWGSC (AGC-147, Appendix 56)."

Further to the above, it is indicated in a letter dated March 25, 1997 from Tom Gallagher of Jacques Whitford Environmental Limited to Claude Burry of DFO (A-83, Appendix 20) that

"The testing revealed that these 2 abandoned pipeline did not past pass testing and were suspected of having been leaking during their operating life." and further indicated that " DFO clean-up activities should be part of a joint effort which should include all impacted property owners.".

In addition, in correspondence dated August 7, 1997 (AGC-468, Appendix 59) Tom Gallagher, Jacques Whitford, states " Mike Sauerteig from Irving Oil called me today about the Shippagan clean-up. He said that he is awaiting a proposal from his consultant (Vic Nowicki-Arc Associates) which he expects to have in about a week. He said the IOL approach will be to dig test pits starting at the edge of IOL property, and progressing down the pipeline towards the wharf. IOL is going to go right across the DNRE property since they have the "go ahead". He also expects to go right into DFO property. I told him that shouldn't be a problem, and he would need to do that anyways to get the full picture."

The was no information located that indicated this was done.

As indicated, the additional investigations carried out by ACER in 2016, (internal record Affidavit A-1877 for reference purposes but not included in an appendix in this report) included additional intrusive investigations to further assess conditions near the DFO/SCH property boundaries with FN and MEL. Additional soil and groundwater sampling was carried out in other locations and to greater depths that also included drilling into bedrock to depths of over 15 metres. Sampling was carried out at new locations as well as several previously existing locations for comparative purposes. A cross section of the overburden and bedrock conditions is provided in Figure 3-2, also included in Appendix 72. Photos of the overburden soil and bedrock conditions observed during excavation activities and downhole videos are also provided Appendix 72. The bedrock shows large fractures including cave and rubble fractures with vertical fractures extending several metres. The cobble and cave fractures appear to represent zones of significant fracturing that extend with a downward dip from the IOL site and the wharf.

Concentrations for TPH in bedrock zones are noted on the profile Figure 3-2 (included in Appendix 72). Concentrations for TPH exceeded marine aquatic guidelines in consideration of the groundwater to surface water pathway. Also of note is that as per the provincial and federal guidelines, that indicate the boundary for the marine aquatic assessment is to include areas at least 10 m landward of the Ordinary High Water Mark. Of further note is that if there are preferential pathways such as fractured rock and tidal influences, that also includes underground services, the guidelines should be applied at source areas. See Figure 3-1 for borehole locations and the marine boundary (blown up version in Appendix 70). Location 12MW88 was screened in the groundwater between 0.6 and 3.7 metres in sand and gravel and in the highly weathered sandstone. Location 12MW43 was screened in the groundwater between 0.3 and 2.2 metres in till and 0.3 m of the highly weathered sandstone." These locations are near the MEL/FN and SCH/DFO property boundary and in close proximity to each other, with locations 18MW120, 121, 130, 133, 134 and 19MW150 also highly fractured bedrock zone. Given the extensive network of underground services the guidelines for aquatic life would also be applicable at the boundary of the IOL site, the EFL, FN and

MEL properties, former CN ROW as well as other nearby properties. Results for soil and groundwater analysis are presented in the Tables in Appendixes 75 and 77, respectively and show exceedences for soil, groundwater and aquatic life considerations. Contamination footprints are presented on Figures 3-6, 3-7 and 3-8 (included in Appendix 72) for soil, groundwater and the groundwater to surface water pathway in consideration of aquatic life, respectively.

The assessment of Harbour Contamination carried out by Three-D GeoConsultants Ltd. in 2002 on behalf of Eastpre Feeds Ltd., (Affidavit document A-285, Appendix 80), showed the estimated extent of the hydrocarbon plume in the soil and groundwater in Figures 3 and 5 (of that report), respectively, that showed contamination extending to the marine environment. It was indicated in a May 2, 1997, (A-87, in Appendix 43) NBDELG occurrence report on a wharf oil spill that a lobster fisherman reported petroleum sheening at the Old North Wharf at 8:00 in the morning and the coast guard investigated and reported that the petroleum product was coming from the rock around the wharf and notified DELG at 2:00 in the afternoon. An NBDELG inspector went on site on May 5, 1997 at 11:00 in the morning and checked around the end of the line formerly used by IOL. The inspector reported that “There is quite a sheen, its hard to tell since I’m standing maybe 20 feet above water level but in some places it looks like it’s thicker than the usual rainbow. It is indicated in the occurrence report that on April 4, 1998 a meeting was held with all parties involved and it was indicated that IOL will try and schedule clean up in July. The clean-up effort resulted in the discovery of significant contamination associated with the two IOL underground gasoline transfer pipelines located on the former CN ROW/driveway that extend from the IOL bulk plant to the tanker ship offloading facilities located at the end of the Wharf (referred to as the Old North Wharf). This further supported that contamination was reaching the harbour with the CN ROW/driveway providing for preferential flow.

During drilling of monitoring well 19MW150, located about 5 m from the corner of the wharf and adjacent to an underground storm discharge line, there was a loss of downhole water pressure at approximately 4 metres depth. Within several minutes, a cloud of dirty water was observed to be discharging from the storm line located at the corner of the wharf that spread across the inner harbour and persisted for several hours (see Photos in Appendix 100). Insert occurrence report

The above also supports that the underground lines provide a direct preferential pathway for release of contaminated groundwater to the harbour in addition to normal groundwater flow. It is important to recognize that contamination in the highly fractured bedrock also exceeds guidelines given the application/protocol of the CCME guidelines. The protocol indicates that “If transport between the contaminant source and receptor (e.g. surface water body) is through fractures instead of unconsolidated soils, either a transport distance of zero should be assumed (i.e. the Canadian Water Quality Guidelines for the Protection of Aquatic Life should be applied to groundwater), or a site-specific risk assessment should be conducted.” This would also apply to a water supply well used for food grade operations.

It is further indicated in the CCME guidelines that limitation in the use of the numerical guidelines include “Other scenarios resulting in a high groundwater velocity (e.g. tidal influences close to a marine water body) may also enhance contaminate transport…”…”and a site-specific adjustment of the guidelines will likely be necessary.” This condition is also applicable to the study area.

Contamination in the soils and completely to highly weathered and fractured bedrock represents a long term persistent source in consideration of the groundwater to surface water pathway. The concentration contours shown in Figures 4-1 and 4-2 (also in Appendix 97) for 2016 sampling support that a long term persistent source is present based on sampling and monitoring between 1989 and 2019.

4.4.2 Harbour Sediments

As indicated in Section 4.4.1 for SCH/DFO inland areas and Section 4.1.3 for areas further inland, contamination identified in association with the IOL bulk plant the former IOL CN Rail petroleum offloading area and the two IOL underground gasoline pipelines including affected properties EFL, FN, MEL Town ROWs as well as other residential/commercial/institutional properties will flow to the harbour as part of groundwater flow via with the extensive network of underground services and roads and fractured bedrock conditions providing preferential pathways for faster movement of contaminants as well as with normal groundwater flow. The details provided in Sections 4.4.1 and 4.1.3 also apply to this section in their entirety in consideration of contributing sources, with long term persistent sources in the soil and bedrock over a large area being problematical. Additional aspects are discussed below.

The historical concentrations of petroleum hydrocarbons in the soil and groundwater were higher for the DFO property, with current concentrations continuing to also show a link to past IOL operations as well, recognizing that natural processes including flushing due to tidal loading effects and spring freshet as well as biodegradation would result in decreasing concentrations over time.

The IOL property is on record with the DOE as a petroleum contaminated site as of October 3, 1989. Based on a review of historical documents related to reported and unreported spills, a volume of 4,617,406 litres was determined to have been spilled with respect to the IOL operations (section 1.3) and would represent a major contributor to contamination in the harbour via shallow and deeper groundwater flow in the bedrock.

A cross section of the overburden and bedrock conditions is provided in Figure 3-2, also included in Appendix 72. Photos of the overburden soil and bedrock conditions observed during excavation activities and downhole videos are also provided Appendix 72. The bedrock shows large fractures including cave and rubble fractures with vertical fractures extending several metres. The cobble and cave fractures appear to represent zones of significant fracturing that extend with a downward dip from the IOL site and the wharf. Water flow rates for these zones ranged from 20 GPM to 50 GPM.

Concentrations for TPH in bedrock zones are noted on the profile Figure 3-2. Concentrations for TPH exceeded marine aquatic guidelines in consideration of the groundwater to surface water pathway. **. Also of note is that as per the provincial and federal guidelines, that indicate the boundary for the marine aquatic assessment is to include areas at least 10 m landward of the Ordinary High Water Mark. Of further note is that if there are preferential pathways such as fractured rock and tidal influences, that also includes underground services, the guidelines should be applied at source areas**. See Figure 3-1 for borehole locations and the marine boundary (blown up version also in Appendix 70). Location 12MW88 was screened in the groundwater between 0.6 and 3.7 metres in sand and gravel and in the highly weathered sandstone. Location 12MW43 was screened in the groundwater between 0.3 and 2.2 metres in till and 0.3 m of the highly weathered sandstone." These locations are near the MEL/FN and SCH/DFO property boundary and in close proximity to each other, with locations 18MW120, 121, 130, 133, 134 and 19MW150 also highly fractured bedrock zone, given the extensive network of underground services the guidelines for aquatic life would also be applicable at the boundary of the IOL site, the EFL, FN and MEL properties, former CN ROW as well as other nearby properties.

Contamination in the soils and highly weathered and fractured bedrock represents a long term persistent source in consideration of the groundwater to surface water pathway. The concentration contours shown in Figures 4-1 and 4-2 for 2016 (also in Appendix 97), 4-15 and 4-16 for 1998 (also in Appendix 96) and 4-7 and 4-8 for 1992 (also in Appendix 98) support that a long term persistent source is present.

With respect to previous comments regarding locations 12MW37D, 12MW43, 12MW75, 12MW78, 12MW46, 12MW47, 12MW53, 12MW58, 12MW74, 12MW75S and 12MW57, 12MW88, showing concentrations for petroleum hydrocarbons and PAHs that exceeded environmental guidelines/criteria on the FN and MEL properties near the DNRE and SCH properties, ACER, FN A-944 (Appendix 9). It was noted in the report by MGI, dated February 2002, Affidavit Reference A-307 in Appendix 42, page 308, that it is indicated that the highest concentrations of TPHs of the 12 samples obtained in November 2001 were found in samples SED-1, SED-2 and SED-3. These locations are closest to the middle wharf. The highest TPH concentration was for SED-1, 3700 mg/kg (ppm), located closest to the FN and MEL properties (see sample location Drawings on page 292, and page 309 for tabulated values).

Historically for sediments in the harbour, MGI report, May, 2001, A-298, (Appendix 37), sediment samples collected from Shippagan Harbour between January 1976 and December 1983 by OceanChem Group had 1,374 mg/kg of oil and grease and exceeded the guidelines for ocean disposal of 10 mg/kg, and being most comparable with the RBCA oil/lube range hydrocarbons TPH criteria of 43 mg/kg and management limit of 500 mg/kg, exceeded this criteria. As indicated, **ACER noted in a report obtained in 2019 that based on sampling by AMEC in 2010 (Affidavit FN 2712 a and FN 2712 b in Appendix 117) the Total Organic Carbon (TOC) value for sediment samples obtained from a nearby area with non-detectable petroleum hydrocarbon concentrations would require the RBCA criteria to be adjusted from 25 to 5 mg/kg. Indicating risks to be even more significant to the marine environment.**

In August 2018 ocean sampling was conducted by ACER Environmental Services (2015) Ltd. (ACER) involving surface sediment grab samples and deeper core sampling with depths of about 2 metres achieved. The footprint for contamination is shown in Figure 3-8 also in Appendix 76. The large footprint of petroleum hydrocarbon and PAH contamination historically and still currently evident in the immediate harbour area and inland, supports that a large quantity of contaminate(s) having been released to the environment. Of 24 sample locations established, over 50% of the locations showed petroleum hydrocarbons, PAHs and metals that exceeded guidelines includingsediment grab samples and deeper core sampling with depths of about 2 metres achieved.

Contamination was evident at a distance of 2.6 KM from the Shippagan wharf. In a number of instances, core samples (obtained below the grab sample depth of 5 to 7 cm) which extended to a depth of 2 metres at a number of locations, showed concentrations to be higher than the surface grab sample at specific locations, with contaminates occurring to the full depth of 2 m. Core sampler refusal occurred at various locations and it is possible that the contamination may extend deeper at specific locations. See Tables in Appendix 29. Consistent with historical sampling, the highest concentrations obtained for the ACER sampling program occurred in the area closest to the Old North Wharf containing the Irving Oil Limited (IOL) underground petroleum transfer line and the “contaminated area” consisting of the former IOL bulk plant and Rail car Off-loading facility, former CN right of Way inclusive of the IOL underground petroleum transfer lines, Eastpre Feeds Ltd, Pecheries FN Fisheries Ltee, Marine Extract Limited (MEL) and DFO properties that are apparent sources of petroleum hydrocarbons and Polycyclic Aromatic Hydrocarbons (PAHs) contamination to the marine receiving environment.

(The basis for the following is internal reference ACER document May 28, 2018, A-2612, not in appendix): Sampling of surface sediments shows historical and current concentrations of petroleum hydrocarbons and PAHs in the groundwater on the FN Fisheries and Marine Extract properties and historical sampling on the DFO property exceed CCME as well as provincial Risk Based Corrective Action (RBCA) criteria for aquatic life. Not all impacted soils identified on the DFO property associated with the pipeline were delineated and removed and or remediated in association with contamination identified on the DFO property associated with the pipeline. Concentrations of petroleum hydrocarbons and PAHs are still present in soils that exceed CCME guidelines for leaching into the

groundwater and impacts associated with the groundwater to surface water exposure pathway. DFO consultants found petroleum contamination in the old north inner harbour at 1374 mg/kg for Total Petroleum Hydrocarbons (TPH) in 1977-1980, A-298 in Appendix 37. A second consultant's report in 2002 showed 3,700 mg/kg in the old north inner harbour for surface sediments. A third consultant report for sampling carried out in 2012 showed concentrations of 34,000 mg/kg for surface sediments in the Bay in the Shippagan channel about 150 metres from the edge of the wharf, FN A-931 in Appendix 54. Concentrations for Total Petroleum Hydrocarbons exceed the Provincial RBCA criteria value of 25 mg/kg that has also been adopted by the Federal government. Contamination in the form of Polycyclic Aromatic Hydrocarbons (PAHs), heavy metals, PCBs (values ranging from 1 to 21.4 µg/kg compared with the CCME Interim Sediment Quality Guideline value of 21.5 µg/kg) and DDT (values ranging from 2.6 to 11.8 µg/kg compared with the Interim Sediment Quality Guideline value of 1.19 µg/kg) have also been identified in the sediments with select parameters exceeding CCME guidelines and the 1991 guidelines for Ocean Disposal, A-307 in 2003 in Appendix 42. Releases of petroleum hydrocarbons, PAHs, heavy metals and other contaminants from inland areas, with associated contamination of soils and groundwater, if not properly contained represent sources of contamination to the marine environment via natural groundwater flow conditions in combination with an extensive network of underground services and fractured bedrock that provide for preferential flow (faster) and historical groundwater pumping activity.

ACER noted that sampling of the harbour sediments by a DFO consultant, Affidavit A-307 in Appendix 42, MGI, February 2002, page 308, it is indicated that the highest concentrations of TPH were found in SED-1, 2, 3 being closest to the IOL pipeline on the wharf tanker boat unloading facility. The highest TPH concentration was for SED-1, 3700 mg/kg, located closest to FN and MEL, with this value exceeding the provincial RBCA Tier 1 criteria of 25 mg/kg (see sample location Drawings on page 292, and page 309 for tabulated values).

It was noted in DFO correspondence AG-202 to 205 (Appendix 61) between Marcia Johannesen of Public Works and Government Services Canada (PWGSC) and Raymond Losier of DFO in November 2012 that CRA recommended that six sediment samples be collected to "Establish current quality of sediment in Harbour waterlot" for PAHs, metals and BTEX/TPH. It was proposed to "Collect sediment sample near former 2001 samples SED-1, 2, 5, 8, 9 and 10". However, the only evidence of additional sediment sampling is provided in the Final Phase III ESA by CRA, 2013 (FN A-931, Appendix 54) that only showed two locations. As indicated previously, one location was established near the outer boundary of the waterlot in the general area of SED-9 that previously showed the lowest TPH concentrations (assumed non-detectable for TPH given that values were indicated to be "less than" a specific value identified as the laboratory estimated quantification limit or lab detection value). Location 12SED-2 was further afield, over 100 metres from any previous sample location, but showed a significantly higher concentration at 34,000 mg/kg for TPH.

Further to this it was noted by ACER that an Eckman Grab Sampler was also used for the sampling carried out in November 2012 by MGI (FN A-931 in Appendix 54). As indicated previously, samples would only represent surficial sediments. As such, no representative "depth profiling" was carried out "to fully define this contaminated site." as recommended by MGI, February, 2002, A-307 in Appendix 42, page 317, of ACER letter dated April 17, 2016. It was also noted on page 320 (report page 55) of the same report that "a Marine and Aquatic Site Classification was carried out." for the waterlot. It was indicated that "The procedure indicated a Hazard Ranking Score of 2 which results in a "Medium-high Priority Site" ranking. An NCS score (National Classification System for Contaminated Sites developed by Canadian Council of Ministers of Environment,) between 50 and 69.9 was identified as having a "Medium" risk potential and "Action Likely Required". An NCS score of greater than 70 was identified as having a "High" risk potential and "Action Required". To our knowledge there has been no action taken to address this issue and further assessment of the extent of contamination in the harbour sediments is

warranted given that higher concentrations of contaminates were identified further afield and sediment sampling has been limited to the surface sediments to this point.

AMEC Earth & Environmental letter report dated January 7, 2010 (Affidavit FN 2712 a and FN 2712 b in Appendix 117) for a marine sediment sampling program carried out at the Marine Service Centre in Shippagan (obtained circa June 2019). It was indicated in the report that "A total of seventeen (17) marine sediment samples were collected between November 28 and 30, 2009 from within the footprint of a proposed dredging area (Figure 1 of the report). Surface grab samples were collected from three locations (SH10, SH14 and SH25) and surface and subsurface core samples were collected from seven stations (SH29, SH46, SH48, SH52, SH65, SH71 and SH76) within the proposed dredge area."

It was indicated that "The three surface grab samples (SH10, SH14, and SH25) were collected by boat with a grab sampler. The sampling protocol followed the above-referenced guidance document for the field program with the upper 10 cm of the sediment column collected." It was further indicated that "The remaining core samples (SH29, SH46, SH48, SH52, SH65, SH71 and SH76) were collected using a drill rig from a barge platform. The core penetrate the substrate to a depth of up to 3.5m below Lowest Normal Tide (LNT), which was then subsequently divided into separate jars as surface (SURF) and subsurface (SUB) samples. The surface samples consisted of the first 60cm of sediment, while sediment between 0.6m (60cm) and 3.5m below the surface was homogenized as subsurface samples."

ACER notes that homogenization of the subsurface portion of the core samples from 0.6 m to 3.5 m would result in an average concentration that would be lower and not provide a true reflection of peak concentrations within the sample zone.

The Government of Canada established an Eco Task Group in 2006 with the purpose of Updating/revising eco-screening checklist in Atlantic Risk-Based Corrective Action (RBCA) User Guidance to:

- Improve guidance
- Include eco-based criteria **sediment in consideration of freshwater and marine aquatic life among other criteria.**

Criteria for Benzene, Toluene, Ethylbenzene, Xylenes (BTEX) and Total Petroleum Hydrocarbon (TPH) fractions were adopted for the RBCA guidelines in 2012. These criteria were referenced during a presentation by representatives of the Government of Canada at the "Real Property Institute of Canada Federal Contaminated Sites National Workshop Montreal, April 2016." **A comparison of the RBCA ecological criteria for marine life with the concentrations for surface samples indicated that TPH concentrations exceeded the RBCA criteria for three of the ten samples. Concentrations were 390 mg/kg at SH14, 200 mg/kg at SH 25 and 190 mg/kg at SH14, and in the fuel oil/lube oil range compared with the applicable RBCA criteria of 25 mg/kg for fuel oil range petroleum hydrocarbons. It should be noted however, that the Total Organic Carbon (TOC) value for sediment samples obtained from a nearby area with non-detectable petroleum hydrocarbon concentrations had a value of 2.2 g/kg which is 5 times lower than the TOC value used to establish the RBCA value of 25 mg/kg. As such, the RBCA criteria would have to be adjusted from 25 to 5 mg/kg. Indicating risks to be even more significant to the marine environment.**

It is also noted by ACER that although dredging has been carried out, that concentrations in areas adjacent to sample locations SH10, SH14 and SH25 that were not dredged would be expected to be comparable and includes

the area toward the Old North Wharf and further out into the channel (with reference to location SH25). This is applicable to both petroleum hydrocarbons and PAHs.

In the AMEC report summary it is also indicated that the analytical results of the ten samples analysed indicate that the sediment did not meet the Canadian Environmental Protection Act (CEPA) Ocean Disposal Guidelines, CCME Interim Sediment Quality Guidelines (ISQGs) and Probable Effect Levels (PELs) for marine/estuarine environments, CCME Soil Quality Guidelines (SQGs) for agricultural, residential/parkland, and commercial/industrial applications as follows:

- PAH- Three samples (SH10, SH14, and SH25) exceeded the CCME ISQGs with 7 to 8 individual compounds.
- PAH - One sample (SH25) exceeded the CCME PELs for 2 individual compounds.
- PAH - Three samples (SH10, SH14, and SH25) exceeded the CCME SQGs for the protection of human health (potable water) for all land use scenarios with 1 to 3 individual compounds.
- PAH- Three samples (SH10, SH14 and SH29 SURF) exceeded the CCME SQG for the protection of human health (potable water) IACR (Drinking Water Check).
- PAH- Three samples (SH10, SH14, and SH25) exceeded the CCME SQGs for the protection of environmental health (freshwater life) for all land use scenarios with 1 to 2 individual compounds.

May 2, 1997, A-87, (Appendix 43) NBDELG occurrence report on wharf oil spill indicates there may be pipeline contamination reaching the harbour.

DFO Affidavit for MEL CA-357 May 27, 2003, (Appendix 44) is a picture of repairs to the old north wharf showing contamination in crib work. DFO affidavit for MEL CA-359 May 29, 2003, (Appendix 45) is a picture showing trucks hauling away contaminated soil. August 20, 2014 AG-611 (Appendix 46) is an email from Rita Mroz to Maria Dober of Environment Canada, regarding historical reference to the Bulk plant, Rita Mroz, Environment Canada, indicates that in a previous email dated November 13, 2002 she indicated that “From the 1950s until the 1980s, Irving has a pipeline that ran from the water over DFO’s property, to the bulk storage tanks. DFO’s property, near the fuel tanks, is now very contaminated, likely caused by the pipeline leak (they did a stress test using seawater a few years ago and the pipe was “like swiss cheese”)”. Tom Gallagher’s letter to Claude Burry of DFO dated November 13, 1996 A-81 a, (Appendix 19) it is indicated on page 2 “Both lines were badly corroded and perforations were evident in the 150 mm diesel line on that section of piping exposed in the cribbing.”. ACER note: It is incorrectly indicated in this quotation that it is a 150 mm diesel line, and should have read 150 mm gas line.

Based on the above, the IOL bulk plant property and associated operations including the former CN tanker car offloading area and two IOL underground gasoline transfer lines are considered apparent sources of petroleum hydrocarbons and PAHs impacting the marine environment. In addition, the contamination on the EFL, FN, MEL, former CN ROW/driveway, Town St. ROWs and SCH/DFO properties and other residential/commercial/institutional properties, <u>with the apparent sources being the IOL bulk plant property and associated operations including the former CN tanker car offloading area and two IOL underground gasoline transfer lines</u>, are in turn apparent contributing sources of contamination to the marine environment..

5.0 REMEDIAL CONSIDERATIONS

Remedial considerations have been identified in consideration of the site conditions as presented in Section 3.0 and location of contaminate sources and spreading and migration as presented in Section 4.0. It is appreciated that financial investors and/or lenders consider risks to high if and when a property becomes contaminated and the most expedient approach to correcting the situation is to have the site remediated as quickly as possible. To this end, excavation of impacted soils and completely too highly weathered bedrock immediately addresses soil impacts on a property. This in turn is a beneficial step towards groundwater remedial efforts by removing the soil and weathered bedrock that may represent a long term persistent source of contamination to the groundwater if not otherwise treated. Groundwater pump and treat can be included during excavation and removal of impacted soil and weathered bedrock to remove a portion of the impacted groundwater and in an effort to minimize potential recontamination of clean backfill materials.

However, critical factors to carrying out remediation on the properties and estimating costs include the following:

- the apparent sources of contamination are located on adjacent and nearby properties;
- the EFL/FN/MEL buildings are large with footprints that cover most of the properties and places constraints on remedial approaches if the buildings are to be left in place resulting in additional costs and would significantly add to costs if the buildings are demolished in order to implement an effective and efficient remedial program;
- the total area of impacts including the harbour sediments is about 50 acres, with the land based area being approximately 20 acres in size and no remedial work is being carried out on source properties that represent just over 10 acres, and therefore represent long term persistent sources of contamination;
- recognition that there has been about 5,000,000 litres and likely more, that has been spilled (A-1877a);
- based on ACER 2016 investigations concentrations of contamination in the soil and groundwater on the former IOL bulk plant property are still similar to investigations carried out in 1989, even though groundwater remedial work was carried out between 1989 and circa 2011, but noting that soil remediation was essentially not carried out and therefore represents a long term persistent source of contamination;
- achieving concentrations in the groundwater to meet aquatic criteria.
- contamination extends into the bedrock to depths of about 15 metres and into the bedrock groundwater aquifers;
- site conditions are very complex for the project area due tidal loading effects, saltwater intrusion, and an extensive network of underground services that increases the difficulty of remedial efforts.

Spreading/migration of contamination is expected to continue and result in recontamination of the MEL, FN and EFL properties (referred to hereafter as properties) by the source properties and as well as adjacent and nearby impacted properties. A low permeability slurry wall can be installed to act as a barrier to the movement of contamination onto the property. However, contamination has also been identified in the deeper bedrock zones that represent a direct risk of concern to the brackish/saltwater aquifer water supply used for food grade operations. Values also represent risks to the marine environment and therefore, also represents a further potential risk to human health and wildlife through food chain consumption

Treatment of contamination in bedrock is:

- considered extremely more difficult and typically requires much longer time periods compared with soil remediation;
- with spreading/migration of contamination from adjacent source properties, that are not being remediated, adding to the difficulty of treatment as well and likely resulting in treatment becoming extremely long term; and
- achieving concentrations in the groundwater to meet aquatic criteria in consideration of the groundwater to surface water pathway.

Fractured bedrock sites are among the most complex of geologic formations because of their considerable geologic heterogeneity and the nature of fluid flow and contaminant transport through fractured media. Relative to most unconsolidated deposits, characterization of contaminant migration in fractured rock usually requires more information to provide a similar level of understanding. (See affidavit FN A-2582 in Appendix 106.)

For fractured bedrock assessment, an iterative and integrative approach is vital. (FN A-2584 in Appendix 107). Iterative means creating a conceptual model and testing the model with data, then revising the model as information is gathered. Integrative means using all the geologic, hydrologic, geophysical, and geochemical data to mutually constrain site interpretations. The assessment starts with desk top studies and moves through surface-based characterization then single-well (limited wells) and then multi-well characterization. Drilling of wells should be done iteratively with the information obtained from each hole being used to plan the location and activities for the next hole(s).

For hydrogeological studies in fractured rock, it is the discrete fracture pathways, rather than the total fracture network, which are important. To be of hydraulic significance, fractures must be both conductive and sufficiently interconnected to serve as part of a pathway. Only some subsets of open fractures will have active groundwater flow, and a small number of transmissive fractures may dominate. The challenge in application of characterization technologies is to locate the significant fractures and apply technologies in a way such that measurements properly reflect in-situ conditions. (FN A-2582 in Appendix 106). **Recognition that a limited number of fractures usually dominate the flow is central to an assessment strategy and rock matrix diffusion, that may significantly retard contaminate migration, requires that the rock matrix porosity and the porosity resulting from weathering and alteration around fractures is recognized applicably.** (FN A-2584 in Appendix 107). Understanding the site and the results of remediation efforts is an iterative and inclusive process. The distribution of contaminant mass in the subsurface and perceived need for short or long term controls are key factors in determining the most appropriate remedial technologies and targets.

Investigations have been relatively limited in the context of characterizing bedrock conditions in the Project Area in consideration of the design and assessment aspects of remedial groundwater treatment programs for the bedrock zone. As such, comments regarding treatment provided herein should be recognized as being of a preliminary nature and that further investigations and pilot testing are necessary in order to obtain a more comprehensive understanding of site conditions for remedial design and assessment of long term effectiveness. Based on investigations in the Project Area by ACER, Three-D-GeoConsultants Ltd., and Modern Well Drilling involving auger boring, air rotary well drilling techniques and downhole video recordings, both large and small fractures are apparent in the shallow and deeper bedrock, with fractures appearing to be more frequent in the upper portions of the bedrock, and finer grain rock below 10 metres.

Apart from pump-and-treat and its enhancements, there is very little experience with other technologies. Many of the innovative technologies being applied in unconsolidated deposits are now also under consideration and testing for application at fractured-rock sites. However, the primary concern with implementing test studies of innovative technologies is the uncertainty in having a sufficient monitoring network to adequately assess the success/failure of technologies implemented. (FN A-2582 in Appendix 106).

Pumping and treating groundwater is the most common technology for hydraulic containment. **To the degree that contamination is contained within accessible fractures, the existence of discrete fracture pathways can be a positive factor for remediation. If the relevant fracture pathways are sufficiently permeable and connected, contaminated groundwater can be readily extracted by pumping. Conversely, the lack of fracture inter-connectivity is the major limiting factor to a successful pump-and-treat system.** (FN A-2582 in Appendix 106). **There appear to be some discrete fracture zones for the site that may be beneficial in this regard.**

Pump and treat system design and implementation in bedrock is more complex than in overburden aquifers, because bedrock aquifers exhibit greater heterogeneity and anisotropy than overburden aquifers. These factors result in unpredictable well yields, which may vary by orders of magnitude due to spatial variability in fracture characteristics. Consequently, groundwater flow or fate and transport modelling is often not a useful tool for pump and treat system design. (FN A-2587 in Appendix 108).

The hydrologic complexity of fractured rock aquifers often requires extensive study, pilot testing, and optimization to design and operate an effective system. The location and construction of the extraction network and the location of the pump within extraction wells are critical in fractured bedrock applications. Aquifer testing is needed to understand the behaviour of fluid flow in the fractured bedrock. Unlike many groundwater extraction well networks in overburden with overlapping zones-of-influence, extraction well networks in fractured bedrock instead focus on fracture flow and communication. Accordingly, an extraction well network in a fractured bedrock setting may differ during the conceptual design stage. **With proper design, testing, and monitoring, pump and treat systems can be applied, with the understanding that the system is likely to be in long-term operation unless combined with other technologies or at sites with relatively low contaminant mass stored in primary porosity.** (FN A-2587 in Appendix 108).

Groundwater pump and treat methods can be augmented or enhanced with other techniques. **Techniques for LNAPL-only recovery can also be successfully applied in fractured rock settings.** The methods are similar to porous media applications and include active and passive skimming, hand-bailing, passive absorption (socks), and multiphase extraction (when targeted to remove LNAPL only). **The primary differences between LNAPL recoveries in fractured rock compared to porous media are related to how groundwater and LNAPL migrate in the subsurface. LNAPL may be present and recoverable in multiple fractures, which may require targeting discrete fracture features with specifically screened vertical, horizontal, or angled wells**.

Groundwater treatment may be enhanced by fracturing of the bedrock, with blast fracturing being preferred over hydraulic or pneumatic methods. (FN A-2582 in Appendix 106)

Air sparging (in contrast to vapour extraction) is generally not widely applied in contaminated fractured rock. Air bubbles may exhibit a greater tendency to coalesce in fractures and bypass large portions of the treatment zone, particularly at sites characterized by vertically oriented fractures. (FN A-2587 in Appendix 108).

Applying surfactants/cosolvents in fractured rock aquifers is generally not recommended. Injected fluid preferentially migrates through highly transmissive, large-aperture fractures associated with secondary porosity, with little or no contact with NAPL in less-transmissive fracture zones, primary porosity, or matrix storage. In

addition, effective distribution and recovery of the surfactant/cosolvent is more challenging in a fractured rock environment due to heterogeneous and anisotropic fluid flow. (FN A-2587 in Appendix 108).

Chemical and biological technologies remediate contamination by transformative and destructive processes such as in situ chemical oxidation (ISCO), in situ chemical reduction (ISCR), in situ bioremediation (ISB), and various combinations of these technologies. As when using these technologies in porous media aquifers, the contaminant properties, geochemistry, rock matrix properties, and presence of organics and inorganics in the matrix are important factors in remedy selection and design. **Formation hydraulics, mineralogy, primary and secondary porosity, matrix storage, and fracture aperture size are considerations specific to fractured bedrock remediation for in situ technologies. For NAPL treatment, an additional challenge is that the NAPL-water interfacial area (which is exposed to reaction with chemical reagents and to microbial processes) is substantially lower than in granular porous media aquifers, and a greater proportion of the NAPL may be trapped in less transmissive fractures. This condition can significantly reduce overall treatment effectiveness.** (FN A-2587 in Appendix 108).

Permeable reactive barrier zones (PRBZs) can be constructed in fractured bedrock aquifers. For this method, a reactive material is injected into existing or induced fractures. Both ISCO and ISCR can be applied as PRBZ containment remedies. Each approach can also be applied as a source-area remedy, targeting NAPL within transmissive fracture zones using a more aggressive (but shorter-lived) reagent (FN A-2587 in Appendix 108). Significant considerations for bedrock applications include reagent lifetime and distribution of the reagent through less transmissive primary porosity and matrix storage domains. **Some of the design considerations such as potential alteration of the groundwater flow regime also apply to source area applications.** Additional considerations for source-area remedies specific to bedrock include the following:

- dispersion may be successful in transmissive zones but resulting contact time may be limited by the rate of groundwater flow;
- in bedrock the reagents primarily contact fracture faces, rather than permeate intergranular primary porosity, and the corresponding rock surface area exposed to react with the oxidants or reductants is much lower, therefore, as a result, particularly with reagents injected as liquids, oxidant or reductant demand must be carefully considered to mitigate risks associated with adding too much reagent;
- **back-diffusion of dissolved contaminants from less-transmissive portions of primary porosity or from matrix storage domains remains a significant area of concern in bedrock;**
- in fractured rock, the interfacial surface area of NAPL droplets or pools exposed to reaction with the oxidant is much lower than in granular aquifers, and NAPL may be trapped in less-transmissive fractures with little or no exposure to oxidant, and a lack of exposure to the oxidant reduces treatment efficiency and potential effectiveness, particularly for short-lived oxidant systems.

Special challenges unique to In-Situ Bioremediation in fractured rock include the distribution of microbial fauna between groundwater within fractures and the primary porosity of the fractured rock matrix and the potential effect of biofilm growth on groundwater flow in transmissive intervals. Stimulated biofilm growth on fracture surfaces resulting from injection of a carbon amendment may also reduce fracture transmissivity, affecting groundwater flow patterns within transmissive fracture zones. (FN A-2587 in Appendix 108).

Literature on hydrocarbon degradation in extreme hypersaline media presents studies that point to a negative effect of salinity increase on hydrocarbonoclastic activity, while several others report an opposite tendency. Despite the fact that microbial ability to metabolize hydrocarbons is found in extreme hypersaline

media, it is apparent that some factors are critical for the occurrence of hydrocarbon degradation in such environments. (FN A-2586 in Appendix 109).

Fracture-controlled groundwater flow in bedrock can be much faster than typically observed in overburden aquifers. This factor must be considered when evaluating remedial technologies, and especially when evaluating technologies that rely on fluid flow, such as injection of a soluble chemical or biological reagent. The much smaller rock surface area exposed to reagent interaction in bedrock aquifers relative to granular overburden aquifers strongly affects characteristics such as oxidant demand and pH shifts. This reduced surface area is significant for technologies such as in situ chemical and biological methods, which require injection of a reactive reagent. The differences in reactivity associated with surface area also affect reagent transport. The reduced surface area exposed to reaction may translate to less degradation or reaction of a reagent, which therefore results in increased reagent transport. As a result, injected reagents may be transported far greater distances and in far shorter time frames in fractured bedrock aquifers than in granular overburden aquifers. At sites where groundwater discharges to surface water (by springs, for example) or other receptors, the risk of reagent discharge must be evaluated. (FN A-2587 in Appendix 108).

NAPL present in fractures has significantly less water interfacial area than in granular aquifers, and NAPL saturation (the amount of NAPL present relative to fracture volume) tends to be higher in less transmissive fractures. This condition generally reduces the effectiveness of remedial processes that rely on NAPL dissolution or on chemical and biological reaction. (FN A-2587 in Appendix 108).

From the above, it can be appreciated that the use of reagents to enhance/augment groundwater pump and treat for the bedrock zone, including ISCO, ISCR and PRBZ containment remedies, but interference with or change in biofilm growth resulting in a potential change to fracture transmissivity, affecting groundwater flow patterns within transmissive fracture zones, potential alteration of the groundwater flow regime, discharge of reagent to the marine receiving environment if there is less degradation or reaction of reagent due to smaller rock surface area uptake are factors that require careful consideration and testing to determine if these methods can be applied effectively.

Based on the information on site characteristics gathered by ACER to date a groundwater pump and treat system is considered to be a favourable approach to remediating groundwater in the bedrock. Additional critical factors to the length of time necessary to operate a remedial groundwater pump and treat system is whether or not the owners of the adjacent and nearby properties that are the apparent sources of contamination to EFL, MEL and FN properties continue to do nothing and the complexity of site conditions. The provincial and federal governments do not appear to be taking any action to ensure the owners are remediating the sites and preventing any risks to the environment. However, sampling by ACER between 2009 and 2019 (A-291 in Appendix 7, A-292 in Appendix 8, FN A-942 in Appendix 30, FN A-944 in Appendix 9 and 1292 in Appendix 118) indicates **concentrations for petroleum hydrocarbon contaminates exceed provincial and federal criteria for human health related risks associated with well water supplies and thereby are also problematic for the brackish/saltwater aquifer utilized for site operations in recognition that petroleum contaminates are present and problematic for food grade operations in consideration of human health risks** and risks to the ecological environment including the marine receiving environment and land based ecology.

As indicated previously, efforts to carry out remediation on individual properties requires consideration of potential for influencing contamination movement and and/or remedial efforts on or from adjacent or other nearby properties. **It is critical that any remediation effort be implemented in a manner that avoids spreading of contamination resulting in cross-contamination and/or recontamination of multiple properties. Site conditions for the project area are somewhat complex and this further complicates any remedial efforts.**

Further to the above, with respect to carrying out remediation of the individual properties by means of excavation and off-site disposal/treatment of impacted soils (including completely too highly weathered bedrock), groundwater treatment issues still remain. Groundwater pump and treat involves creation of a zone of drawdown influence and it is necessary to design the system to avoid drawing contamination across multiple properties and/or causing temporary displacement of contamination and subsequent re-contamination of a property (ies). Several consultants who are familiar with the area, including the IOL consultant recognize the complexities of the site and potential for spreading of contamination and that an integrated/coordinated remedial system for groundwater treatment should be designed to address contamination on all of the affected properties collectively.

With regards to the widespread contamination in the harbour area, it was indicated by Three-D GeoConsultants Ltd. in Affidavit document A-285, Appendix 80, "that the past and current remediation programs will have little or no effect unless a wider area is covered and thus if clean-up is to be done, it should include all peripheral properties where contaminates are detected."

It is indicated in a letter dated March 25, 1997 from Tom Gallagher of Jacques Whitford Environmental Limited (DFO consultant) to Claude Burry of DFO (A-83 in Appendix 20) that;

"The testing revealed that these 2 abandoned pipelines did not pass testing and were suspected of having been leaking during their operating life." And further indicated that "DFO clean-up activities should be part of a joint clean-up effort which includes all impacted property owners."

The IOL consultant ARC, April 1998, report, A-117 in Appendix 28, for investigations carried out on the former CN Right of Way (now owned by the Town), about 80 metres down gradient of the former IOL bulk plant property where the abandoned underground IOL petroleum transfer lines are located, indicated:

"The dissolved hydrocarbons occur more widely, as would be expected due to groundwater movement and tidal fluctuation effects, FIGURE 3). Dissolved hydrocarbons occur in highest concentrations in the same zone as defined for the residual hydrocarbons.

The groundwater flow indicates a gradient of 0.0015 is operative to the west, (0.0015 between MW2 and MW1), (FIGURE 4). This groundwater flow direction may be influenced by the pumping of remedial wells on the IOL Bulk Plant site or alternatively, through the pumping of any local wells, which extract fresh or saltwater for processing.

The groundwater flow across the site must be considered as having potential to change due to the small differences between the water elevations in the wells. With such small elevation differences, tidal loading could easily cause localized flow to change direction. The orientation and occurrence of both the dissolved and residual plumes appear to indicate that changes in the direction of groundwater flow have taken place. These changes may occur due to high tides and/or high recharge events (spring and fall) or local well pumping. If these changes only occur at specific times of the year, and are only in force for short time spaces, then the spreading of the plume would be limited and may to some degree reverse itself at other times of the year."

An assessment of Harbour Contamination was carried out by Three-D GeoConsultants Ltd. in 2002 on behalf of Eastpre Feeds Ltd., (Affidavit document A-285, Appendix 80), showed the estimated extent of the hydrocarbon plume in the soil and groundwater in Figures 3 and 5 (of that report), respectively, that showed contamination extending to the marine environment. The assessment showed the footprint for contamination in soil and groundwater to encompass the SCH/DFO/DNR properties with the IOL bulk plant, former IOL CN Rail tanker car off-loading area, former CN ROW/driveway and the EFL/FN/MEL properties. The report identified a number of variables that influence the spread of contamination related to geology, groundwater influences, contaminate characteristics, and pumping of commercial and private water supply wells and remedial wells. TDG further commented that "The area has not been subjected to a comprehensive examination of the entire potential area for contamination nor as it appears has the tidal effects of the area been considered. Both items would be of extreme

importance if any type of clean-up is contemplated." TDG also commented concerning the "effectiveness of remedial action plans and remedial facilities in place at the present time (IOL and DNRE/DFO)". Several potential concerns were identified:

- Whether or not the efforts to remedy contamination of the area have been premature (Premature Remediation), and if so, this ultimately leads to re-contamination of the whole area due to the number of complex variables involved within the locality and.
- Whether or not the efforts to remedy contamination of the area have been premature (Premature Remediation), and if so, this ultimately leads to re-contamination of the whole area due to the number of complex variables involved within the locality: and
- If contamination has been proven to be depleted on a subsequent property, have the contaminants actually been removed from that site or have the contaminants simply been displaced from one site to another?
- Recognition of land use as being sensitive or non-sensitive for affected properties (including source properties and adjacent properties that have been impacted by the source properties) and whether or not:

  - a more effective remedial plan/design should be implemented for each contaminated site or;
  - an alternative remedial action plan be implemented for "total decontamination of all contaminated properties".

ACER, May 21, 2017, A-1877 (internal reference not included in an appendix), it is indicated that the intrusive sampling program showed that the bedrock has extensive vertical and horizontal fracturing with large fractures evident. The bedrock surface ranges from 1.8 to 4.0 metres below surface grade. This provides for a more direct pathway for flow of contaminated groundwater from the shallow groundwater flow system (overburden) into the bedrock system and spreading of contamination. Combined with the zone of pumping influence associated with the operation of remedial wells installed into the bedrock for individual properties, there is increased potential for spreading of contamination and cross-contamination of properties if pumping operations are not coordinated-integrated.

Spreading/migration of contamination over large areas is a major factor for the project area, with several conditions existing that promoted migration/spreading of contamination in combination with long term delays in clean-up being initiated including remediation systems, no implementation of remedial system and ineffective remedial system to address contamination in soils above the water table that provide a long term persistent source, and incomplete remediation.

Extensive Network of Multiple Underground Services Providing Preferential Flow Pathways

Preferential Flow Pathways are defined in Provincial guidelines as "Means by which contaminants may migrate faster or easier than through soil leaching or bulk transport processes (e.g., culverts, trenches, ditches, sewer lines, pipelines, swales, cabling etc.)." The presence of preferential flow pathways including but not necessarily limited to water supply, storm water and sewer lines as well as ocean discharge lines from the fisheries operations, gravel sub-base for street construction acting like a French drain (as indicated by an IOL consultant) and fractured bedrock zones are important factors to be assessed and if present, to consider the implications of this in the assessment with respect to movement of contaminates off site. An extensive network of multiple underground services are located in the project area, connecting and extending across multiple properties and as such contribute to spreading of contamination over the entire project area including the marine environment (petroleum hydrocarbons reported in sediments and surface water between 1975 and 2013).

With respect to streets, the granular sub-base materials for the street and placement of piping combine to provide a very significant preferential flow pathway for contaminates, and this situation is very evident for this project . **The IOL consultant ARC January 9, 1993, A-481a (Appendix 24) indicated:**

"This street appears to act as a groundwater sink as the three monitoring wells to the southeast of 14th Street flow towards the northwest. The groundwater contour centred on MW13 also indicates that there is a groundwater sink between 14th Street. It is likely that the installation of services such as sewers and water mains and the ensuing backfill with coarse material may in fact act to provide a "french drain effect" along the pipeline. This could account for the apparent observed groundwater data."

ACER has drawn similar conclusions.

It is expected that any groundwater pump and treat operations on the EFL, FN and MEL properties or other adjacent properties would also have an influence on contaminate migration and spreading along preferential flow pathways.

Several Commercial Water Supply Wells and Remediation Pumping Influence

It is expected that should IOL reinitiate remedial activities that when operational, that the three pumping wells installed into the bedrock as part of remediation for the IOL Bulk plant and wells installed for the DFO/CN ROW (transferred to DNRE and then to Town) properties at the northern end of the FN and MEL properties would have an influence on groundwater flow, and more specifically it is critical to note that these wells would also be expected to draw contaminants into the groundwater aquifers in the bedrock zones. ARC, April 98, A-117 in Appendix 28, indicated that with respect to groundwater flow in the area of the DFO/CN ROW adjacent to the FN and MEL properties that "this groundwater flow direction may be influenced by the pumping of remedial wells on the IOL Bulk Plant site or alternatively, through the pumping of any local wells, which extract fresh or saltwater for processing.".

Craig HydroGeoLogic Inc. assessed the groundwater capture area for the MEL and FN reflected by a pumping rate of 250 GPM for FN operations (operational range from 200 to 350 GPM) and it was indicated that contaminated groundwater on the IOL, EFL, FN, MEL, former CN Rail and other adjacent and nearby properties would be drawn to the potable water wells. This would contribute to spreading of contamination over the entire project area. It is critical to note that this would also be expected to draw contaminants into the groundwater aquifers (several zones identified between 4 metres and 15 metres with petroleum hydrocarbons reported) in the bedrock zones.

The Town commercial water supply wells have been reported to have an influence on groundwater flow in the project area. It is critical to note that historically one of the town wells would also be expected to draw contaminants into the aquifers in the bedrock zones.

Tidal Loading Effects

Tidal loading" causes groundwater levels to change within the soil and bedrock zones for inland areas near the shoreline. Of specific relevance is that during rising tide the groundwater elevation will rise due to "blockage of discharge" to the sea. This blockage may cause increased spreading of contamination to adjacent areas, and spreading can be expected to be further increased due to the presence of preferential flow pathways associated with underground services as well as pumping influences from commercial water supply wells and remedial pumping wells. The spreading of contamination due to tidal loading effects alone across the Project Area (extends from shoreline to the westerly side of the IOL bulk plant property) makes it more challenging to implement an effective remedial program. It was evident from ACER investigations that Tidal loading effects extended across the MEL, FN, EFL and IOL bulk plant property as well as other adjacent and nearby properties.

General Groundwater Flow Toward Shoreline

The Shippagan wharf area, which also includes the affected properties for the Project Area for this assessment, is very flat and only a few feet above high tide. General groundwater flow for the Project Area is towards the shoreline of the bay even though underground services and structures such as building foundations are expected to have some localized influence. As indicated by Doug Craig in FN A-2721 in Appendix 111, "An examination of a property map shows the spatial relationship of the individual properties, the IOL bulk plant property is located further inland from the seacoast than portions of the FN Pecheries Ltee., Property (FN), the Marine Extract Limited Property (MEL) and the Eastpre Feeds Ltd property. This spatial relationship will result in a net groundwater flow beneath the IOL property and moving beneath the FN, MEL and EFL properties, towards the sea. Any dissolved groundwater contaminates will move with the groundwater flow."

Groundwater flow contours are shown in Figure 3-4 (also in Appendix 73) for a monitoring event on May 18, 2017, for a high tide cycle represented by a lower end of the range for the high tide cycle. It is important to note that groundwater flow conditions are consistent with conditions previously reported by the IOL consultants for investigations for the area between 1989 and 2004. Groundwater flow occurs from the IOL bulk plant property in all directions;

- northerly onto the EFL property and residential properties;
- southerly onto 14th St. (Town property) and the Enterprise Shippagan Ltd. property;
- westerly onto several commercial and institutional properties;
- and easterly onto the FN and MEL properties and former CN Rail ROW (Town property that is also used as a driveway and contains the two IOL underground petroleum transfer pipelines), 15th St. (Town property) and SCH/DFO property, ultimately discharging to the harbour.

Monitoring carried out by ACER and the IOL consultants show groundwater flow gradients favour roadways with underground services including 14th St. and the former CN ROW located between the FN and MEL properties, and are representative of preferential flow pathways. Groundwater contours show flow occurring from the IOL bulk plant property toward 14th St. and continuing onto the former CN ROW/driveway area between the FN and MEL properties with flow components occurring onto the FN and MEL properties. Contamination identified in association with the two underground gasoline lines located within the former CN ROW, reported to be "suspected of having been leaking during their operating life" circa 1938 by an IOL consultant, would also spread across the FN and MEL properties as well as onto the SCH/DFO property, and ultimately discharge into the harbour. Flow also occurs along the former CN ROW between the FN and MEL properties that is in a landward direction from the SCH/DFO property with flow components occurring northerly and southerly onto the FN and MEL properties, respectively.

Water supply, storm and sewer lines as well as saltwater lines and effluent lines from FN fisheries and other operations extend under the buildings, thereby also providing for preferential flow and increased spreading of contamination under the buildings and across properties. This results in broad spreading of contaminated groundwater that is further exacerbated by historical water supply pumping operations associated with the FN operations as well as a Town municipal well, nearby wells for ice plant operations and IOL remedial pumping wells on the IOL bulk plant property and former CN ROW and SCH/DFO properties that also influence groundwater flow.

As indicated previously, groundwater on the IOL bulk plant and rail spur petroleum offloading facilities flows to the shoreline with preferential flow afforded by the former CN ROW/driveway. It was indicated in a May 2, 1997, (A-

87, in Appendix 43) NBDELG occurrence report on a wharf oil spill that a lobster fisherman reported petroleum sheening at the Old North Wharf at 8:00 in the morning and the coast guard investigated and reported that the petroleum product was coming from the rock around the wharf and notified DELG at 2:00 in the afternoon. An NBDELG inspector went on site on May 5, 1997 at 11:00 in the morning and checked around the end of the line formerly used by IOL. The inspector reported that "There is quite a sheen, its hard to tell since I'm standing maybe 20 feet above water level but in some places it looks like it's thicker than the usual rainbow. It is indicated in the occurrence report that on April 4, 1998 a meeting was held with all parties involved and it was indicated that IOL will try and schedule clean up in July. This further supported that contamination was reaching the harbour with the CN ROW/driveway providing for preferential flow.

During drilling of monitoring well 19MW150, located about 5 m from the corner of the wharf and adjacent to an underground storm discharge line, there was a loss of downhole water pressure at approximately 4 metres depth. Within several minutes, a cloud of brown water was observed to be discharging from the storm line located at the corner of the wharf that spread across the inner harbour and persisted for several hours (see Photos in Appendix 100). This supports that the underground lines and road construction also provide a direct preferential pathway for release of contaminated groundwater to the harbour in addition to normal groundwater flow to the marine environment.

The FN as well as MEL, IOL former CN rail line offloading area and CN ROW/driveway, Town Streets and the SCH/DFO wharf properties are all located between the IOL bulk plant and the shoreline. Given that soil and groundwater contamination on the former IOL bulk plant for 2016 sampling by ACER is still similar to initial investigations by the IOL consultant between 1989 and 1992, and no remedial work is being carried out on the IOL bulk plant property and other impacted properties, it is expected that **contaminated groundwater** associated with the properties **would be expected to continue to spread across all of these and other down gradient (may also be referred to as downstream) properties, and would be further influenced by any remedial pumping operations carried out on the EFL, FN and MEL properties**.

Lack of Action and No Action to Remediate

Lack of action by IOL in implementing clean-up measures provided an opportunity for contaminants to continue to migrate/move off site. Documentation shows that the DELG (note that NBDELG, DOE and DELG are the same) has continually had non-compliance issues with IOL (1989 trough to 2016) regarding the petroleum hydrocarbon associated with the IOL bulk plant property, including non-compliance with the Ministerial Order in regards to the initial assessment of the extent of contamination in the soil or groundwater, inadequate and incomplete installation/implementation of remedial systems/measures and on-going reporting and maintaining effective remediation measures. See Section 1.4.

Contaminated soils on the IOL property were never remediated and represent a long term persistent source of contamination to the IOL bulk plant and other adjacent and nearby properties. A VES was not installed until the fall of 1994, but it was only connected to BH6M and BH8M (Affidavit document A-550 a, Appendix 69). In this instance, treatment of impacted soils would be very localized and therefore the effectiveness would be extremely limited in the context of the extent of petroleum hydrocarbon impacts reported across the site to be treated (Affidavit document A-291 in Appendix 7). The footprint for soil contamination identified by the IOL consultant ARC, 1992 (A-450 in Appendix 101, A-493 a in Appendix 67 and A-494 Appendix 82) covered most of the bulk plant property (see Acer Figures 4-9 and 4-10). However, no investigations were carried out inside the containment dikes to define the soil contamination footprint. ACER 2016 investigations on the IOL bulk plant property included sampling inside and outside the dikes and confirmed that contamination was significant across

the entire property (see FN A-1292 in Appendix 118). Concentrations inside the dikes were comparable to values outside the dikes, but it was noted that the highest petroleum hydrocarbon concentrations in the soil and groundwater were obtained outside the diked areas. **These impacted soils would provide a long term persistent source of contamination to the groundwater zones that would move off site and spread to adjacent and nearby properties.** It appears that IOL discontinued groundwater pump and treat operations circa 2011 based on ACER observations that no electrical power being supplied to the facility.

Given that IOL appears to have discontinued remedial efforts circa 2011 and contamination levels obtained by ACER in 2016, FN A-129 in Appendix 118, for the soil and groundwater on the IOL bulk plant property continue to be similar to that obtained by the IOL consultant between 1989 and 1992 (almost 20 years ago), it is expected that contamination would continue to migrate and spread off-site and any remedial pumping carried out on the EFL, FN and MEL properties would further influence movement off the IOL bulk plant site and onto the EFL, FN and MEL properties, and require an extremely long time period for remediation to achieve provincial and federal guidelines in consideration of the marine receiving environment.

Contamination in Groundwater in the Overburden Soils and Shallow and Deeper Bedrock Groundwater Aquifers

Petroleum hydrocarbon contamination was identified in the groundwater in the overburden soils and underlying completely to highly weathered and fractured bedrock and deeper bedrock zones on the IOL bulk plant property, former IOL CN rail spur petroleum offloading facilities, SCH/DFO and FN and MEL (with the FN food grade water supply well showing elevated concentrations) and other nearby properties.

A letter was provided from ARC to Chris Clinton of IOL that is dated September 12, 1994 (ARC, A-531 in Appendix 119) concerning the detection of **free phase product including fuel oil at MW5D and MW5S**. Monitoring Well MW5D was installed in March, 1993 as a deeper MW in the bedrock to further assess groundwater conditions. Monitoring well MW5D established as a deep well in the bedrock (5 to 6.5 m into the bedrock) showed free phase product during sampling in May, 1994. It was indicated that "This well is screened approximately 5.00 m below the water table depending on the time of groundwater table measurement. This means for product to enter the well, it had to be present at some depth of below the water table." It was also indicated that "The change in hydrocarbons from gasoline or combined gasoline/fuel oil to fuel oil is also of concern." The depth of the groundwater remedial pumping wells ranged from about 5.8 to 7.62 metres into the bedrock. Detection of free phase product and contamination in MW5D and MW5S is most likely the result of remedial pumping operations and/or additional petroleum spills. **It is also possible that pumping operations may have resulted in mobilization of contamination in bedrock fractures as a consequence of back-diffusion of dissolved contaminants from less-transmissive portions of primary porosity or from matrix storage domains. As indicated previously this remains a significant area of concern in the contamination and remediation of bedrock**.

Three-D GeoConsultants Ltd. July 12, 2001, A-281, Appendix 4, it is indicated that during drilling for MEL water supply wells four levels of petroleum contamination were encountered to the 44 ft. depth as indicated on Pages 11 and 41 (14 to 16 feet, 20.5 to 21.5 ft., 38 plus/minus, to 44 plus/minus ft.). The presence of contamination at depths of 14 metres in the bedrock at this distance from the IOL bulk plant site necessitated ACER drilling a number of wells into the deeper bedrock in order to assess conditions in accordance with regulatory requirements. A water sample from the FN water supply well collected by ACER in April 2011 showed all BTEX and the TPH exceeded the RBCA Tier I and CCME potable water criteria. Toluene, Xylene and TPH exceeded the RBCA Tier I criteria for non-potable water as well.

As indicated, based on ACER investigations in the Project Area, both large and small fractures are apparent in the shallow and deeper bedrock. For hydrogeological studies in fractured rock, it is the

discrete fracture pathways, rather than the total fracture network, which are important. To be of hydraulic significance, fractures must be both conductive and sufficiently interconnected to serve as part of a pathway. Only some subsets of open fractures will have active groundwater flow, and a small number of transmissive fractures may dominate. The challenge in application of characterization technologies is to locate the significant fractures and apply technologies in a way such that measurements properly reflect in-situ conditions. (FN A-2582 in Appendix 106).

Rock formations can have both secondary and primary porosity. Secondary porosity, the result of chemical leeching of minerals or the generation of a fracture system, is the primary source of fluid movement in rocks. The network of interconnected fractures (and solution channels in the case of karst) allows fluid movement through rock formations with very low primary porosity. Dissolved contaminants and fluids will generally spread through fracture networks. (FN A-2583 in Appendix 120.)

Primary porosity is the ability of the rock matrix to accept and transport fluids. **Poorly cemented sandstones have relatively high primary porosity and will allow fluids to move through them, as is the conditions for the impacted zones.** Rock with a crystalline matrix, such as granite, will not readily transport fluids, and the matrix acts as a barrier to water and contaminants. **The primary porosity of a rock is also important to fate and transport considerations in that the more porous a rock matrix is, the greater the potential for dissolved contaminants to diffuse into it.** (FN A-2583 in Appendix 120) Shales (also identified for the site), for example, whose matrix comprises primarily clay and silt particles, are moderately impermeable to water flow through the matrix but still have sufficient porosity to allow for the diffusion of contaminants into the matrix (FN A-2585 in Appendix 121). This **diffusion is an important consideration in the construction of a conceptual site model and selection of a site remedy because the contaminants in the rock matrix could become a contaminant source zone if the concentration in the fractures falls below the concentration of contaminants in the rock matrix.** (FN A-2584 in Appendix 107).

With respect to Matrix Diffusion, matrix is defined as a mass of fine grained and/or fractured rock, enclosing the main water bearing features. The matrix has a lower permeability than the main water yielding horizon or fracture, but consists of the biggest mass of rock and therefore stores the largest volume of groundwater. Water is transferred from the matrix to the fracture or high permeability zone when abstraction takes place. Flow of groundwater through such fractures can require a long period of time over relatively short distances even with high pumping rates.

The distribution of contaminant mass in the subsurface, and the perceived need for short or long term controls, will determine the most appropriate remedial technologies and targets. Therefore, conceptual models must reflect the most likely distribution of contaminants as well as the transport processes controlling that distribution. This makes it possible to consider both current and future contaminant impacts under different remediation scenarios, and to identify the mass that is most likely to be limiting to clean-up. Dissolved contamination migrating with advecting ground-water in fractures typically represents the fastest pathway and primary transport pathway of concern. However, it may comprise only a very small portion of the total mass. Contamination may be sequestered within the rock matrix, on fracture coatings, in NAPL zones, or within poorly connected fractures. Over the long term, such sources control ground-water contaminant conditions and the need for on-going remediation. Discrete fracture pathways and matrix diffusion for contaminant fate and transport are important aspects in the remediation of contamination. (FN A-2582 in Appendix 106)

The direction and the rate of fracture-matrix exchange depend on the relative concentrations of the solute in the fracture and the matrix as well as the amount of surface area available for this process. Once a solute has

diffused into the matrix, it may absorb onto pore surfaces, and the surface areas of the matrix pores are many times larger than the surfaces of fractures. **The majority of the solute may be in the matrix pores.** (FN A-2584 in Appendix 107). **The amount of solute that enters the matrix pores is expected to increase with longer periods of exposure to the solute/contamination, and would be expected to result in a longer time frame for remediation.**

Matrix Diffusion is defined as the transfer of solutes from the main groundwater conduits to the surrounding rock matrix by means of diffusion. The description of Matrix Diffusion is given as the movement of solutes from fractures to the rock matrix due to a concentration gradient. **Matrix Diffusion is indicated to be important because, when contaminants are being diffused into the matrix, the rehabilitation and remediation of the aquifer is made increasingly more difficult with residence time of the contaminant.**

Matrix porosity may act as a persistent reservoir that can slowly release contaminates after a site appears to have been cleaned up. For similar reasons, matrix diffusion can cause pump and treat efforts to be misleading, where the water appears to be clean, only to be re-contaminated by diffusion back from the matrix, (FN A-2584 in Appendix 107), into the fractures.

Matrix diffusion is a significant mechanism by which contaminants may enter a rock matrix with appreciable pore space, such as sedimentary rocks, as present on the site. After the contaminant has diffused into the rock matrix, the process of diffusion works in reverse (which is called "back-diffusion") and releases the contaminant stored within the rock matrix back into the fracture. Back-diffusion is a dynamic phenomenon, causing the passing plume to persist at a point of observation, albeit at a relatively low concentration, longer than it would otherwise, even if the contaminant is removed from the fluid within the fractures. This process increases effective plume longevity and, if not accommodated, can greatly delay remediation time frames. If, however, the flow in the fracture is very high relative to the flow in the secondary porosity, fractures, the back-diffusion may be diluted to such an extent not be an issue. (FN A-2587 in Appendix 108).

Organic carbon may line fractures (secondary porosity) or may occur within the rock matrix (primary porosity). Organic matter affects fate and transport and ultimately the remediation of a contaminant, for the following reasons:

- Organic matter retards contaminants so that the rate of dissolved-phase contaminant migration is less than the groundwater velocity.
- Over time, the mass of contaminant in the rock matrix can be greater than in open fractures.
- The time required to remediate the site may be controlled by desorption from organic carbon in the rock matrix and back-diffusion of the dissolved-phase contaminant. Higher organic carbon content in the rock matrix prolongs the time frame for removing the contaminants.
- Organic carbon is more likely to occur in sedimentary rock, as occurs on the Project Site.

Removal of contamination from bedrock zones requires "flushing" of the impacted zone in order to remove contaminated groundwater in the open fractures with active groundwater flow, transmissive fractures, and the rock matrix. Continuous flushing is necessary over a long period of time in order to allow contamination to be removed from the fractures by advection, capillary flow, dispersion and diffusion, that also allows for the desorption of contaminate from the sides of the fracture walls and rock matrix.

As indicated previously, for fractured bedrock assessment, an iterative and integrative approach is vital, much more costly compared to unconsolidated media/soils, and time consuming, involving various investigation techniques and pilot testing (such as single and multi-well pilot testing and subsequent additional

iterative/integrative assessment and implementation as the number of wells increase if/as required based on on-going assessment).

It is understood that financial lenders are not prepared to invest in a venture that is subject to risks and liabilities associated with a contaminated site. Not withstanding this, any delays in operation of a venture also has an associated loss of revenue and profits, another limiting factor to financial lenders. On the basis of the above being the driving factors, the preferred approach to remediation would be clean-up of the properties as expediently as possible. ***It can be appreciated from the discussions provided above that achieving a clean site in the most expedient time frame possible will be complicated, difficult and costly due to the following:***

- the complexities of remediating groundwater in fractured bedrock;
- the significant time frames expected to treat contaminated groundwater in the bedrock zone;
- that remediation is further complicated given the fact that properties representing the apparent source(s) of contamination have been known to be impacted almost thirty years and likely longer, thereby increasing the significance and extent of impacts to the bedrock zone and representing a long term persistent so;
- saltwater intrusion and tidal loading effects;
- the EFL/FN/MEL buildings are large with footprints that cover most of the properties and places constraints on remedial approaches if the buildings are to be left in place and would significantly add to costs if the buildings are demolished in order to implement an effective and efficient remedial program;
- the owners of the properties representing apparent sources are not carrying out any clean-up efforts and significant contamination of soil and groundwater is present and represents a long term persistent source;
- regulatory agencies have apparently not taken any enforcement action to have the owners clean up their properties or other adjacent and nearby properties that have been impacted by contamination originating from the apparent source properties, and migration/spreading of contamination to adjacent and nearby properties is expected to continue;
- the further increase in the significant time frames expected to treat contaminated groundwater in the bedrock zone given that no remedial work is being carried out on apparent source properties; and
- the added complexities of the area including tidal loading influences, an extensive network of underground services providing preferential flow pathways for contaminates and seasonal influences that contribute to migration and spreading of contamination.

Additional investigations involving various techniques would be essential in developing a remedial design and associated cost estimate to remediate the properties in consideration of the groundwater in the bedrock zone in particular. The state-of-the practice for fractured rock as a distinct subclass of contaminated sites is being developed, although experience with characterization technologies is generally more advanced than that for many remediation technologies. Geological characterization at fractured rock sites includes use of conventional techniques such as outcrop mapping, fracture trace analysis, drilling, coring, and, more recently, increased use of borehole geophysics. (FN A-2582 in Appendix 106). It appears that the only technique used to characterize the bedrock zone on the contaminate source properties was by means of auger borings and historical geological maps which provides limited information. The occurrence of fracture systems may be indicated based on reduced difficulty of auger advancement and/or the auger cuttings becoming wet, being typically indicative of water bearing fracture zone. Investigations by ACER in 2016 included downhole video. Several downhole video

stills showing the extensive and significant fracturing in the bedrock are provided in Photos 3-15 to 3-18 for 16MW20A located on the IOL bulk plant and adjacent to 14th St. and Photos 3-16 to 3-19 for 16MW 22B located about 140 metres down gradient of 16MW20A and are also included in Appendix 72. A downhole video was taken in 2000 and it is reported that oil like globules were evident in the water column (A-57, Appendix 32 is provided as a digital video included as a separate digital file that can be opened using the open source video program "VLC media player"). A still photo at time frame 14h18m17s247 from the aforementioned video and a photo of a water sample collected during purging of the well are provided in Appendix 99. A cross section of the overburden and bedrock conditions is provided in Figure 3-2, also included in Appendix 72. Photos taken during rehabilitation of underground services by the Town that show the overburden and bedrock conditions as well as petroleum sheening and staining in the soils and groundwater are provided in Photos 3-1 to 3-14 (also included in Appendix 72).

Cores are collected to provide information on site geology and physical samples for laboratory testing including porosity testing to assess matrix diffusion, and visual observation of contaminants in the rock matrix. When core recovery is sufficient, fracture characteristics can be determined directly. However, it is very expensive to collect oriented cores to establish the dip and strike of the fracture features; and it may also be very difficult to ascertain if the fractures are not caused by the drilling itself. The presence or absence of fracture oxidation and weathering, and fracture fill or coatings, can provide direct indications of likelihood of ground-water flow. However, fracture zones, which are of most interest for investigations, are poorly recovered from core samples. **Zones of potential importance for ground-water flow frequently correspond to rubble zones or lost sections of core.** Therefore, drilling and coring are often followed by use of geophysical borehole logging to provide more information on fracture zones. (FN A-2582 in Appendix 106). Flow logging or packer testing can be carried out in a borehole to identify/confirm conducting fractures/features.

Surface geophysical methods (DC resistivity, electromagnetics, and ground-penetrating radar, seismic) are typically used in conjunction with other remote methods early in the site investigation process to assist in locating and defining the geologic contacts, structural features, and location and orientation of fracture sets. Because these methods are non-intrusive, this avoids some of the risks of drilling, such as cross-contamination and DNAPL remobilization. However, these methods may be limited to fairly large-scale resolution. Also, the application of these methods can be hampered by structural interferences, such as utilities, pipes, overhead wires, buildings and pavement. This provides a limitation which makes these methods inappropriate for some sites in urban areas and where active facilities are situated. In addition, these methods use can also be limited by the presence of significant unconsolidated deposits overlying bedrock. (FN A-2582 in Appendix 106).

Conventional wireline logging methods, such as caliper, fluid logs (temperature, conductivity), EM conductivity, and gamma logs, are the most commonly used geophysical tools. Borehole applications have expanded to include improved methods of imaging the borehole and identifying which fracture zones have active flow. More recent techniques are television/televiewer (downhole video) methods (acoustic and televiewer) and flow metres (heat-pulse and EM). Technologies being introduced circa 2001 included digital borehole imaging methods which allow direct inspection of the borehole surface and viewing fractures in-situ. Orientation of the features as they intersect the borehole can also be determined. The possibilities of these methods are further enhanced by the advancement of software that constructs oriented virtual cores from the televiewer data. Interpretations using these methods are subject to the same limitations experienced by other borehole based techniques. (FN A-2582 in Appendix 106).

An interdisciplinary approach using multiple lines of evidence is recommended and is particularly important for characterizing fractured rock. This approach has been borne-out by experience with geophysical methods in

particular. The non-uniqueness of geophysical signatures and the need for parallel use of several methods has long been recognized. Side-by side comparison of geophysical logs is standard. (FN A-2582 in Appendix 106).

In the absence of data that can be obtained using the techniques identified above to allow for a more precise design for groundwater treatment in the bedrock, a simplified approach that essentially assumes conditions are somewhat homogeneous would have to be taken, and it would be appropriate for a larger than normal contingency to be applied (FN A-1292). As previously indicated, given that investigations by ACER in 2016 in particular that involved downhole video, indicate large fracture systems both horizontally and vertically, and this is favourable for groundwater treatment in the bedrock zone for the sandstone bedrock. This aspect also provides some support to applying a somewhat homogeneous approach to remedial design estimating. In addition, although an iterative and integrative approach is utilized in developing a groundwater treatment system for the bedrock zone, that should result in any test wells installed for further assessment and pilot testing to become part of the remediation system, a separate cost allowance should be applied for the "remedial design phase".

Given the above, the estimates are considered to be preliminary. A brief description of the approach and implementation plan for remediation is provided below.

Phase 1: Soil excavation and remediation including dewatering and treatment.

1. Installation of sheet piles to stabilize the excavation and to minimize potential disturbance to adjacent infrastructure and services and facilitate subsequent installation of slurry walls around the properties to reduce the potential for contaminated groundwater in the shallow groundwater flow system from flowing back onto the properties.
2. Installation of 8 inch diameter wells to depths of 15 metres to facilitate dewatering during excavation, with groundwater to be treated by means of granular activated carbon systems located in trailer units (up to 14 anticipated). The wells will be used as part of the long term groundwater treatment component of the program.
3. Excavation of clean overburden materials estimated at about 1 metre, stored on site for latter backfilling purposes.
4. Excavation of contaminated soils and weathered bedrock, expected to achieve 2 to 3 metres of excavation, with soils transported off site for treatment and disposal.
5. Backfill excavated areas using clean materials excavated and stored on site, with supplemental granular material hauled in.
6. Final site surface grades to be established about 1 metre below adjacent grades and below the slurry walls to create an impoundment.
7. Construction of recharge galleries to promote infiltration of groundwater stored in the impoundment area in an effort to create a downward head relative to adjacent areas and further minimize the potential movement of ongoing migration of contaminated groundwater from source areas onto the EFL, FN and MEL properties.

Phase 2: Long term treatment of groundwater

1. Long term treatment of groundwater is expected to be necessary given that significant contamination remains on the adjacent IOL source property and no remediation is being carried out and contamination is present in the deeper bedrock, depths of 20 metres.

2. Long term treatment of groundwater will be necessary and a groundwater pump and treat system is proposed consisting of pumping wells (installed during the Phase 1 soil excavation and remediation component), oil water separator system, granular activated carbon treatment system, air stripper system and coagulant/flocculent treatment component.
3. A black oily petroleum hydrocarbon sheen was observed on the groundwater discharging from several test holes installed on the IOL and MEL/FN properties and therefore an oil water separator system is considered necessary at the front end.
4. The oil water separator is followed by a granular activated carbon treatment system and coagulation/flocculation treatment. This approach is applied for the treatment of ship ballasts in a saltwater environment. This section has a high efficiency in the removal of BTEX, TPH and naphthalene.
5. The final stage of treatment consists of an air stripper that is expected to further reduce concentrations to meet guidelines for marine discharge.
6. The proposed approach to treatment involves flushing of contamination by means of periodic pumping of groundwater to create temporary drawdown to depths in the order of 5 metres.
7. Drawdown periods would include two events with 2 months duration, April and May as well as October and November during spring freshet and heavier periods of rain in the fall. Two one month periods would include July and January.
8. Temporary drawdown is intended to create free flow type conditions in the aquifers that would be expected to promote the flow of contaminated groundwater from the bedrock fracture systems.
9. The positive head created by pumping is expected to promote the movement of contaminated groundwater below depths of 5 to 6 metres upward towards the well points and at the same time have a flushing effect that is expected to assist in the removal contaminants.
10. A portion of the treated water would be returned underground via several wells (installed for initial dewatering) and recharge galleries constructed in the impoundment areas created within the footprint of the former buildings.
11. Recharge via several wells located on opposite sides of the properties is intended to promote flow in the bedrock system towards the drawdown wells in an effort to prevent further spreading of contamination onto the respective properties.
12. The recharge galleries within the impoundments created within the footprint of the former buildings are also intended to create downward flow conditions towards the drawdown wells in an effort to also prevent further spreading of contamination onto the respective properties.
13. The water returned to the bedrock and overburden is expected to aid in the flushing of contaminants from impacted bedrock aquifers.
14. Pumping flow rates are expected to range up to 130 gallons per minute for each property to achieve draw down to about 6 metres to treat the bedrock aquifers.

Costs have been developed with inflation considerations, with a 110 year time span recognizing that contamination has been present on the IOL property for almost 30 years and concentrations have been reported for investigations carried out by ACER Environment Services (2015) Ltd. that showed concentrations at higher values in the soil and groundwater than reported when sampling was carried out in 1989. Similarly contamination has apparently been present over the life of the IOL underground gasoline transfer line, suspected of having been leaking over the life

of the pipeline, and still represents a persistent long term source. The remedial criteria objective is for marine aquatic life that will also reduce concentrations to levels acceptable for use of the on-site brackish/saltwater aquifer as per previous use/operations.

Costs are estimated to range between $4,582,785,736 to 6,599,615,745 (inclusive of a 30% contingency and taxes). See FN A-2589 a in Appendix 112 for details.

Remediation of Marine Sediments

Remediation of the marine sediments may be accomplished by dredging with disposal options including land disposal or ocean disposal or a combination of both disposal methods. Analysis results indicate that for the land disposal option PHC concentrations exceed acceptable RBCA criteria for a commercial site with non-potable water for land based considerations. Some form of treatment or containment would be required. This is not an undertaking that you would be expected to be liable for given “you do not directly represent a responsible party for a source property”. Costs are estimated to be in the order of $328,522,230 (inclusive of a 30% contingency and taxes) based on dredging followed by treatment by a method that satisfies RBCA criteria for a commercial site with non-potable water for land disposal. See FN A-2589 a in Appendix 112 for details. No cost recovery as a fill material was considered.

6.0 SUMMARY AND CONCLUSIONS

The assessment involved investigations for an area of over 70 acres that is assessed to be contaminated, consisting of 20 acres of land based area, with the MEL, FN, EFL, Town of Shippagan properties and private properties representing almost 17 acres, with the IOL Bulk Plant being over 1.24 acres and the remaining area being associated with the SCH/DFO wharf. A drawing showing the area of the site and property locations is provided on a site plan contained in Appendix 1. An historical aerial photograph showing the area is provided in Figure 1-2 and is also provided in Appendix 1.

The purpose of the investigations were to identify the apparent source(s) of contamination. Investigations extended over a long period of time primarily due to the following:

- Efforts continued with IOL between 2002 and 2016 to obtain approval to carry out investigations on their properties including the bulk plant, former CN rail petroleum tanker car offloading facilities and underground petroleum transfer line that extended from the bulk plant to the end of the wharf at the former petroleum tanker ship offloading facilities. A court order was subsequently obtained in February 2016 to carry out investigations on the IOL properties.
- In the interim, sampling was carried out on the FN, MEL, EFL and property boundaries of the IOL bulk plant between 2009 and 2012. Sampling was done for the Royal Bank in 1995 and Three-D GeoConsultants Ltd. in 2002 on the EFL property.
- Efforts to obtain approval to carry out investigations on the DFO property continued between 2012 and 2018 with approval being obtained after a motion was made to court in 2018.

The former bulk petroleum storage facility was constructed in 1944 or earlier, and is located immediately up gradient of the Assessed Property. The IOL operations included the bulk plant site consisting of an above ground tank farm containing 15 large above ground single walled tanks for the storage of furnace oil, gasoline, and waste oil as well as a tank with unknown storage purposes. Operations also included:

- a CN Rail spur petroleum tanker offloading facility located between the IOL bulk plant and the FN and MEL properties that was installed in 1953;
- **two underground gasoline transfer lines installed circa 1938** that extend from the IOL bulk plant property along the former CN ROW to the end of the wharf at a former ship tanker unloading facility reported by an IOL consultant **to be "suspected of having been leaking during their operating life"**; and
- an underground fuel oil transfer line installed circa 1953 that extends from the IOL bulk plant to the end of the wharf and is located immediately to the north of the FN property.

The IOL bulk plant property has been on record with the DELG as a petroleum contaminated site as of October 3, 1989. The former CN ROW that the two IOL underground petroleum transfer lines are located on has been on record as a petroleum contaminated site since May 2, 1997, with IOL identified as the party responsible for remediation. The area associated with the located down gradient of the bulk plant property has been on record with the DELG as a petroleum contaminated site as of October 3, 1989. **Prior to 1987 there was no regulatory requirement to report a petroleum spill to the DELG. The IOL site appears to have been subject to frequent releases of petroleum product. Based on a review of historical documents related to reported and**

unreported spills, a volume of 4,617,406 litres was determined to have been spilled with respect to the IOL operations (section 1.3).

Lack of action by IOL in implementing clean-up measures provided an opportunity for contaminants to continue to migrate/move off the bulk plant site and former CN ROW/driveway. Documentation shows that the DELG has continually had non-compliance issues with IOL regarding remediation associated with the IOL bulk plant property and CN ROW/driveway. This includes non-compliance with the Ministerial Orders (A-472 dated February 3, 1993 in Appendix 30 that also references previous ministerial orders dated September 20, 1992 and July 22, 1992) for the IOL bulk plant property in regards to assessment of the extent of contamination in the soil or groundwater, inadequate and incomplete installation/implementation of remedial systems/measures and ongoing reporting and maintaining effective remediation measures (see Section 1.4). **A recent Ministerial Order dated September 13, 2019 that IOL was notified was forth coming, was placed on hold given IOL demonstrated a commitment to undertake action in accordance with the requirements identified in the Order. The Order requires IOL to undertake investigations to delineate contamination associated with operations. It is indicated in the IOL documentation that IOL adopted the RBCA protocols developed in 1999 and was part of the Atlantic PIRI Committee (Partnership in RBCA Implementation).**

The ACER assessment shows the footprints for contamination for current investigations are similar to the IOL investigations carried out to the end of 1992 for the bulk plant and investigations in 1998 for the bulk plant and former CN ROW. The footprint for contamination in the soil based on investigations carried out by the IOL consultant for the IOL bulk plant between 1989 and 1992 is shown on Figure 4-9 (also in Appendix on an ARC drawing and Figure 4-7 (also in Appendix 98) as an ACER figure that shows the study area. The footprint for soils for the former CN ROW for investigations in 1998 is shown on Figure 4-15 (also in Appendix 96). The current footprint identified from ACER investigations for soil is shown in Figure 4-1 (also in Appendix 97).

The footprint for groundwater contamination on the IOL bulk plant and former CN ROW/driveway and gasoline pipeline for sampling carried out on both sites for the July and August period is shown on Figure 4-16 (also in Appendix 96). The current footprint for ACER investigations for groundwater is shown in Figure 4-1 (also in Appendix 97).

Investigations by the IOL consultant for the study area in 2000 (AMEC, A-280 in Appendix 78) did not identify any apparent sources of contamination on the EFL. MEL, FN properties or other adjacent or nearby properties, and did not identify any other apparent sources during their intrusive investigations on the EFL, FN and MEL properties or other

Photos 3-1 to 3-14 in Section 3.2.1 (also in Appendix 72) show soil and bedrock conditions and petroleum contamination staining observed during excavation in the vicinity of the two IOL underground gasoline pipelines, located between the IOL bulk plant site and FN and MEL properties, during upgrading of underground services by the Town of Shippagan. Video stills showing the highly fractured bedrock are provided in Photos 3-15 to 3-18 (also in Appendix 72) for 16MW20A located on the IOL bulk plant property, and Photos 3-19 to 3-22 (also in Appendix 72) for 16MW22B located on the MEL property opposite the FN industrial/commercial water supply well. The overburden and bedrock profile for a transect extending from the IOL bulk plant site to the edge of the wharf is shown in Figures 3-2 and 3-3 (also contained in Appendix 72) with concentrations of petroleum hydrocarbons (PHCs) in the groundwater zones also shown. Photos CA-357 and CA-359 in Appendixes 44 and 45, respectively, show excavation of contaminated soils for the Old North Wharf adjacent to the IOL underground petroleum transfer lines. The extensive spreading of contamination in the soil and completely to highly weathered and fractured bedrock, and the groundwater is shown on the following figures;

- Figure 3-5 (also contained in Appendix 76) shows the footprint of contamination in the soils in consideration of

leaching from soils to water supply aquifers, health risks due to soil impacts, ecological impacts to wildlife (birds and mammals), plant life, and risks to the marine environment associated with petroleum hydrocarbons and PAHs leaching from soils and migrating via groundwater to surface water transport.

- Figure 3-6 (also contained in Appendix 76) shows the footprint of contamination in the groundwater in consideration of water supply aquifers and health risks due to water use, vapor inhalation and ecological impacts for plants and invertebrates.
- Figure 3-7 (also contained in Appendix 76) shows the footprint of contamination in the groundwater in consideration of risks to the marine environment associated with groundwater to surface water transport of contaminates.
- Figure 3-8 (also contained in Appendix 76) shows the footprint of contamination in the soils and groundwater in consideration of pathway specific soil concentrations and associated leaching, representing a long term persistent source of contamination, and groundwater concentrations representing risks to the marine environment for the groundwater to surface water transport of contaminates as well as sediment impacts in the harbour.

Also refer to the following figures that show the contamination contours that also reflect the distribution and source(s) of contamination.

Figures 4-1 and 4-2 (also contained in Appendix 97) show contamination contours in the soil and groundwater for the 2012 to 2019 period of the ACER investigations, respectively, that further demonstrate that the IOL bulk plant, former IOL CN Rail tanker car petroleum offloading area, and underground gasoline transfer lines are apparent sources of contamination to the MEL, FN, EFL and Town of Shippagan properties, to the SCH/DFO property and other adjacent and nearby properties,.

Figures 4-7 and 4-8 (also contained in Appendix 98) show contamination contours in the soil and groundwater for IOL consultant investigations for the former IOL bulk plant property (including portions of the EFL and FN properties, portions of the former CN ROW and Enterprise Shippagan Ltd. property, and commercial property to the east) between 1989 and 1992. This was before remediation measures were implemented, and free phase product was first reported in December 1990, with thicknesses of 37 cm measured and frequently reported at a number of wells to the end of 1992, and continued to be reported for the last report date of 2007. The concentrations contours further demonstrate that the IOL bulk plant, former IOL CN Rail spur petroleum tanker offloading area are apparent sources of contamination to the MEL, FN, EFL, Town of Shippagan properties, SCH/DFO property and other adjacent and nearby areas.

Figures 4-15, 4-16 (also contained in Appendix 96) show contamination contours in the soil and groundwater for investigations carried out in 1998 in association with the two IOL underground gasoline pipelines that extend from the IOL bulk plant to the end of the wharf. The pipelines pass between the FN and MEL properties within the former CN ROW/driveway (now owned by the Town), cross 15th St. and the SCH/DFO property to the former tanker ship unloading area at far end of the wharf. The concentration contours further demonstrate that the IOL bulk plant, former IOL CN Rail, spur petroleum offloading area and underground gasoline transfer lines are apparent sources of contamination to the MEL, FN, EFL, Town of Shippagan properties, SCH/DFO property and other adjacent and nearby properties.

The large footprints for contamination indicated in the figures for the soil and completely to highly weathered and fractured bedrock and groundwater, are due to very complex site conditions for the project area as detailed in Section 4.2, and is considered reflective of a large volume of petroleum product having been released. As indicated 4,617,406 litres were conservatively determined to have been released from the IOL operations. The

extensive network of underground services (water supply, storm water and sewage lines, saltwater pipelines, electrical lines and road construction etc.) provide preferential flow pathways for faster and easier movement of contaminated groundwater and promotes spreading of contamination. Spreading is influenced further due to fractured bedrock conditions and tidal influences that also contribute to preferential flow conditions, with the tidal loading effect also causing a change/reversal in ground flow resulting in increased spreading. Tidal loading effects were noted to be evident from the edge of the wharf to the west side of the IOL bulk plant property. Spring and fall groundwater recharge periods as well as heavy rainfall events also cause increased flow and spreading to occur as well as additional mobilization of contamination due to washing within the smear zone of the impacted soils and completely to highly weathered bedrock.

The significant vertical fractures in the bedrock would be conducive to contaminate migration into the deeper bedrock aquifer from the overburden/bedrock interface and in combination with the horizontal fracturing and flow gradients would promote/increase migration and spreading of contamination. In addition, historical groundwater aquifer pumping wells for FN, ice production operations at the wharf, Town of Shippagan municipal water supply well(s) and remedial pumping wells operated by IOL on the bulk plant property and in association with contamination related to the two IOL underground gasoline pipelines, would influence the direction of groundwater flow and draw contamination deeper into the soil and bedrock aquifers. This would result in additional spreading of contamination throughout the study area.

Groundwater flow contours are shown in Figure 3-4 (also in Appendix 73) for a monitoring event on May 18, 2017, for a high tide cycle represented by a lower end of the range for the high tide cycle. It is important to note that groundwater flow conditions are consistent with conditions previously reported by the IOL consultants for investigations for the area between 1989 and 2004. Groundwater flow occurs from the IOL bulk plant property in all directions;

- northerly onto the EFL property and residential properties;
- southerly onto 14th St. (Town property) and the Enterprise Shippagan Ltd. property;
- westerly onto several commercial and institutional properties;
- and easterly onto the FN and MEL properties and former CN Rail ROW (Town property that is also used as a driveway and contains the two IOL underground petroleum transfer pipelines), 15th St. (Town property) and SCH/DFO property, ultimately discharging to the harbour.

Monitoring carried out by ACER and the IOL consultants show groundwater flow gradients favour roadways with underground services including 14th St. and the former CN ROW located between the FN and MEL properties, and are representative of preferential flow pathways. Groundwater contours show flow occurring from the IOL bulk plant property toward 14th St. and continuing onto the former CN ROW/driveway area between the FN and MEL properties with flow components occurring onto the FN and MEL properties. Contamination identified in association with the two underground gasoline lines located within the former CN ROW, reported to be “suspected of having been leaking during their operating life” circa 1938 by an IOL consultant, would also spread across the FN and MEL properties as well as onto the SCH/DFO property, and ultimately discharge into the harbour.

Flow also occurs along the former CN ROW between the FN and MEL properties that is in a landward direction from the SCH/DFO property with flow components occurring northerly and southerly onto the FN and MEL properties, respectively. Water supply, storm and sewer lines as well as saltwater lines and effluent lines from FN fisheries and other operations extend under the buildings, thereby also providing for preferential flow and increased spreading of contamination under the buildings and across properties. This results in broad spreading of contaminated groundwater that is further exacerbated by historical water supply pumping operations associated

with the FN operations as well as a Town municipal well, nearby wells for ice plant operations and IOL remedial pumping wells on the IOL bulk plant property and former CN ROW and SCH/DFO properties that also influence groundwater flow.

Although several of the default criteria/conditions for application of select provincial RBCA and federal CCME guidelines are not met, CCME and RBCA are used for comparison/screening assessment purposes for consistency, given that CCME and RBCA criteria have been applied historically for assessment purposes by the IOL consultants and for investigations by others on behalf of property owners in the study area. This is discussed in more detail in Section 3.3 and it should also be noted that there are also other limitations with respect to the application of the RBCA and CCME guidelines.

It is also critical to recognize that the property boundary for the SCH property is defined by the 1966 Mean High Water Level (MHWL) as shown in the drawing for proposed land based sampling locations provided in Figure 3-1, also in Appendix 70. Therefore, contamination that occurs on the SCH/DFO property in areas that are located between the property line and the current edge of the marine receiving waters, defined by the edge of the wharf structures, occurs within the boundaries of the Mean high Water Level for the marine receiving waters. CCME requires that marine guidelines for aquatic life be applied directly; **at least 10 metres beyond this boundary**, and the distance should be adjusted further depending on site specific conditions.

Notwithstanding this and that contamination has been historically identified within 150 metres of receiving waters and therefore requires appropriate considerations in any assessment, but there are also multiple underground services including water supply, storm water, waste water and saltwater supply lines, effluent discharge lines, electrical lines and other underground services, that provide preferential pathways for migration of contaminants to the marine receiving environment. **The CCME 2008 Federal guidelines indicate that for "Fractured bedrock or fractured silt/clay…The transport models used to develop the numerical guidelines assumes that contaminant transport occurs through unconsolidated soils. If transport between the contaminant source and receptor (e.g. surface water body) is through fractures instead of unconsolidated soils, either a transport distance of zero should be assumed (i.e. the Canadian Water Quality Guidelines for the Protection of Aquatic Life should be applied to groundwater), or a site-specific risk assessment should be conducted." What is meant by a transport distance of zero should be assumed (i.e. the Canadian Water Quality Guidelines for the Protection of Aquatic Life should be applied to groundwater) is that the aquatic guidelines should be applied at the source property boundary. This would also apply to any water supply well/aquifer used for private, commercial or industrial operations.**

It is indicated in the CCME guidelines that limitations in the use of the numerical guidelines include "Other scenarios resulting in a high groundwater velocity (e.g. tidal influences close to a marine water body) may also enhance contaminate transport…"…"and a site-specific adjustment of the guidelines will likely be necessary." This is applicable to the study area.

The eastern edge of the FN Fisheries building extends across the MHWL, with the MEL property boundary being approximately 10 m from the MHWL, being separated by 15th St., and the EFL property being located about 30 metres from the FN property boundary. Given the location of the boundary relative to impacted areas and preferential pathways associated with the extensive network of underground services and significant fracturing in the bedrock and tidal effects, direct application of the CCME marine guidelines to the assessment of soils and groundwater in consideration of leaching and the groundwater to surface water pathway and risks to the marine environment is considered to be an appropriate screening approach for the FN, MEL, EFL, former CN ROW containing the IOL underground gasoline transfer lines and Town ROWs and SCH properties as well as the former IOL bulk plant and rail car unloading facility.

The RBCA criteria for aquatic/marine life was selected in recognition of the extensive network of underground water supply lines, storm water and sewage lines, saltwater pipelines and road construction etc., that provide preferential pathways for faster and easier movement of petroleum hydrocarbons. In addition, the 2016 intrusive sampling program showed that the bedrock has extensive vertical and horizontal fracturing with large fractures evident and further supports direct application of the criteria for marine life. This would also apply to a water supply well aquifer used for food grade operations with a **zone of pumping influence that extends to include nearby contaminated properties (IOL bulk plant, EFL, MEL, FN, SCH/DFO and Town ROWs)**.

As indicated in **CCME, March, 1991, it is critical to recognize** that when assessing risks to the environment that the assessment should also recognize the **combined or synergistic effects of contaminates**. It is also indicated in RBCA 2015 that "This protocol is applicable only to sites with petroleum hydrocarbon impacts. It should not be used for sites where other potential contaminants of concern (e.g., PCBs, PAHs, dioxins/furans, metals/ metalloids, nutrients, pesticides, etc.) have been identified, as screening levels for such potential contaminants of concern have not been provided." It is further indicated in RBCA that "If multiple non-petroleum contaminants are included in the risk assessment at Tier II or III (assuming approval from the regulatory agency having jurisdiction), it may be necessary to consider the cumulative effects in the derivation of SSTLs. Different compounds may act on different body organs, thereby affecting the compounds that need to be considered as having cumulative effects." This is also reflected in previous versions of RBCA.

In this instance, it is known that the SCH/DFO lands and marine environment are impacted with multiple contaminants of concern and an assessment and remedial approach that avoids contributing to cumulative and synergistic effects should be considered accordingly for up gradient contaminated properties.

As stated in the DELG Guidelines, "A critical factor associated with an ESA is that the extent of the contamination in both soil and groundwater must be adequately defined and delineated, even if it has crossed the source property boundary. Delineation to applicable screening criteria levels is the minimum level of delineation required in all situations."

Historical investigations by the IOL consultants as well as more current ACER investigations indicate concentrations for petroleum hydrocarbon contaminates exceed provincial and federal criteria for human health related risks associated with well water supplies and thereby are problematic for the brackish/saltwater aquifer utilized for site operations in recognition that petroleum hydrocarbon contaminates are present and similarly problematic for food grade operations carried out by FN since the 1950's.

Initially, the ministerial order issued to IOL for remediation **required petroleum hydrocarbon contaminates in soils and groundwater to be reduced to concentrations that did not represent a risk to local water supply use**. **This would include *petroleum hydrocarbon concentrations that would not represent a risk to human health for consumption* in recognition of the Town municipal water supply, *that is also applicable for food grade operations* that also requires petroleum hydrocarbon contaminates to be at concentrations *that would not represent a risk to human health for consumption*, with criteria identified in RBCA and CCME for consumption being applicable**. Subsequently the criteria was changed to a non-sensitive site and criteria for water quality was reduced. Although the **IOL consultant and the DELG were knowledgeable that FN operations and ice production facilities were located in the area and had on site water supply wells for food grade operations, utilizing the brackish/saltwater aquifer, protection of the brackish/saltwater aquifer water supply in consideration of historical and on-going existing use in accordance with requirements of the DELG Guideline for the Management of Contaminated Sites was not recognized** (refer to Section 1.2.2 Groundwater Aquifer and Water Supply Use for details). As indicated in Section 1.2.2, MEL made an application

for another industrial potable water well in 1993 to the DELG and received approved in 1996 with an 8 inch diameter well at 120 ft. deep, and capacity of 350 gal/min. **Permits issued by the DELG for petroleum storage facilities in this area have recognized the existence of potable water wells nearby and designate the site as "sensitive".**

Since 1950 or earlier, FN utilized the brackish/saltwater *supply aquifer* in the area of the FN and MEL properties to satisfy a requirement to continuously supply approximately 200 gal/min of water for food grade fish processing purposes. The water supply aquifer was tapped into utilizing a 6 inch water supply well, that is approximately 120 feet deep with a well casing installed about 20 feet below grade. An assessment for groundwater supplies was carried out in 1993 to assess the aquifer as a supply source for Marine Extract Ltd. and the possibility of increasing the supply for FN Pecheries Ltd. operations. During drilling for the MEL water supply wells (two wells drilled) four levels of petroleum contamination were encountered (14 to 16 feet, 20.5 to 21.5 ft., 38 plus/minus, to 44 plus/minus ft.) to the 44 ft. depth (13 m). Subsequent testing of the FN water supply well was carried out and showed petroleum hydrocarbon contamination to be present and the saltwater supply well was no longer suitable for use for food grade seafood operations.

A private food grade water supply well must first satisfy drinking water supply criteria with respect to chemical contaminants prior to any further refinement. For federal information on potable saltwater (brackish) wells used by fish and pharmaceutical processing plants, reference is made to the Canadian Food Inspection Agency "Facility Inspection Manual" FN A-1105, May 8, 2013 (in Appendix 30).

– 6. Registered Processing Vessels on page 28, "sanitary seawater for processing". This clearly verifies that saltwater from wells is acceptable for seafood processing.

– 6.0 Sanitation on page 86, "Compliance Guidance. The source and/or supply of water used for cleaning and/or sanitizing facilities and equipment using in the unloading, handling and transporting of fish must not be a source if biological, chemical or physical contamination. Clean sea water is acceptable for cleaning. Clean sea water is sea water which meets the same microbiological standards as potable water and is free from objectionable substances. Potable water is fresh- water fit for human consumption. Standards of potability shall not be less than those outlined in Tables 7.1 and 7.2 for microbial contaminants and Table A3.3 for chemical contaminants of the latest edition of the WHO "International Guidelines for Drinking Water Quality"."

With respect to detectable petroleum hydrocarbon contaminants, a saltwater/brackish well must meet the same chemical contaminant standards established for a potable water well and **in this instance RBCA residential criteria for petroleum contaminates is acceptable/applicable**. As such, c**oncentrations of BTEX exceeded RBCA residential criteria and the CCME guidelines, with TPH exceeding RBCA residential criteria as well,** and therefore the **brackish/saltwater *supply aquifer*** could no longer be used for food grade seafood operations.

The top 5 metres of the bedrock was highly weathered and significantly fractured. A cross section of the overburden and bedrock conditions is provided in Figure 3-2, included in Appendix 72. Photos of the overburden soil and bedrock conditions observed during excavation activities and downhole videos are also provided in Appendix 72. The bedrock shows large fractures including cave and rubble fractures with vertical fractures extending several metres. The cobble and cave fractures appear to represent zones of significant fracturing that extend with a downward dip from the IOL bulk plant property across the FN and MEL properties to the edge of the wharf. Investigations for this study indicated the significant fracture zones correlated with contaminated zones, based on the downhole video. Water flow rates for groundwater veins encountered in these zones ranged from 20 GPM to 50 GPM. The significant vertical fractures in the bedrock would be conducive to contaminate migration

into the deeper bedrock aquifer from the overburden/bedrock interface and in combination with the horizontal fracturing and flow gradients would promote/increase migration and spreading of contamination.

An assessment of the zone of drawdown influence under existing Department of Environment approved pumping rates was carried out by Craig Hydrogeologic Inc., April, 2011, for the MEL and FN properties (Affidavit document A-662, Appendix 30). As indicated on Figures 2, 3, 5, and 6 of the report, the groundwater capture area for the Marine Extract and FN Fisheries pumping wells reflected by a pumping rate of 250 GPM for FN operations (operational range from 200 to 350 GPM) includes the IOL bulk plant and former tanker car unloading area, former CN ROW owned by the Town of Shippagan with the two IOL underground gasoline pipelines, Street ROWs, DFO property and other adjacent and nearby properties that have all been assessed to be contaminated. Craig indicates that "Any properties which are located within the groundwater capture areas of the pumping wells and which have sources of groundwater pollution/contamination pose a risk to the pumping wells."

The cost to install and operate a treatment system to achieve suitable water quality was indicated to be too costly and prohibitive to operations.

6.1 Other Key findings

1. As indicated above, extensive spreading of contamination has occurred due to a number of factors as detailed in Section 4.2. Groundwater flow conditions for ACER 2016 are shown in Figure 3-4 (also in Appendix 73) for a monitoring event on May 18, 2017 for a mid-level tide event. Flow behaviour showed similarities to previous IOL consultant reporting. Flow directions shown in ACER Figure 3-4 are similar to that shown on the IOL consultant groundwater flow drawing provided in Figure 1-9 (also in Appendix 24) for May 1999, that shows preferential flow originating from the area of the IOL bulk plant and former CN Rail tanker car offloading facilities along the former CN ROW containing multiple underground services including the **two IOL underground gasoline transfer lines (reported by an IOL consultant following pressure testing to be "suspected of having been leaking during their operating life" circa 1938)**, with flow splitting off in a northerly direction under the FN building and southerly direction under the MEL building.

   The IOL consultant commented in a monitoring report for the IOL bulk plant property dated January 9, 1993 (A-481a and A-470 in Appendix 24 including an IOL consultant Figure provided in this report as Figure 1-5 also included in Appendix 24) that "Outside of the influence of the two remedial wells, groundwater flow appears to be taking place in a south-easterly direction towards 14th Street. This street appears to act as a groundwater sink as the three monitoring wells to the southeast of 14th Street flow towards the northwest. The groundwater contour centred on MW13 also indicates that there is a groundwater sink between 14th Street. It is likely that the installation of services such as sewers and water mains and the ensuing backfill with coarse material may in fact act to provide a "french drain effect" along the pipeline. This could account for the apparent observed groundwater data." Refer to Figure 1-5 (also contained in Appendix 24). It should be noted that petroleum contamination was identified by the IOL consultant at the three monitoring wells to the south east of 14th St., (opposite side of 14th St. with respect to the bulk plant and 37 cm of free product being detected on the bulk plant side of 14th St), and may be attributed to fluctuations to the small gradients evident to the south of the bulk plant (study area in general) that would be influenced by spring melt and rainfall events as well as tidal effects, resulting in spreading of contaminates in this area. This would be particularly prominent during periods when the IOL remedial wells were not operating, being frequent.

   The term "french drain effect" and "sink" is equivalent to indicating "preferential pathway" and it is apparent from the IOL consultant and ACER investigations that preferential flow occurs from the IOL bulk plant onto 14th St. that is directly connected to the former CN ROW/driveway (approximate location of IOL MW13) with

underground services from 14th St. extending along the CN ROW/driveway and continuing to the edge of the wharf.

An NBDELG occurrence report (A-87, in Appendix 43) related to petroleum sheening at the Old North Wharf reported that the petroleum product was coming from the rock around the wharf around the end of the line formerly used by IOL. IOL was identified as the responsible party with significant contamination identified in association with the two IOL underground gasoline transfer pipelines. This further supported that contamination was reaching the harbour with the CN ROW/driveway providing for preferential flow.

During drilling of monitoring well 19MW150, located about 5 m from the corner of the wharf and adjacent to an underground storm discharge line, there was a loss of downhole water pressure at approximately 4 metres depth. Within several minutes, a cloud of brown water was observed to be discharging from the storm line located at the corner of the wharf that spread across the inner harbour and persisted for several hours (see Photos in Appendix 100). This supports that the underground lines and road construction also provide a direct preferential pathway for release of contaminated groundwater to the harbour in addition to normal groundwater flow to the marine environment.

Underground water and sewer and other service lines also extend from the Streets and CN ROW/driveway under the FN/MEL buildings and onto other properties. With respect to the bulk plant remedial program, the DELG and IOL consultant (WMS/ARC) continually expressed concerns regarding concentrations at MW13 and off-site migration in the direction of the CN ROW, FN, MEL, SCH/DFO properties and harbour and directed IOL to install additional MWs to further assess conditions, but IOL disregarded these requests.

Photos 3-10 to 3-14 (also included in Appendix 72) show petroleum staining in the soils and completely to highly weathered bedrock during upgrading of underground services by the Town for 14th St. Photos 3-1 and 3-2 (also included in Appendix 72) shows petroleum staining and sheening on the 4 metre trench excavation for Town underground services upgrading that is essentially on the opposite side of 14th St., with Photo 3-3 (also included in Appendix 72) showing petroleum sheening on the water surface in this area. Photos 4-1, 4-2 and 4-3 show petroleum sheening on water displaced during installation of 16MW20 in 2016 at the boundary of the IOL bulk plant and 14th St. Petroleum sheening was evident for about 30 minutes during development of the well, with very strong petroleum odours evident. Photo 1-1 shows petroleum sheening in a manhole demonstrating that underground services are providing a preferential pathway for movement of contaminated groundwater (from page 11 of FN A-1871 a,b,c,d,e,f,g,h,I,j, also provided in Appendix 18). This further supports that contaminate migration occurred historically and was still occurring onto 14th St., after the remedial program was discontinued for the IOL and CN ROW/driveway circa 2011.

2. Contaminated groundwater in the shallow groundwater flow system and bedrock zones ultimately flows to the harbour, with preferential flow occurring in association with storm lines and other underground services located within street ROWs and otherwise as well as the highly fractured bedrock. It is indicated in the CCME guidelines that fractured bedrock provides preferential flow pathways for transport of contaminated groundwater and either a transport distance of zero should be assumed (i.e. the Canadian Water Quality Guidelines for the Protection of Aquatic Life should be applied to groundwater), or a site-specific risk assessment should be conducted." It appears this protocol was not applied for previous assessments.

3. With respect to the EFL property, flow contours presented on Figure 3-4 (also in Appendix 73) show strong flow gradients from the IOL bulk plant onto the EFL property and towards other adjacent/nearby commercial and residential properties. This is attributed to the raised elevations of the tank pads being a couple metres

above neighbouring grades. Preferential flow conditions also exist between the bulk plant and the EFL property and 12th St., by way of;

- strong groundwater flow gradients from the IOL bulk plant property onto the EFL property (Figure 3-4 in Appendix 73);
- with preferential flow afforded from the sump collection trench located parallel to the EFL/IOL northern property boundary where petroleum spillage is collected for the containment dike (see Photo 4-4) and noting that the permeability of the containment dike liner is 50 times higher than required under regulations;
- with preferential flow towards the EFL property further afforded by the underground service trenches installed for the remediation system that are located parallel and adjacent to the sump collection trench where spillage is collected for the containment dike (see Photo 4-4).;
- with preferential flow further afforded by an underground line located between the EFL building and the northern bulk plant property boundary being located parallel to the line and sump collection trench in the containment dike (see Photo 4-4); with
- with preferential flow further afforded by a foundation wall that extends off the south end of the EFL building that connects with a partial basement at that end of the building; and
- with preferential flow further afforded by underground service lines that extend to 12th St.

In addition, the underground fuel oil transfer line exits the dike near the sump trench and based on contamination contours, shown in Figures 4-1 and 4-2, (also provided in Appendix 97) for soils and groundwater, respectively, represents an apparent source pathway for contamination to the EFL property.

There are a number of other factors supporting that the IOL bulk plant is the apparent source of contamination to the EFL property as discussed further in Section 6.2 and detailed in Section 4.3.5.

4. The extent/footprint of contamination identified by the IOL consultant for the EFL, FN, MEL, Town, SCH/DFO for soils and groundwater shown on Figures 1-6 and 1-7 (also contained in Appendix 24), is consistent with the current ACER investigations as shown in Figure 3-5 for soils and Figure 3-7 for groundwater and human health. The extent of contamination for the aquatic site specific pathway and preferential flow considerations identified by ACER is shown in Figure 3-7 (provided in Appendix 76). Concentrations are elevated along the preferential flow pathways as demonstrated by the contamination contours in Figures 4-1 and 4-2 for soil and groundwater (also provided in Appendix 97), respectively, and the IOL consultant Figures 1-6 and 1-7 for soil and groundwater, respectively (also contained in Appendix 24). Concentrations are generally expected to be higher for preferential flow pathways.

5. It is apparent from the ACER and IOL consultant drawings that preferential flow occurs along roadways and driveways containing underground services including 14th St., and the former CN ROW (also referred to as the driveway between the FN/MEL properties). The two IOL underground gasoline pipelines, reported by an IOL consultant following pressure testing to be “suspected of having been leaking during their operating life” circa 1938, are also located within the former CN ROW. Service lines for water and sewer and electrical etc., also extend under the buildings thereby resulting in an extensive network of underground services that provide for preferential flow throughout the study area and is a key factor in the spreading of contamination, with tidal loading effects further contributing to the spreading of contamination due to reversal of flows and backwater effects.

6. Further similarities to previous IOL consultant reporting for groundwater flow, includes areas that show flow to be multidirectional due to **tidal loading effects that result in flow reversal** as well as drawdown conditions "sinks" or upwelling also being evident. The IOL consultant also observed flows to occur opposite/reverse to that shown in Figure 1-9 (included in Appendix 24 and is an IOL consultant Figure), as shown in the IOL consultant drawing Figure 1-8 for July 1988 (also included in Appendix 24 and is an IOL consultant figure). The IOL consultant attributed this reversal to tidal loadings and small flow gradients. This flow behaviour is an important factor, in combination with the extensive network of underground services that cross properties and also extend under buildings, that **results in the increased spreading of contamination in the study area**. Groundwater "sinks" and upwelling would also affect groundwater flow and influence spreading of contamination in the study area.

7. In addition to tidal loading effects increasing the spreading of contamination, pumping of water supply wells also influence the direction of flow and draw contamination deeper into the soil and weathered and fractured bedrock resulting in additional spreading. An assessment of the zone of drawdown influence under existing Department of Environment approved pumping rates was carried out by Craig Hydrogeologic Inc., April, 2011, for the MEL and FN properties, (Affidavit document A-662, Appendix 30). The groundwater capture area reflected by a pumping rate of 250 GPM for FN operations (operational range from 200 to 350 GPM) includes the IOL bulk plant and former tanker car unloading area, the underground petroleum gasoline and fuel oil pipeline, former CN ROW owned by the Town of Shippagan, and Street ROWs and SCH/DFO property that have all been assessed to be contaminated. Craig indicates that "Any properties which are located within the groundwater capture areas of the pumping wells and which have sources of groundwater pollution/contamination pose a risk to the pumping wells."

8. Pumping of remedial wells and utilizing recharge galleries would also influence the direction of flow and draw contamination deeper into the soil and weathered and fractured bedrock as well, resulting in further spreading of contamination. A cross section of the overburden and bedrock conditions is provided in Figure 3-2, also included in Appendix 72, shows the recovery wells and monitoring wells MW5S and MW5D. IOL installed remedial wells to depths of 8 metres into the bedrock. Adjacent monitoring well MW5D installed 5 to 6.5 m into the bedrock subsequently showed free phase product to be present in May 1994, compared to non-detectable concentrations prior to May 1994. Another adjacent well MW5S showed free product in May 1994, but in December 1993 only showed low concentrations. The top 5 metres of the bedrock is completely to highly weathered and significantly fractured. Photos of the fractured bedrock conditions observed during excavation activities and downhole videos of monitoring wells on the IOL property and central area of FN/MEL properties about 18 metres from the FN well and several metres from the IOL underground gasoline pipelines are also provided in Appendix 72. A downhole video was taken in 2000 and it is reported that oil like globules were evident in the water column (A-57, Appendix 32 is provided as a digital video included as a separate digital file that can be opened using the open source video program "VLC media player"). A still photo at time frame 14h18m17s247 from the aforementioned video and a photo of a water sample collected during purging of the well are provided in Appendix 99. Video stills showing the highly fractured bedrock are provided in Photos 3-15 to 3-18 (also in Appendix 72) for 16MW20A located on the IOL bulk plant property, and Photos 3-19 to 3-22 (also in Appendix 72) for 16MW22B located on the MEL property opposite the FN industrial/commercial water supply well. The bedrock shows large fractures including cave and rubble fractures with vertical fractures extending several metres. The cobble and cave fractures appear to represent zones of significant fracturing that extend with a downward dip from the IOL site and the wharf. Water flow rates for these zones ranged from 20 GPM to 50 GPM.

9. The **pumping** operations of the FN water supply well alone would act to **draw and spread contamination into the soils and completely to highly weathered and fractured bedrock**, with pumping of remedial wells on the IOL bulk plant site and DFO/DNR properties and the Town of Shippagan municipal wells significantly adding to this effect. The FN wells and remedial systems installed to remediate contamination in association with the two IOL underground gasoline pipelines would also promote flow to these properties from the IOL bulk plant and tanker car offloading areas and also draw the contamination from those areas deeper into the soil and weathered/fractured/bedrock. In addition, the FN well would also draw contamination associated with the two IOL underground gasoline pipelines deeper into the soils and bedrock. The FN well is located about ten metres from the location identified as "pipeline break" that is located in the area of the gasoline pipelines where the highest concentrations were reported for soils and groundwater. See Figure 4-2, also included in Appendix 97, with location of well identified as WS/FN WELL and "Pipeline Break". Maximum drawdown would occur in this area and given concentrations associated with the gasoline pipelines were extremely high in this area, it would not be unexpected to result in higher concentrations in the deeper bedrock in this area as determined from these investigations as indicated by the BTEX and TPH values shown for groundwater on Figure 3-3 (also included in Appendix 72). A TPH value of 65 mg/L is shown for the FN well with monitoring wells MW30D, 16MW24, Three-DWS also showing relatively high values compared with some shallow wells showing comparatively lower values (18MW160 shows a value of 0.24 mg/L for TPH). In addition, operation of the remedial wells installed to remediate the IOL bulk plant site and contamination associated with the two IOL underground gasoline pipelines concurrent with the FN well would result in contamination being drawn deeper into the bedrock. This would be further exacerbated during operation of the Town Well located near 12th St.

10. Free phase (floating) petroleum product was detected/reported on the IOL property in December 1990 with sampling in November 1989 showing gasoline at all locations. Free phase product was widespread on the IOL bulk plant property with no free phase product being reported for the EFL property in April 1992 and petroleum hydrocarbon concentrations several magnitudes lower than the IOL bulk plant and IOL/EFL plant boundary. Free phase petroleum product was reported for several MWs located between the IOL truck loading rack and 14th St., between December 1990 and June 2007, with free phase product thicknesses in the order of 35 cm reported in May 1993, and being reported frequently thereafter. **For May 1993 (A-485 in Appendix 123) TPH concentrations on the EFL property ranged from non-detectable at MW11 and MW14 to 3,100 mg/L at MW15 (at edge of ELF building opposite the IOL bulk plant property) compared with values ranging from non-detectable to 13,000 mg/L at MW6 (at the EFL/IOL property boundary and adjacent to the petroleum spill "sump collection trench" of an IOL tank farm). Free product thicknesses were greater on the bulk plant site for MWs located between the truck loading rack and 14th St.**

    It is also important to note that free product was removed from the MWs using bailers as part of monitoring efforts. Given that bailers were used to remove free product and thicknesses of 15 to 37 cm were commonly recorded between December 1990 and January 1995, thicknesses of up to 4 cm being measured thereafter, and remedial pumping wells were installed in October 1992 to remove contaminated groundwater, and soil and groundwater concentrations established in 2016 for the IOL bulk plant still showed similar concentrations to 1989, this would indicate that a very large quantity of petroleum product was released on site (see section 1.3). The long term release of petroleum product as indicated above is equivalent to an historically long term persistent source, that would contribute to further spreading of contamination and a continuing long term persistent source.

    It appears from this assessment that spills on site were a regular occurrence but quantities in some cases were simply estimates, with other cases normally indicated to be "unknown quantity" (see

Section 1.3). It was further noted in a letter dated July 8, 2005 from Mr. J. Paul Harquail, provided in response to Undertaking 63 from the Examination of Discovery Court File No. M/C/0793/02, March 2004, pages 368-369 Q.989 (in Appendix 88) concerning records **(blue book) of daily inventories for tank contents, that it was indicated "We continue to take this undertaking under advisement to determine issue of relevance and commercial sensitivity, however, we have not located such documents.". This information would provide an indication of the "unknown quantity" released for spills and operations in general as this information is intended to achieve as well. Daily budget provides an indication if leaks are occurring from tanks and piping.**

11. Given the behaviour of groundwater flow due to groundwater pumping operations on the FN property pumping of wells for the Town Water Supply, pumping of remedial wells and return of treated groundwater to the recharge galleries for remediation on the DFO and DNRE properties, extensive underground services that provide for preferential flow conditions across the properties for the movement of contaminated groundwater, and tidal loading/influence in combination with the long term presence of petroleum hydrocarbons and PAHs in the soils, weathered and fractured bedrock, groundwater and harbour sediments, it is reasonable to expect that contamination present on the EFL, FN, MEL, former CN ROW and SCH/DFO properties associated with the IOL bulk plant operations and underground gasoline transfer line represents an historical and on-going persistent source of contamination to these properties, and in turn to the marine environment.

12. With regards to spreading of contamination, it is also noted that there was an incident in December 1997 that required a lift station located on 16th St, one street over from 14th St. for the IOL bulk plant, to be shut down due to gasoline infiltration into the sewer lines between 12th St. and 15th St. (see Section 9.5a in FN A-1887 a in Appendix 64). Gaskets on the sewer line were reported to breakdown due to gasoline in the soils and groundwater in the area of 12th St. to 15th St., with the IOL bulk plant and underground petroleum transfer lines being located between these streets. NBDELG measured the gasoline content in the manhole at 67 percent. Product was removed from a manhole with pumping carried out over a 25 day period using a pump with a pump rate of 400 gallons per minute that was operated 24 hours a day until the gasoline level diminished below the explosion level. The remaining product was allowed to move through the system to the Town lagoon, although it is reported that the system was not equipped to provide treatment, with discharge to the ocean. This may have resulted in the discharge of effluent of unacceptable quality into the harbour.

    The volume pumped to achieve non-explosive conditions would be very significant with a significant amount remaining in the lines given the concentration level, indicating a very large volume of product having been released and only a portion likely being drawn into the sewer system. The remaining portion would migrate through the soils and groundwater and add to additional spreading of contamination. Deterioration of gaskets on the lines was reported to be due to petroleum product in the soils. These deteriorated lines would provide an opportunity for contaminated groundwater to be "sucked in" to the sewer lines. This condition would also affect the spreading of contamination. Storm lines that discharge to the harbour would also be susceptible to deteriorating gaskets and provide an opportunity for contaminated groundwater to move more easily and faster to the marine receiving waters.

13. **A comparison of TPH concentrations for the ACER 2016 investigations (Figures 4-1 and 4-2, also in Appendix 97) and IOL consultant investigations in 1989 (Figures 4-3 and 4-4) for the IOL bulk plant property show the following:**

    - concentrations for TPH in the soil are significantly higher for 2016, compared with locations previously sampled in 1989, with maximum values of 23,000 mg/kg in the fuel oil and gasoline range compared with

230 mg/kg in the gasoline range in 1989. Elevated concentrations for TPH in 2016 occur in the area of the south east corner of the tank farm dike, where the underground pipe network for the tanker truck offloading facilities and underground gasoline transfer line that extends to the wharf cross the dike boundaries, and in the area of the former rail tanker car offloading facilities.

- concentrations for TPH in the groundwater are similar for 2016 compared with locations previously sampled in 1989 for the bulk plant property, with maximum values of 45 mg/L in the fuel oil and gasoline range in 2016 and 56 mg/L in the fuel oil and gasoline range in 2017 compared with 46.10 mg/L in the gasoline range in 1989.

- concentrations for TPH in the groundwater are greater for 2016 compared with locations previously sampled in 1989, with maximum values of 56 mg/L in the fuel oil and gasoline range for 2016 sampling location compared with 46.10 mg/kg in the gasoline range in 1989. Of note was that t**he maximum concentration for the drilling program in May 2016 for the bulk plant site was 45 mg/L compared with a value of 56 mg/L obtained a year later in May 2017 for groundwater monitoring with *concentrations showing a general increase* between May 2016 and May 2017. A sample was collected at MW7A in August 2016 for comparison with May 2016, thereby allowing about 4 months for the wells to acclimate (more pristine condition). A TPH value of 8.7 mg/L was obtained in August compared with the May 2016 value of 2.9 mg/L at 16MW7A, located adjacent to the eastern containment dike. Several water samples collected a year later in May 2017 on the IOL bulk plant showed higher concentrations than previous sampling in 2016, concentrations increasing from 8.6 mg/L to 21 mg/L at 16MW17, from 13 mg/L to 16 mg/L at 16MW13, from 5.4 mg/L to 8.7 mg/L at 12MW72, 2.5 mg/L to 3 mg/L at 16MW16. A concentration of 56 mg/L was obtained at 16MW13 compared with the adjacent 16MW11 that previously showed 45 mg/L.**

- elevated concentrations for TPH in the groundwater in 2016 occur in the area of the south east corner of the tank farm dike, where the underground pipe network for the tanker tuck offloading facilities and underground gasoline transfer line that extends to the wharf cross the dike boundaries, and in the area of the former rail tanker car offloading facilities. Concentrations were also elevated near 14th St, that the IOL consultant indicated would provide a "french drain effect" (see Figure 1-5, also in Appendix 24) that would draw contamination across the IOL property, and continue along 14th St. and spread to other areas via the extensive network of underground services and areas with lower gradients as discussed herein.

14. TPH concentrations for soil and groundwater for the IOL bulk plant area and the FN, MEL and DFO/DNRE properties in August 1998 are shown in Figures 4-15 and 4-16 (also provided in Appendix 96), respectively, as an overlay on an ARC site drawing. This represents investigations associated with the underground gasoline transfer pipeline, prior to any remedial operations being implemented by IOL on the DFO/DNRE properties in association with contamination associated with **the two IOL underground gasoline transfer lines located on the former CN ROW**. An IOL consultant indicated that the lines "**were suspected of having been leaking during their operating life".** A comparison of the August 1998 contours with ACER 2012 investigations indicates the following:

    - sources of contamination continue to be indicated by the tanker offloading and truck loading rack area and the tanker car offloading facility as per previous years with PHC concentrations on the FN and MEL properties in 2012 being similar to reported values on the IOL bulk plant and rail tanker car unloading facility in 1998.

- the pattern of contamination shown for groundwater in 1998 is somewhat similar to that assessed by ACER for 2012 for the FN and MEL properties, with higher concentrations noted in the central portion of the properties, in the area of the FN water supply well where contaminated water would be expected to be drawn to by pumping operations. The former CN ROW/driveway between the FN and MEL properties where the two IOL underground gasoline pipelines are located shows the highest concentrations, as would be expected given preferential groundwater flow conditions and bulk plant and pipeline being apparent source locations, with concentrations generally deceasing to the north on the opposite side of the FN and MEL properties, as would be expected given apparent bulk plant and pipeline source locations. The groundwater flow directions and concentration contours indicate the IOL underground petroleum transfer line represents a contributing source to adjacent areas.
- TPH concentrations in the soil and groundwater were significantly higher for 1998 compared with ACER 2012. Remedial activities were apparently discontinued circa 2011, but concentrations of PHCs and naphthalene for the ACER sampling program show exceedences of soil and groundwater as well as aquatic criteria in consideration of the groundwater to surface water pathway including groundwater in the bedrock aquifer.
- concentrations in the groundwater were lower for the IOL bulk plant compared with the down gradient area for the August 1998 sampling, but it is also noted that concentrations in the groundwater for the IOL bulk plant showed similar concentrations several months prior to the August data and is shown to be highly variable historically. This is likely due to spring and fall groundwater recharge periods as well as other significant rainfall events. The higher concentrations for contaminated groundwater on the IOL bulk plant property that migrates to down gradient areas would be expected to show a decrease and likely contributed to the higher concentrations down gradient given time factors.

15. Sampling showed PHC concentrations in soils (assessed as sediments in accordance with CCME and RBCA requirements) and groundwater (assessed as water quality for aquatic life in accordance with CCME and RBCA requirements) that exceeded CCME and RBCA criteria at the SCH property boundary with FN and MEL and the former CN ROW where the two IOL underground gasoline pipelines are located Concentrations of PHCs in soils and groundwater between this boundary and the edge of the wharf also showed exceedences, with concentrations at locations at the edge of the wharf showing exceedences. Also noting that criteria apply to a distance of at least 10 metres beyond this boundary, but with application at the contaminate source boundary in recognition of preferential pathways afforded by the highly fractured bedrock, in accordance with CCME and RBCA.

16. Remediation programs carried out for the IOL Bulk plant property and area associated with the underground gasoline pipeline contamination did not provide adequate containment and did not maintain concentrations of PHCs and naphthalene to levels that no longer represented a risk or liability to adjacent and nearby property owners including MEL, FN, ELF, the Town of Shippagan, SCH/DFO (PID No. 20374203, 20373775), International Seafood and Bait (PID No. 20374518), Enterprises Shippagan Limitee and Robigate Inc. (PID No. 20739108), Enterprises Shippagan Limitee and Sea-Alex Inc. (PID No. 20731188), Ville De Shippagan (PID No. 20374104), Chez Robichaud Ltee (PID No. 20371035), [redacted] (PID No. 20374567), [redacted] (PID No. 20373114), [redacted] (PID No. 20371373), [redacted] (PID No. 20370797), [redacted] (PID No. 20371431), [redacted] (PID No. 20377602), [redacted] (PID No. 20371142), Government of Canada-Public Works (PID No. 20528196), New Brunswick Transportation and Infrastructure (PID No. 20834990, 20838231). These properties include commercial, industrial, residential and institutional land use.

Petroleum hydrocarbon impacts to adjacent and nearby properties occur at concentrations that exceed the RBCA and CCME criteria in consideration of the groundwater to surface water pathway to the marine receiving environment and therefore represent an additional liability for these properties, including MEL, FN, EFL, the Town of Shippagan, SCH and others. Contamination in the soils and bedrock on those properties and the IOL bulk plant and tanker car unloading area represent a long term persistent source of contamination to the marine environment. An effective remediation program would require consideration of the entire area to ensure that recontamination of individual properties does not occur as a result of contaminate spreading due to the extensive network of underground services, tidal loading effects and conflicting remedial well as also recommended historically by the DFO consultant and Three-D GeoConsultants Ltd.

Soil Analysis Results

Analysis results for soils are provided in Tables 1 to 11 contained in Appendix 75. The footprints showing the extent of contamination in soils in consideration of human health and the groundwater to surface water pathway for aquatic life are shown in Figure 3-5, also included in Appendix 76.

17. Analysis results for soils show petroleum hydrocarbon concentrations exceed RBCA Residential ***Potable*** **Water criteria** in consideration of human health, including use of the salt/water aquifer by FN/MEL for food grade processing operations, and ice plant operations at the wharf for commercial fishing operations. See Table 1 in Appendix 75.

18. Analysis results for soils show petroleum hydrocarbon concentrations **also exceed** RBCA Residential ***Non-*** **Potable Water** criteria in consideration of human health. See Table 2 in Appendix 75.

19. Sampling results for subsurface soils show petroleum hydrocarbon concentrations exceed CCME criteria in consideration of leaching into groundwater and risks to groundwater aquifers used for the commercial FN/MEL food grade processing operations and ice plant operations at the wharf for commercial fishing operations. See Table 3 in Appendix 75.

20. Analysis results for soils show petroleum hydrocarbon concentrations exceed RBCA criteria in consideration of Pathway Specific Screening Levels (PSSL's) for soil leaching into groundwater and risks to groundwater aquifers used historically for commercial FN/MEL food grade processing operations and ice plant operations at the wharf for commercial fishing operations. See Table 4 in Appendix 75.

21. Also of note, given that RBCA PSSL concentrations for groundwater consumption identified in Table 4 in Appendix 75 (as per Item 20) are higher than criteria applicable for marine receiving waters and with a transport distance of zero applied due to preferential pathways, concentrations in the groundwater would also exceed the marine guidelines for the groundwater to surface water pathway recognizing preferential flow pathways are a concern in accordance with RBCA protocol.

22. Analysis results for soils show petroleum hydrocarbon concentrations exceed RBCA criteria in consideration of PSSL's for vapour inhalation. See Table 5 in Appendix 75. There was an office building located on the IOL bulk site and the concentrations recorded would likely have represented a health risk. Concentrations were noted to be significant in the shallow and near surface soils. Given that the depth to the ground water table typically ranged from 1.66 to 2.56 metres below surface grade, but with depths of 0.55 to 1.36 metres observed during periods of recharge events that would include seasonal fall and spring conditions. A number of sampling locations on the IOL site were noted to be less than 10 cm below surface grade during a number of monitoring events. This represents a further contributing factor to health risks. Also see items 23 and 31.

23. Sampling results for subsurface soils show petroleum hydrocarbon concentrations exceeded CCME criteria in consideration of vapour inhalation. See Table 6 in Appendix 75. Also note items 22 and 31.

24. Sampling results for subsurface soils show petroleum hydrocarbon concentrations exceed CCME criteria in consideration of Soil Management Considerations for Free Phase Formation, Explosive Hazards, and Buried Infrastructure Effects. See Table 7 in Appendix 75.

25. Sampling results for subsurface soils show petroleum hydrocarbon concentrations exceed CCME criteria in consideration of leaching into groundwater and risks to marine life recognizing preferential flow pathways are a concern in accordance with CCME protocol. See Table 8 in Appendix 75.

26. Sampling results for soils show petroleum hydrocarbon concentrations exceed RBCA and CCME soil ecological screening criteria for protection of plants and invertebrates. See Table 9 in Appendix 75.

27. Sampling results for soils show petroleum hydrocarbon concentrations exceed RBCA and Alberta Environment soil ecological screening criteria for protection of wildlife (mammals and birds). See Table 10 in Appendix 75.

28. Sampling results for soils show PAH concentrations exceed CCME criteria in consideration of human health. See Table 11 in Appendix 75.

Groundwater Analysis Results

Analysis results for groundwater are provided in Tables 12 to 18 contained in Appendix 77. The footprints showing the extent of contamination in groundwater in consideration of human health and the groundwater to surface water pathway for aquatic life are shown in Figures 3-6, and Figure 3-7, respectively, also included in Appendix 76.

29. **as indicated, concentrations for TPH in the groundwater are greater for 2016** compared with locations previously sampled in 1989, and also noting that groundwater monitoring showed ***concentrations at several locations increased*** **significantly between May 2016 and May 2017. See Item 13 for further details.**

30. Sampling results for groundwater show petroleum hydrocarbon concentrations for deep and shallow wells exceed RBCA and CCME potable water criteria in consideration of historical use of the salt/water aquifer by MEL/FN for food grade processing operations, and ice plant operations at the wharf for commercial fishing operations. See Tables 12 and 13 for RBCA and CCME criteria, respectively in Appendix 77.

31. As noted there was an office building located on the IOL bulk site. It was observed at a number of IOL monitoring well locations that during periods of recharge events, that would include seasonal fall and spring conditions, that the depth to groundwater was less than 10 cm below surface grade. This is considered to represent a contributing factor to health risks. Also refer to items 22 and 23.

32. Sampling results for groundwater showed petroleum hydrocarbon concentrations exceed RBCA and CCME groundwater ecological screening criteria for plants and invertebrates. See Table 14 in Appendix 77.

33. Sampling results for groundwater showed petroleum hydrocarbon concentrations exceeded RBCA criteria for the groundwater to surface water pathway, for protection of marine life recognizing preferential flow pathways are a concern in accordance with RBCA protocol. See Table 15 in Appendix 77.

34. Sampling results for petroleum hydrocarbons analysis presented in Table 16 in Appendix 77 show that concentrations for Benzene, Toluene and Ethylbenzene exceed the CCME guidelines for marine aquatic life in consideration of the groundwater to surface water pathway and also recognizes preferential pathways associated with underground services as well as bedrock fracturing and tidal considerations in accordance with CCME guidelines/protocol.

35. Sampling results for PAHs presented in Table 17 in Appendix 77 show that concentrations exceed CCME guidelines in consideration of the salt/water aquifer by FN/MEL for food grade processing operations, and ice plant operations at the wharf for commercial fishing operations**.**

36. Sampling results for PAHs presented in Table 18 in Appendix 77 indicate that concentrations exceed CCME guidelines in consideration of Marine Aquatic Life in consideration of the groundwater to surface water pathway and also recognizes preferential pathways associated with underground services as well as bedrock fracturing and tidal considerations in accordance with CCME guidelines/protocol**.**

37. Naphthalene was detected in the groundwater, but there is currently no guideline in place for this parameter in consideration of human consumption, only a soil based guideline. The U.S. Department of Health and Human Services concluded that naphthalene is reasonably anticipated to be a human carcinogen. Public Health Statement for Naphthalene, 1-Methylnaphthalene, and 2-Methylnaphthalene (Naftalina), August 2005 (http://www.atsdr.cdc.gov/toxprofiles/phs67.html).

    The United States government has developed regulations and advisories to protect individuals from the possible health effects of naphthalene in the environment. The Occupational Safety and Health Administration (OSHA) set a limit of 10 parts per million (ppm) for the level of naphthalene in workplace air over an 8 hour workday. The National Institute for Occupational Safety and Health (NIOSH) set a limit of 500 ppm for the level of naphthalene in workplace air expected to be immediately dangerous to life or health. Exposure to workplace air concentrations above this limit for more than 30 minutes would be expected to impair a worker's ability to escape the contaminated workplace. A preliminary qualitative risk assessment and/or air quality sampling is recommended for this parameter to further assess potential risks to receptors.

Sediment Analysis Results

Sampling of sediments for the marine receiving environment for this study involved surface sediment grab samples and deeper core sampling with depths of about 2 metres achieved. Analysis Results for Sediment Samples are contained in Tables 19 to 23, in Appendix 29. The footprint for contamination is shown in Figure 3-8, also included in Appendix 76.

38. Similar to historical assessments carried out on behalf of DFO/SCH between 1978 and 2013 for the harbour sediments, analysis results for sediments show petroleum hydrocarbon concentrations exceed RBCA sediment ecological screening criteria for the protection of marine life. See Table 19 in Appendix 29. The screening criteria of 25 mg/kg for diesel/fuel oil range hydrocarbons was exceeded as well as the maximum screening value of 500 mg/kg for modified TPH that is analogous to a “management limit” that is applied irrespective of the organic carbon content of the sediment. **It should be noted however, that the Total Organic Carbon (TOC) value for sediment samples obtained by AMEC from a nearby area with non-detectable petroleum hydrocarbon concentrations had a value of 2.2 g/kg which is 5 times lower than the TOC value used to establish the RBCA criteria of 25 mg/kg. As such, the RBCA criteria would have to be adjusted from 25 to 5 mg/kg, indicating risks to be even more significant to the marine environment.**

39. Similar to historical assessments carried out on behalf of DFO/SCH between 1978 and 2013 for the harbour sediments, analysis results for sediments show PAH concentrations exceed CCME Interim Sediment Quality Guideline (ISQG) criteria for the protection of marine life. See Table 20 in Appendix 29. The ISQG are intended to be used for evaluating the potential for biological effects, CCME, 1999, updated 2001.

40. Similar to historical assessments carried out on behalf of DFO/SCH between 1978 and 2013 for the harbour sediments, analysis results for sediments show PAH concentrations exceed CCME Probable Effect Levels (PEL) for marine life. See Table 21 in Appendix 29. The PEL is a CCME guideline that is indicated to represent a Probable Effect Level and the ISQL is an Interim Sediment Quality Level. The ISQG are intended to be used for evaluating the potential for biological effects, CCME, 1999, updated 2001. The PEL "defines the level above which adverse effects are expected to occur frequently"….."(i.e., more than 50% adverse effects occur above the PEL).",
41. Similar to historical assessments carried out on behalf of DFO/SCH between 1978 and 2013 for the harbour sediments, analysis results for sediments show metals concentrations exceed CCME ISQG criteria for the protection of marine life. See Table 22 in Appendix 29.
42. Similar to historical assessments carried out on behalf of DFO/SCH between 1978 and 2013 for the harbour sediments, analysis results for sediments show metals concentrations exceed CCME PEL criteria for the protection of marine life. See Table 23 in Appendix 29.

Of the 24 sample locations established for this assessment (over 80 samples collected for analysis), over 50% of the locations showed petroleum hydrocarbons, PAHs and metals that exceeded guidelines including core samples (depth of 2 metres). This represents an area of over 30 acres and the boundaries of contamination still requires further delineation. Contamination in sediments was evident at a distance of 2.6 km from the edge of the Shippagan wharf structure. Contaminates also exceed RBCA and CCME criteria 10 m landward of the **OHWM (represented by the Mean High Water Level-MHWL), with CCME requiring criteria to be applied a minimum distance of 10 m beyond the OHWM. The OHWM for the harbour area extends inside the north east corner of the FN fish processing building and is within 10 m of the MEL property.**

As indicated above for the soil and groundwater sampling for upland areas, concentrations of petroleum hydrocarbons and PAHs in the soils and groundwater exceed provincial and federal criteria for the protection of the marine receiving environment in consideration of leaching of contaminates from soils and the completely to highly weathered bedrock and transport to the marine environment, via preferential pathways associated with the extensive network of underground services and utilities, as well as extensive bedrock fracturing and tidal effects. The contaminated soils and weathered bedrock as well as the highly fractured bedrock represent long term persistent sources of contamination by way of leaching of contaminates into the groundwater and transport to the marine environment via the groundwater to surface water pathway that is further facilitated by the preferential pathways associated with the extensive network of underground services and fractured bedrock.

As indicated previously, during drilling of monitoring well 19MW150, located about 5 m from the corner of the wharf and adjacent to an underground storm discharge line, there was a loss of downhole water pressure at approximately 4 metres depth. Within several minutes, a cloud of dirty water was observed to be discharging from the storm line located at the corner of the wharf that spread across the inner harbour and persisted for several hours (see Photos in Appendix 100). This supports that the underground lines and road construction also provide a direct preferential pathway for release of contaminated groundwater to the harbour in addition to normal groundwater flow to the marine environment.

It was also noted that with the exception of the sample location near the channel of the outer harbour, the highest concentrations in the sediments were obtained along the edge of the old north wharf where the underground petroleum transfer lines are located. The highest concentration was near the edge of the wharf where the wharf begins, and further noting that contaminated groundwater from up gradient source areas associated with IOL operations and the underground gasoline transfer lines follows the preferential pathway afforded by 14th St. and the

former CN ROW/driveway containing underground services as well as 15th St., providing for a relatively direct flow pathway to the harbour and the storm discharge out fall is located.

An area referred to as the “pollution pit” involved excavation of contaminated soils in the summer of 1998 with IOL having paid the invoice associated with the transport of contaminated soils to Belledune, A-39 (Appendix 53). This area is located within the OHWM and as indicated, no sampling was carried out to confirm all contaminated soils had been removed. Also note Photos CA-357 and CA-359 in Appendixes 44 and 45, respectively, show excavation of contaminated soils for the Old North Wharf adjacent to the IOL underground petroleum transfer lines.

Petroleum hydrocarbons, PAHs, metals and other parameters identified in the sediments have been reported for land based sampling including the IOL bulk plant property and former CN rail tanker car rail spur unloading area, MEL, FN, ELF, former CN rail ROW, Town and SCH/DFO properties as well as other adjacent privately owned lands. These contaminated areas represent long term persistent sources of contamination to the marine environment recognizing the groundwater to surface water pathway and preferential flow conditions associated with underground services and the highly fractured bedrock, in addition to normal groundwater flow.

Concentrations for Total Petroleum Hydrocarbons in the harbour sediments were detected as high as 34,000 mg/kg **for previous assessments carried out on behalf of DFO/SCH**, exceeding the Provincial RBCA criteria value of 25 mg/kg (noting this value required adjustment to 5 mg/kg as discussed herein) that has also been adopted by the Federal government. Previous assessments carried out on behalf of DFO/SCH, dating back to circa 1978, were for surface samples only, with MGI indicating in 2003 that “depth profiling is required to fully define this contaminated site” in A-308 in Appendix 39.

In 2010 (Affidavit A-2712a in Appendix 117) a marine surface and core sediment sampling program was carried out by AMEC for a dredging project at the Marine Service Centre in Shippagan, located immediately south of the Shippagan wharf area on behalf of DFO (Figure 1 of the report). TPH concentrations for the four subsurface samples were less than the laboratory detection limit of 20 mg/kg, and would require analysis to lower levels for comparison with the applicable criteria of 5 mg/kg. However, it should also be noted that homogenization of the subsurface portion of the core samples from 0.6 m to 3.5 m (sample collection depth reported to be “below Lowest Normal Tide”) would result in an average concentration that would not provide a true reflection of peak concentrations within the sample zone.

For ACER 2018 investigations, core samples extended to a depth of 2 metres at a number of locations, that showed concentrations to be higher than the surface grab sample at specific locations, with contaminates also occurring to the full depth of 2 m. Core sampler refusal (penetration less than 25 mm for 15 blows) occurred at various locations and it is possible that the contamination may extend deeper at specific locations. Previous sampling carried out on behalf of DFO was by means of grab samples that only sample to a depth of 5 to 7 cm, and as such the extent and significance of contamination is more extensive than initially assessed on behalf of DFO.

Within the inner harbour and outer harbour near the wharf structures, it is reported that bed sediments are disturbed by commercial boats hauling catches, as evidenced from dirty water occurring in the water column and at surface in the harbour area. Loaded boats are reported to plough through the bottom sediments during low tides in particular. As such, the collection of core samples for this assessment allowed for analysis of sediments at depths greater than 5 cm to further assess that there is increased potential risks of concern to marine life due to re-suspension and transport of sediments below the surface.

Further to the individual analysis of parameters presented in Tables 19 to 23 in Appendix 29 for sediment samples, it is also critical to recognize that when assessing risks to the marine and inland environment that the assessment should also recognize the combined or synergistic effects of multiple contaminates (CCME, March, 1991). The known presence of multiple contaminates appears to have been ignored for the original National Classification System (NCS) for Contaminated Sites assessment and would have resulted in a higher score for several of the assessment items, in turn resulting in a higher cumulative score and indicating increased risk. It is likely that the same concerns would apply if the more recent NCS for contaminated sites was used. No further action was apparently undertaken for this site."

Assessments of contamination on behalf of DFO between circa 1978 and 2001 showed Polycyclic Aromatic Hydrocarbons (PAHs), heavy metals, PCBs (values ranging from 1 to 21.4 µg/kg compared with the CCME ISQG value of 21.5 µg/kg) and the pesticide DDT (values ranging from 2.6 to 11.8 µg/kg compared with the ISQG value of 1.19 µg/kg) have also been identified in the sediments with select parameters exceeding CCME guidelines and the 1991 guidelines for Ocean Disposal. Analysis detected PAHs exceeding PELs. A Marine and Aquatic Site Classification were carried out for the waterlot on behalf of DFO in 2002 as part of a Phase I ESA carried out for the SCH. It was indicated that "The procedure indicated a Hazard Ranking Score of 2 which results in a "Medium-high Priority Site" ranking, in A-307 in Appendix 42. Additional limited sampling of sediments as part of Phase II and III follow up investigations was carried out in 2003 and 2013 on behalf of DFO/SCH that showed locations having higher concentrations of petroleum hydrocarbons (34,000 mg/kg compared with previous maximum value of 2,700 mg/kg than previous sampling compared with the guideline of 25 mg/kg that should be adjusted to 5 mg/kg based on the Total Organic carbon value for sediment established for the AMEC sampling program carried out in 2010) and identified a larger area of contamination but did not included any depth profiling, or establish the outer boundaries of contamination, or updating of the 2002 Marine/Aquatic Site Classification.

In the AMEC report summary 2010 (Affidavit A-2712a in Appendix 117) it is indicated that the analytical results of the ten samples analysed showed that the sediment did not meet the Canadian Environmental Protection Act (CEPA) Ocean Disposal Guidelines, CCME Interim Sediment Quality Guidelines (ISQGs) and Probable Effect Levels (PELs) for marine/estuarine environments in consideration of ocean disposal.

To our knowledge there has been no action taken by DFO/SCH to address contamination issues at the time of report preparation. The additional sampling carried out by the SCH/DFO consultants between 2003 and 2013 and ACER in 2018 shows the aerial extent of contamination to be much larger, and with contamination extending 2 metres below the surface grab sample depth of 5 cm. The higher concentrations, increased aerial extent established by the SCH/DFO consultants and ACER after 2002, and greater depth of contamination established by ACER after 2002 when a Marine and Aquatic Site Classification Hazard Ranking Score of 2, that results in a "Medium-high Priority Site" ranking, was first determined, further demonstrates the high risks to the marine receiving environment.

The IOL bulk plant and tanker car offloading area, IOL underground petroleum transfer line(s) and former CN ROW represent apparent sources of significant contribution given 4,617,406 litres of product has been spilled from the bulk plant operations alone (see details in Section 1.3) and that the underground gasoline line was assessed to have been leaking for the entire life of the pipelines. The contamination that has in turn resulted to the MEL, FN, EFL, Town and SCH properties and other adjacent privately held properties in association with the IOL properties, facilities and operations have also in turn become long term persistent sources of contamination to adjacent and neighbouring properties and the marine receiving environment. It is recognized that other inherent non-point sources are associated with harbour related activities but would be expected to be comparatively limited.

6.2 Petroleum Hydrocarbon and PAH Contamination Sources

The former IOL bulk plant and associated operations including the former CN Tanker car Off-Loading facilities and rail spur and the two IOL underground gasoline transfer lines that extend to the wharf within the former CN ROW, represent apparent sources of contamination to the FN, MEL, EFL, Town and SCH/DFO properties as well as a number of other properties (see Item 16) given the following:

- concentration contours show elevated concentrations for soil and groundwater that are representative of petroleum source areas, with concentrations on third party properties being lower (Section 4.3), Figures 4-1 and 4-2 (also contained in Appendix 97) current ACER investigations, Figures 4-7 and 4-8 (also contained in Appendix 98) between 1989 and 1992 before remediation measures were implemented, Figures 4-15, 4-16 (also contained in Appendix 96) for investigations in 1998 (also in Appendix 96);
- the relative thickness of free phase product above the groundwater measured to be in the order of 35 cm and evident on the IOL property between 1990 and 2007, as reported by the IOL representatives, and being significantly higher for the IOL property compared with the adjacent properties based on historical monitoring by IOL representatives.
- the relative concentrations for contaminate parameters in the soil and groundwater as reported by the IOL representatives between 1992 and 2007 (last available document), being significantly higher for the IOL property compared with the adjacent properties based on historical monitoring by IOL representatives.
- groundwater flow conditions demonstrate that flow occurs from these properties onto adjacent and nearby properties, with concentrations on third party properties being lower;
- frequent spillage on the IOL bulk plant property including large quantities of petroleum product and lack of effective remedial action and containment of contamination;
- contamination in the soils and groundwater on these properties, the bulk plant property more specifically, showed concentrations to be higher at the property boundaries compared with third party properties and represents a long term persistent source of contamination;
- presence of underground services and preferential pathways for contaminate migration to areas with lower gradients;
- there were no other apparent sources identified/evident based on the sampling program, with the exception of the area of 01MW4. ACER 2016 investigations for this area indicated the contamination to be a localized source. The IOL underground diesel oil transfer line is located in this area with the location of 01MW4 being located immediately adjacent to the line and shows the highest concentrations for this area. Therefore the pipeline is considered to be the apparent source. The Acer investigations indicated the contamination to extend beyond the DFO and FN property boundary (refer to Figures 4-1 and 4-2 in Appendix 97 for contamination contours); and
- given the large footprint for soil and groundwater contamination identified, and the long time frame for contaminates to persist, a large volume of product would have to be released such as the IOL operation.

Additional supporting comments are provided below.

As indicated by Doug Craig in FN A-2721 in Appendix 111, “An examination of a property map shows the spatial relationship of the individual properties, the IOL bulk plant property is located further inland from the seacoast than portions of the FN Pecheries Ltee., Property (FN), the Marine Extract Limited Property (MEL) and the Eastpre Feeds Ltd property. This spatial relationship will result in a net groundwater flow beneath the IOL property and

moving beneath the FN, MEL and EFL properties, towards the sea. Any dissolved groundwater contaminates will move with the groundwater flow." **The groundwater flow in turn will also be affected by historical pumping of the water supply well for the FN operations, operation of one of the Town municipal wells, as well as remedial wells installed into the bedrock on the IOL bulk plant property and in association with the two IOL underground gasoline transfer pipelines**, drawing contamination across properties and deeper into the completely to highly weathered and fractured bedrock.

Lack of action by IOL in implementing clean-up measures provided an opportunity for contaminants to continue to migrate/move off the bulk plant site and CN ROW/driveway. Documentation shows that the DELG (note that NBDELG, DOE and DELG are the same) has continually had non-compliance issues with IOL (1989 trough to 2016) regarding the petroleum hydrocarbon spill that occurred on September 24, 1989, including non-compliance with the Ministerial Order in regards to the initial assessment of the extent of contamination in the soil or groundwater, inadequate and incomplete installation/implementation of remedial systems/measures and ongoing reporting and maintaining effective remediation measures (see Section 1.4).

Free product was detected on the IOL bulk plant property in December 1990. Free product was reported frequently for the IOL bulk plant for a number of monitoring wells through to October 1992, with thicknesses being most significant in the area of BH5 to BH8 adjacent to 14th St., before remedial wells were installed with measurements up to 37 cm. Free product continued to be reported for a number of wells to 2007, with thicknesses being most significant in the area of BH5 to BH8 adjacent to 14th St. Free product was also indicated to be present at MW14 on the EFL property for one of the two monitoring events conducted in 2007.

The high values shown for the contamination contours near 14th street and CN ROW/driveway on the west side of FN for the rail tanker car offloading facilities, support that the streets containing underground services provide a "french drain" effect (see figure 1-5 in Appendix 24), with preferential flow conditions for contaminants to move down gradient faster as part of groundwater flow onto properties of interest and ultimately to the marine environment. The volume of contaminated groundwater moving off-site would be particularly significant from December 1990 to October 1992 before remedial wells were finally installed and free product thicknesses of 37 cm were available. However, it is important to also note that a recovery well was not installed in the area of BH5 to BH8 located between the truck loading rack and 14th St,. until November 1993 to prevent migration onto 14th St. As indicated previously, migration off site continued to be a concern given concentrations being reported at MW3, located at the juncture of It is also noted that the remedial wells for the IOL bulk plant and contamination associated with the two IOL underground gasoline pipelines were reported to be non-operational for extended periods of time (months) and frequently for several days due to failure and repair issues. This would provide further opportunity for contaminants to move off site and contribute to further spreading of contamination in the study area.

It is also noted that the remedial wells for the IOL bulk plant and contamination associated with the two IOL underground gasoline pipelines were reported to be non-operational for extended periods of time (months) and frequently for several days due to failure and repair issues. This would provide further opportunity for contaminants to move off site and contribute to further spreading of contamination in the study area.

Contamination contours for TPH concentrations in soil and groundwater for the IOL bulk plant and other areas investigated by ACER are shown in Figures 4-1 and 4-2 (also in Appendix 97), respectively. Remediation was apparently discontinued on the IOL property circa 2003 and apparently also discontinued with respect to contamination associated with the two IOL underground gasoline pipelines on the former CN ROW DFO/DNR properties, that also represents an apparent source of contamination to FN/MEL and other properties of interest. Investigations show PHC concentrations in the soil and groundwater to be higher for areas previously sampled

compared with investigations by IOL in 1989 with current concentrations continuing to exceeded RBCA and CCME criteria.

As indicated, a significant increase in concentrations was noted on the IOL bulk plant property and tanker car unloading facility for years 1992 and 1998. Free phase product was measured in monitoring wells with levels up to 37 cm and free product still reported in 2007, being the last report available and not provided until 2014. EFL was shown to be contaminated throughout sample monitoring by IOL consultants with the bulk plant being the apparent source.

Flow directions are shown on ACER Figure 3-4 also in Appendix 73. Groundwater flow occurs from the IOL bulk plant property in all directions;

- northerly onto the EFL property and residential properties;
- southerly onto 14th St., (Town property) and the Enterprise Shippagan Ltd. property;
- westerly onto several commercial and institutional properties;
- and easterly onto the FN and MEL properties and former CN Rail ROW (Town property that is also used as a driveway and contains the two IOL underground petroleum transfer pipelines), 15th St. (Town property) and SCH/DFO property, ultimately discharging to the harbour.

Investigations carried out in 1998 for down gradient properties, including FN and MEL, the former CN ROW/driveway with the underground gasoline pipeline and SCH/DFO properties and 15th St., show concentrations extend along 14th St. onto the CN ROW containing the gasoline pipeline and 15th St, with concentrations generally being highest in the area of the pipeline and immediately adjacent areas, being the FN and MEL properties, Figures 4-15, 4-16 (also contained in Appendix 96. Locations with elevated concentrations under the FN/MEL buildings are attributed to underground water and sewer services providing preferential pathways from the adjacent contaminated CN ROW and/or possibly localized pockets that may have formed in the past during periods when higher concentrations were available and less susceptible to natural degradation processes and flushing. Concentrations on the FN and MEL properties showed deceasing trends between the CN ROW/pipeline area and opposite side of the properties.

Monitoring carried out by ACER and the IOL consultants show groundwater flow gradients favour roadways with underground services including 14th St. and the former CN ROW/driveway located between the FN and MEL properties, and are representative of preferential flow pathways. Groundwater contours show flow occurring from the IOL bulk plant property toward 14th St. and continuing onto the former CN ROW/driveway area between the FN and MEL properties with northerly and southerly flow components occurring onto the FN and MEL properties, respectively. Contamination identified in association with the two underground gasoline lines located within the former CN ROW, reported to be “suspected of having been leaking during their operating life” circa 1938 by an IOL consultant, would also spread across the FN and MEL properties as well as onto the SCH/DFO property, and ultimately discharge into the harbour. Flow also occurs in a landward direction from the SCH/DFO property onto the former CN ROW between the FN and MEL properties, with flow components occurring northerly and southerly onto the FN and MEL properties, respectively.

As indicated, the IOL consultant commented in a monitoring report for the IOL bulk plant property dated January 9, 1993 (A-481a and A-470 in Appendix 24 including an IOL consultant Figure provided in this report as Figure 1-5) that "Outside of the influence of the two remedial wells, groundwater flow appears to be taking place in a south-easterly direction towards 14th Street. This street appears to act as a groundwater sink as the three monitoring wells to the southeast of 14th Street flow towards the northwest. The groundwater contour centred on MW13 also

indicates that there is a groundwater sink between 14th Street. It is likely that the installation of services such as sewers and water mains and the ensuing backfill with coarse material may in fact act to provide a “french drain effect” along the pipeline. This could account for the apparent observed groundwater data." Refer to Figure 1-5 (also contained in Appendix 24).

The DELG **and IOL consultant (WMS/ARC) continually expressed concerns regarding concentrations at MW13 and off-site migration in the direction of the CN ROW/driveway, FN, MEL, SCH/DFO properties and harbour. The DELG directed IOL to install additional MWs to further assess conditions further down gradient on numerous occasions, and the IOL consultant also recommended additional MWs, but IOL disregarded these requests.**

As indicated previously, during drilling of monitoring well 19MW150, located about 5 m from the corner of the wharf and adjacent to an underground storm discharge line, there was a loss of downhole water pressure at approximately 4 metres depth. Within several minutes, a cloud of dirty water was observed to be discharging from the storm line located at the corner of the wharf that spread across the inner harbour and persisted for several hours (see Photos in Appendix 100). This supports that the underground lines and road construction provide a preferential pathway for release of contaminated groundwater to the harbour in addition to normal groundwater flow to the marine environment.

It was also noted that with the exception of the sample location near the channel of the outer harbour, the highest concentrations in the sediments were obtained along the edge of the old north wharf where the IOL lines begin to cross the wharf, and further noting that contaminated groundwater from up gradient source areas associated with IOL operations and the underground gasoline transfer lines follows the preferential pathway afforded by 14th St. and the former CN ROW/driveway containing underground services as well as 15th St., providing for a relatively direct flow pathway to the harbour. It is also noted that the IOL underground petroleum transfer lines are located along the edge of the wharf.

Further similarities to previous IOL consultant reporting for groundwater flow, includes areas that show flow to be multidirectional due to **tidal loading effects that result in flow reversal** as well as drawdown conditions “sinks” or upwelling also being evident. The IOL consultant also observed flows to occur opposite/reverse to that shown in Figure 1-9 for May 1999 (also included in Appendix 24 and is an IOL consultant Figure), as shown in the IOL consultant drawing Figure 1-8 for July 1988 (also included in Appendix 24 and is an IOL consultant figure). The IOL consultant attributed this reversal to tidal loadings and small flow gradients for the general area. This flow behaviour is an important factor, in combination with the extensive network of underground services that cross properties and also extend under buildings, and bedrock fracturing and formation flow, that **results in the increased spreading of contamination in the study area**. **The significant vertical fractures would be conducive to contaminate migration into the deeper bedrock aquifer from the overburden/bedrock interface and in combination with the horizontal fracturing and flow gradients would promote/increase migration and spreading of contamination.**

With respect to the EFL property and several IOL consultant reports that contend that there is a petroleum source on the EFL or another property that is impacting the IOL and possibly other properties. Flow contours shown in Figure 3-4 (also in Appendix 73) show strong gradients from the IOL bulk plant onto the EFL property and towards other adjacent/nearby commercial and residential properties. Preferential flow conditions also exist between the bulk plant and the EFL property and 12th St. by way of;

- an underground line located between the EFL building and bulk plant property boundary; with

- a foundation wall that extends off the south end of the EFL building that connects with a partial basement at that end of the building; and
- underground service lines that extend to 12th St.

Preferential flow towards the EFL property is further afforded by the underground service trenches installed for the remediation system and sump collection trench that where petroleum spillage is collected for the containment dike (see Photo 4-4), that are located on the EFL/IOL northern property boundary. In addition, the underground fuel oil transfer line exits the dike near the sump trench and based on contamination contours, shown in Figures 4-1 and 4-2, (also provided in Appendix 97) for soils and groundwater, respectively, represents an apparent source of contamination to the EFL property and contributing source to the area of the former CN Rail tanker car offloading area. insufficient containment of contamination noting that RW2 located at the EFL and IOL property boundary drawing contamination in the direction the south west corner of the EFL building where MW14 is located, and increasing the potential for contaminant to move in that direction during periods of non-operation of the pumps (days to months)

There are a number of other factors supporting that the IOL bulk plant is the apparent source of contamination to the EFL property as detailed in Section 4.3.5, with several of the key factors identified as follows. Initial reporting by the IOL consultants showed concentrations to be much higher for the IOL bulk plant property (5 times) and more notably reported free phase product to be present on the bulk plant property in 1990 years before being detected on the EFL property in 1992. In addition, when free phase product was detected on the EFL property only a thin sheen was reported compared with 37 cm for the bulk plant, with significant thicknesses being reported frequently. Concentrations and free phase product thicknesses are expected to be higher for source properties. Further to this there are no apparent sources of contamination associated with the EFL property and concentrations at the up gradient property boundary show decreasing concentrations as would be expected based on groundwater flow direction and the bulk plant being an apparent source.

As documented in the AMEC 2001 report (A-280 in Appendix 78) prepared for IOL, the EFL property was identified as a contaminated site and was cleaned up with no further action required with confirmation sampling carried out by the DELG (see section 4.1.2 for historical review of study area on behalf of IOL. ACER note that this was equivalent to a Phase I ESA). Two 45 gallon storage drums containing refrigeration oil and stained surface soils were the basis for DOE indicating storage that the Eastpre Feeds Ltd. property required some remedial clean-up in November 1992. The two 45 gallon storage drums and seven 45 gallon drums of stained soils excavated from a localized area to a depth of about 20 cm, containing unidentifiable products in the heavy petroleum hydrocarbon range were removed, and sampling carried out by DOE in July 1993 confirmed remedial clean-up was acceptable. The remedial file was officially closed in March 1994 based on the July 1993 sampling. AMEC did not identify any apparent sources of contamination other than the bulk plant property and former CN ROW that includes the IOL gasoline pipelines.

In a letter from Service NB taxing authority to Eric Smith dated June 1, 1999 regarding the Eastpre Feeds Ltd (FN A-923 in Appendix 124) it is indicated that “After consulting with the Department of Environment and verifying the report on the property it was concluded that the property under referral” …..”The responsibility for cleanup belongs to Irving Oil Ltd.”.

The extent/footprint of contamination identified by the IOL consultant for the EFL, FN, MEL, Town, SCH/DFO for soils and groundwater shown on Figures 1-6 and 1-7 (also contained in Appendix 24), is consistent with the current ACER investigations as shown in Figure 3-5 for soils and Figure 3-7 for groundwater and human health. The extent of contamination for the aquatic site specific pathway and preferential flow considerations identified by

ACER is shown in Figure 3-7 (also in Appendix 76). **Concentrations are elevated along the preferential flow pathways as demonstrated by the contamination contours in Figures 4-1 and 4-2 for soil and groundwater (also provided in Appendix 97), respectively, and the IOL consultant Figures 1-6 and 1-7 (also contained in Appendix 24) as would typically be expected.**

As indicated previously, in addition to tidal loading effects increasing the spreading of contamination, pumping of water supply wells also influence the direction of flow and draw contamination deeper into the soil and weathered and fractured bedrock resulting in additional spreading (see Section 4.2). An assessment of the zone of drawdown influence under existing Department of Environment approved pumping rates was carried out by Craig Hydrogeologic Inc., April, 2011, for water supply wells on the MEL and FN properties, (Affidavit document A-662, Appendix 30). The groundwater capture area reflected by a pumping rate of 250 GPM (within the operational range of 200 to 350 GPM for FN) includes the IOL bulk plant and former tanker car unloading area, the underground petroleum gasoline and fuel oil pipeline, former CN ROW owned by the Town of Shippagan, and Street ROWs and SCH/DFO property that have all been assessed to be contaminated. Craig indicates that "Any properties which are located within the groundwater capture areas of the pumping wells and which have sources of groundwater pollution/contamination pose a risk to the pumping wells."

Pumping of remedial wells and utilizing recharge galleries would also influence the direction of flow and draw contamination deeper into the soil and weathered and fractured bedrock as well, resulting in further spreading of contamination. A cross section of the overburden and bedrock conditions is provided in Figure 3-2, also included in Appendix 72, shows the recovery wells and monitoring wells MW5S and MW5D. IOL installed remedial wells to depths of 8 metres into the bedrock. Adjacent monitoring well MW5D installed 5 to 6.5 m into the bedrock subsequently showed free phase product to be present in May 1994, compared to non-detectable concentrations prior to May 1994. Another adjacent well MW5S showed free product in May 1994, but in December 1993 only showed low concentrations. The top 5 metres of the bedrock is completely to highly weathered and significantly fractured.

Photos of the fractured bedrock conditions observed during excavation activities and downhole videos of monitoring wells on the IOL property and central area of FN/MEL properties about 18 metres from the FN well and several metres from the IOL underground gasoline pipelines are also provided in Appendix 72. A downhole video was taken in 2000 and it is reported that oil like globules were evident in the water column (A-57, Appendix 32 is provided as a digital video included as a separate digital file that can be opened using the open source video program "VLC media player"). A still photo at time frame 14h18m17s247 from the aforementioned video and a photo of a water sample collected during purging of the well are provided in Appendix 99. Video stills showing the highly fractured bedrock are provided in Photos 3-15 to 3-18 (also in Appendix 72) for 16MW20A located on the IOL bulk plant property, and Photos 3-19 to 3-22 (also in Appendix 72) for 16MW22B located on the MEL property opposite the FN water supply well. The bedrock shows large fractures including cave and rubble fractures with vertical fractures extending several metres. The cobble and cave fractures appear to represent zones of significant fracturing that extend with a downward dip from the IOL site and the wharf. Water flow rates for these zones ranged from 20 GPM to 50 GPM. The fractured bedrock represents a source pathway under natural groundwater flow conditions but is more significant in recognition that the IOL bulk plant property is located in the zone of influence for the FN water supply well and would draw contamination towards the CN ROW/driveway, FN and MEL properties and the SCH/DFO property.

The large contamination footprints for the soil and completely to highly weathered and fractured bedrock and groundwater would support that a very large quantity of petroleum product was released. As indicated previously, the IOL bulk storage facilities and boat tanker unloading facility at the end of the wharf and the two IOL

interconnecting underground gasoline pipelines were established in approximately 1938 (Affidavit document IOL A-8 in Appendix 13). Fifteen tanks were on the bulk site with a combined storage of approximately 5.5 million litres (1.2 million imperial gallons). A third pipeline was reportedly installed by IOL in 1953 as well as two additional petroleum storage tanks (Affidavit document IOL A-1 in Appendix 15). The rail tanker unloading facility was reportedly installed adjacent to the IOL bulk plant property in 1953 (Affidavit document IOL A-8 in Appendix 13). **Based on a review of historical documents related to reported and unreported spills, a volume of 4,617,406 litres was determined to have been spilled with respect to the IOL operations (see section 1.3).** The long term release of petroleum product as indicated above is equivalent to an historically long term persistent source, that would contribute to the spreading of contamination and a continuing long term persistent source.

Given the behaviour of groundwater flow due to groundwater pumping operations on the FN property associated with food grade operations, pumping of wells for the Town Water Supply, pumping of remedial wells and return of treated groundwater to the recharge galleries for **remediation on the DFO and DNRE properties**, **attributed to lifetime leakage of the two IOL underground gasoline pipelines** , extensive underground services that provide for preferential flow conditions across the properties for the movement of contaminated groundwater, and tidal loading/influence in combination with the long term presence of petroleum hydrocarbons and PAHs in the soils, bedrock groundwater and harbour sediments, it is reasonable to expect that contamination present on the SCH/DFO property related to the two IOL underground gasoline lines also represents a source of contamination to the FN and MEL properties, and in turn to the marine environment.

Existing conditions represent a long term persistent source of contamination for all properties in the area and risk to human health and the ecological environment.

6.3 Remedial Considerations

6.3.1 Land Based Areas

Given that there is an extensive network of underground services that provides preferential flow for faster and easier migration and spreading of contamination across properties and ultimately to the marine environment via the groundwater to surface water pathway, direct application of the aquatic life criteria at the property boundary of the source area(s), similar to the application of a transport distance of zero that is consistent with RBCA and CCME protocols, would be expected to address risks of concern. This would reduce the potential for contamination to migrate onto adjacent and nearby properties at concentrations that in turn may represent a risk to the marine environment, and liabilities to the property owner in terms of financial aspects. This approach would also address migration concerns into the bedrock that has been assessed to have significant fracturing and concentrations of PHCs that represent a risk of concern to the marine environment. A remedial plan would require additional sampling, field scale application testing in order to establish a design approach that can be implemented accordingly.

The same approach is applicable to PHC contamination in the bedrock in consideration of the water supply aquifer for FN and MEL operations. Groundwater criteria applicable for any pumping well operations would be applied at source areas, in recognition that the zone of pumping influence extends across all of the impacted properties, and remedial methods would be designed and implemented accordingly. In this instance, application of the aquatic criteria at the property boundary would inherently address concerns with the groundwater supply aquifer(s) groundwater quality issues as well as risks of concern associated with groundwater vapour inhalation. Concentrations of PHCs in the soil would also need to be reduced to satisfy criteria for leaching to groundwater in consideration of the groundwater to surface water pathway for the marine environment, and would

inherently address Management Considerations for Free Phase Formation, Explosive Hazards, and Buried Infrastructure Effects for Human Health.

The same approach may be applied for PAHs.

Remedial measures for impacted properties should be developed and carried out in a broad context as acknowledged and recommended by other consultants in the past. With regards to the widespread contamination in the harbour area, it was indicated by Three-D GeoConsultants Ltd. in Affidavit document A-285, Appendix 80, "that the past and current remediation programs will have little or no effect unless a wider area is covered and thus if clean-up is to be done, it should include all peripheral properties where contaminates are detected."

It is indicated in a letter dated March 25, 1997 from Tom Gallagher of Jacques Whitford Environmental Limited to Claude Burry of DFO (A-83, Appendix 20) that "The testing revealed that these 2 abandoned pipeline did not pass testing and were suspected of having been leaking during their operating life." and further indicated that " JWEL recommends that the extent of the contamination (both on and off DFO property) be established prior to DFO initiating any remedial action. DFO clean-up activities should be part of a joint effort which should include all impacted property owners. Premature clean up may result in recontamination of DFO property".

Remediation measures to address PHC contamination issues in saltwater environments for soils, bedrock and the groundwater

Critical factors to carrying out remediation on properties in the study area include the following:

- contamination extends into the bedrock and into the bedrock groundwater aquifers and remediation is much more difficult in bedrock;
- the site conditions are very complex for the project area resulting in extensive spreading of contaminates with all properties being subject to recontamination;
- no remedial work is being carried out on any of the contaminated source properties or adjacent and nearby contaminated properties and therefore the EFL/FN/MEL properties are subject to recontamination by the source and other properties not undergoing remediation;
- based on ACER 2016 investigations concentrations of contamination in the soil and groundwater on the former IOL bulk plant property are still similar to 1989, even though groundwater remedial work was carried out between 1989 and circa 2011, but noting that soil remediation was essentially not carried out and therefore represents a long term persistent source of contamination;
- the apparent sources of contamination are located on adjacent and nearby properties that are no longer undergoing remediation and therefore represent a long term persistent source of contamination to any properties undergoing property specific remediation, and therefore would require a long time frame for remedial efforts, resulting in additional significant costs for implementation and monitoring;
- remediation in a saltwater environment is more difficult.

Achieving a clean site in the quickest time frame possible will likely be difficult and costly due to the following:

- the complexities of remediating groundwater in highly fractured bedrock and contamination extending to over 15 metres into the bedrock;
- the significant time frames expected to treat contaminated groundwater in the bedrock zone resulting in a long time frame;
- the further increase in the significant time frames expected to treat contaminated groundwater in the bedrock

zone given that no remedial work is being carried out on apparent source properties;

- the fact that properties representing the apparent source(s) of contamination have been known to be impacted almost thirty years and likely longer, and still show concentrations that are greater than originally reported for similar areas, thereby increasing the significance and extent of impacts to the bedrock zone and represent a long term persistent source;
- the EFL, FN and MEL properties are located down gradient of the IOL bulk plant and CN Rail tanker car offloading facilities operated by IOL, and the former CN ROW acts like a "french drain" that provides preferential flow downgradient of the bulk plant property and the former CN Rail tanker car offloading facilities associated with the bulk plant operations, and increases the potential for spreading of contamination to the FN/MEL and other properties making remediation more difficult; and
- the added complexities of the area including tidal loading influences and an extensive network of underground services providing preferential flow pathways for contaminates and seasonal influences requiring a complex system to achieve containment.

Discrete fracture pathways and matrix diffusion for contaminant fate and transport are important aspects in the remediation of contamination. The direction and the rate of fracture-matrix exchange depend on the relative concentrations of the solute in the fracture and the matrix as well as the amount of surface area available for this process. Once a solute has diffused into the matrix, it may absorb onto pore surfaces, and the surface areas of the matrix pores are many times larger than the surfaces of fractures. The majority of the solute may be in the matrix pores. (FN A-2584 in Appendix 107). **The amount of solute that enters the matrix pores is expected to increase with longer periods of exposure to the solute/contamination, and would be expected to result in a longer time frame for remediation.**

Matrix diffusion is indicated to be important because, when contaminants are being diffused into the matrix, the rehabilitation and remediation of the aquifer is made increasingly more difficult with residence time of the contaminant. Matrix porosity may act as a persistent reservoir that can slowly release contaminates after a site appears to have been cleaned up. For similar reasons, matrix diffusion can cause pump and treat efforts to be misleading, where the water appears to be clean, only to be re-contaminated by diffusion back from the matrix, (FN A-2584 in Appendix 107), into the fractures. As such, spreading/migration of contamination could be expected to continue and result in re-contamination of properties.

Matrix diffusion is a significant mechanism by which contaminants may enter a rock matrix with appreciable pore space, such as sedimentary rocks, as present on the site. After the contaminant has diffused into the rock matrix, the process of diffusion works in reverse (which is called "backdiffusion") and releases the contaminant stored within the rock matrix back into the fracture. Back-diffusion is a dynamic phenomenon, causing the passing plume to persist at a point of observation, albeit at a relatively low concentration, longer than it would otherwise, **even if the contaminant is removed from the fluid within the fractures**. **This process increases effective plume longevity and, if not accommodated, can greatly delay remediation time frames.** If, however, the flow in the fracture is very high relative to the flow in the secondary porosity (within fractures), the back-diffusion may be diluted to such an extent not to be an issue. (FN A-2587 in Appendix 108).

Costs detailed in FN A-2589 a in Appendix 112 are estimated to range between $4,582,785,736 to $6,599,615,745 (inclusive of a 30% contingency and taxes). The estimate considers investigations for pilot scale testing, larger scale testing, implementation of remedial measures including excavation, slurry wall applications, a groundwater pump and treat train involving reverse osmosis (saltwater treatment), granular activated carbon, air stripers and

coagulant application, , with a requirement for long term monitoring. A time span of 110 years has been applied recognizing that:

- thirty years has expired since remedial measures were developed for the IOL bulk plant property and concentrations continue to exceed guidelines at this time in combination with flushing cycles, and therefore a threefold time frame has been applied;
- remedial measures have been discontinued on the IOL bulk plant property and in association with the two IOL underground gasoline pipelines, and concentrations of concern are still present on the former CN Rail tanker car offloading area including the IOL facilities as well as several other adjacent and nearby properties and represent long term persistent sources of contamination to the groundwater;
- the objective is to achieve treatment of groundwater to concentrations acceptable for aquatic guidelines in consideration of the groundwater to surface water pathway. This will inherently achieve acceptable limits for historical food grade operations by EFL/FN/MEL as well as ice plant operations, while also meeting CCME guidelines for Management Considerations for Free Phase Formation, Explosive Hazards, and Buried Infrastructure Effects for Human Health.

6.3.2 Marine Sediments

Remediation of the marine sediments may be accomplished by dredging with disposal options including land disposal or ocean disposal or a combination of both disposal methods. Analysis results indicate that for the land disposal option PHC concentrations exceed acceptable RBCA criteria for a commercial site with non-potable water. Therefore, some form of treatment or containment, or combination thereof would be required. This is not an undertaking that you would be expected to be liable for given “you do not directly represent a responsible party for a source property”.

Costs detailed in FN A-2589 a in Appendix 112 are estimated to be in the order of $328,522,230 (inclusive of a 30% contingency and taxes) based on dredging followed by treatment by a method that satisfies RBCA criteria for a commercial site with non-potable water for land disposal. No cost recovery as a fill material was considered.

7.0 STATEMENT OF LIMITATIONS

This report has been prepared and the work referred to in this report has been undertaken by ACER Environmental Services (2015) Ltd. (ACER) for Marine Extract Limited, Pecheries FN Fisheries Ltd. and Eastpre Feeds Limited. It is intended for the sole and exclusive use of Marine Extract Limited, Pecheries FN Fisheries Ltd. and Eastpre Feeds Limited., and authorized agents for the purpose(s) set out in this report. Any use of, reliance on or decision made based on this report by any person other than Marine Extract Limited, Pecheries FN Fisheries Ltd. and Eastpre Feeds Limited., for any purpose, or by Marine Extract Limited, Pecheries FN Fisheries Ltd. and Eastpre Feeds Limited., for a purpose other than the purpose(s) set out in this report, is the sole responsibility of such other person or Marine Extract Limited, Pecheries FN Fisheries Ltd. and Eastpre Feeds Limited.... Marine Extract Limited, Pecheries FN Fisheries Ltd. and Eastpre Feeds Limited.. and ACER makes no representation or warranty to any other person with regard to this report and the work referred to in this report and ACER accepts no duty of care to any other person or any liability or responsibility whatsoever for any losses, expenses, damages, fines, penalties or other harm that may be suffered or incurred by any other person as a result of the use of, reliance on, any decision made or any action taken based on this report or the work referred to in this report.

The investigation undertaken by ACER with respect to this report and any conclusions or recommendations made in this report reflect ACER's judgment based on the site conditions observed at the time of the site inspection and investigations on the date(s) set out in this report, on information available at the time of preparation of this report, and on the interpretation of data collected from the field investigation. This report has been prepared for specific application to this site and it is based, in part upon visual observation of the site, subsurface investigation at discrete locations and depths, as described in this report. Unless otherwise stated, the findings cannot be extended to previous or future site conditions, portions of the site which were unavailable for direct investigation, subsurface locations which were not investigated directly, or chemical parameters, materials or analysis which were not addressed. Substances other than those addressed by the investigation described in this report may exist within the site; substances addressed by the investigation may exist in areas of the site not investigated and concentrations of substances addressed which are different than those reported may exist in areas other than the locations from which samples were taken.

As the evaluation and conclusions reported herein do not preclude the existence of other chemical compounds and/or that variations of conditions within the site may be possible, this report should be used for informational purposes only and should absolutely not be construed as a comprehensive hydrogeological or chemical characterization of the site. If site conditions change or if any additional information becomes available at a future date, modifications to the findings, conclusions and recommendations in this report may be necessary.

Nothing in this report is intended to constitute or provide a legal opinion. ACER makes no representation as to the requirements of or compliance with environmental laws, rules, regulations or policies established by federal, provincial or local government bodies. Revisions to the regulatory standards referred to in this report may be expected over time. As a result, modifications to the findings, conclusions and recommendations in this report may be necessary.

Other than by Marine Extract Limited,, Pecheries FN Fisheries Ltd., and Eastpre Feeds Limited., and as set out herein, copying or distribution of this report or use of or reliance on the information contained herein, in whole or in part, is not permitted without the express written permission of ACER.

8.0 REFERENCES

References are provided by way of affidavit numbering as identified in the report, with affidavits provided in the Appendixes as presented herein.

APPENDICES

Appendices 1 to 129 are provided separately in digital PDF due to size and for ease of referencing. Refer to table of contents in this document for Appendix listing.

Correspondence previously received from the Town of Shippagan

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VILLE DE SHIPPAGAN

TOWN OF SHIPPAGAN

A-2827b

le 28 avril 2021

PÊCHERIES F.N. FISHERIES LTD.
99, 15e rue
Shippagan, NB
E8S 1E2

Compétence : Monsieur Eric Smith

MARINE EXTRACT LTD.
761 Hillborough Road
Riverview, NB
E1B 3W1

Compétence : Monsieur Eric Smith

OBJET : APPROVISIONNEMENT EN EAU POTABLE POUR DES PUITS INDUSTRIELS
Notre dossier : 16B113

Monsieur,

La Ville de Shippagan, comme municipalité, encourage le développement et la croissance des entreprises qui choisissent d'investir dans la communauté. En ce sens, la municipalité est prête à supporter tout projet entrepris par Pêcheries F.N. Fisheries Ltd. et Marine Extract Ltd. qui implique l'usage des puits industriels d'eau potable qui peuvent desservir les deux corporations.

Bien entendu, comme tous les autres citoyens corporatifs de la municipalité ainsi que les résidents de la Ville, Pêcheries F.N. Fisheries Ltd. et Marine Extract Ltd. devront payer tout frais d'usage et les frais de consommation, s'il y en a, associés aux puits industriels d'eau potable selon les tarifs en vigueur de temps à autre, en vertu de l'arrêté municipal pertinent.

Veuillez agréer, Monsieur, l'expression de nos sincères salutations

VILLE DE SHIPPAGAN

Anita Savoie Robichaud

Anita Robichaud, mairesse

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VILLE DE SHIPPAGAN

TOWN OF SHIPPAGAN

A-2828

le 28 avril 2021

MINISTÈRE DE L'ENVIRONNEMENT
ET DES CHANGEMENTS CLIMATIQUES
Place Marysville
Casier postal 6000
Fredericton, NB
E3B 5H1

Compétence : L'Honorable Gary Crossman, ministre

OBJET : VILLE DE SHIPPAGAN, MARINE EXTRACT LTD.
ET PÊCHERIES F.N. FISHERIES LTD.
Notre dossier : 16B113

Monsieur le ministre,

La Ville de Shippagan, comme municipalité, encourage le développement et la croissance des entreprises qui choisissent d'investir dans la communauté. En ce sens, la municipalité est prête à supporter tout projet entrepris par Pêcheries F.N. Fisheries Ltd. et Marine Extract Ltd. qui implique l'usage des puits industriels d'eau potable qui peuvent desservir les deux corporations. Bien entendu, comme tous les autres citoyens corporatifs de la municipalité ainsi que les résidents de la Ville, Pêcheries F.N. Fisheries Ltd. et Marine Extract Ltd. devront payer les frais d'usage et les frais de consommation, s'il y en a, associés aux puits industriels d'eau potable selon les tarifs en vigueur de temps à autre, en vertu de l'arrêté municipal pertinent.

Sujet à ce qui précède, la Ville de Shippagan vous demande de supporter l'approbation de la demande d'eau potable présentée le 5 décembre 2004. Vous trouverez d'ailleurs sous pli une copie d'un document coté A-976 pour votre commodité.

La municipalité, au fil des ans, a perdu des revenus très importants du fait de la fermeture des usines de transformation de poisson de Pêcheries F.N. Fisheries Ltd. et de Marine Extract Ltd., de même que la possibilité de fournir 500 emplois aux gens de la région. De plus, la pollution causée par Irving Oil Limited a fait en sorte que maintenant, 20 acres de terrain près des quais de la municipalité ainsi qu'au moins 50 acres en bordure de la baie de Shippagan suite à un déversement au fil des ans de 4,6 millions de litres de pétrole.

Le problème entraîné par la pollution causée par Irving Oil Limited a eu comme conséquences d'importantes réductions de revenus d'emplois et d'occasions d'affaires pour la municipalité qui peuvent facilement s'étendre au-delà de 200 ans si un nettoyage des sites contaminés par le pétrole n'est pas effectuée. Il y a actuellement des dommages significatifs à l'environnement marin par l'écoulement de pétrole qui continue à s'écouler dans le bassin de la baie de Shippagan.

Nous approuvons le principe de l'usage des sites industriels d'eau potable par Pêcheries F.N. Fisheries Ltd. et Marine Extract Ltd. sujet aux termes et conditions prévus par les arrêtés municipaux de la Ville de Shippagan qui sont pertinents et à toute entente pouvant être requise avec ces entreprises.

Nous vous demandons votre attention immédiate à notre demande.

Veuillez agréer, Monsieur le ministre, l'expression de nos sincères salutations

VILLE DE SHIPPAGAN

Anita Annie Robichaud

Anita Robichaud, mairesse

AR/
pj

cc : M. Eric Smith

Report on FN Fisheries and Marine Extract Wells Suitability for Human Consumption Food Processing

CRAIG HYDROGEOLOGIC INC.

Groundwater and Soil Contamination
Groundwater Protection
Environmental Assessment
Groundwater Modelling
Resource Development

A-3000

September 18, 2022.

Mr. Eric Smith
Chatham Biotec Ltd.
761 Hillsborough Road
Riverview, NB, E1B 3W1

Attention: Eric Smith

Re: FN Fisheries and Marine Extract Wells Suitability for Human Consumption Food Processing.

There is considerable existing evidence relating to the hydrocarbon contamination of the groundwater sourced by these wells and the bedrock aquifer around them. When groundwater contamination situations are evaluated relative to potential exposures, it may be worthwhile to consider the specific situation as having three components. These component are (1) contaminant source, (2) contaminant pathway and (3) receptor that the contaminant is impacting. If all three components can be demonstrated to exist in a specific situation or case, then it can be concluded that contamination impacts will occur on the receptor.

In this specific instance the contaminant source is documented by the following:

1. In A-292, July 31, 2012, (page 3-13) Phase II Environmental Assessment Pecheries FN Fisheries Ltd. by ACER Environmental Services Ltd. states:

"Groundwater sample analysis showed values exceeding RBCA Tier I guidelines, in consideration of **commercial** land use and **potable water** for the Assessed Property, for all BTEX parameters,

and modified TPH at 11MW13 and 11MW14. Product was reported to resemble the gasoline fraction, with possible weathered fuel oil present as well. Select BTEX parameters were exceeded at 11MW10, 11MW11, 11MW13, 11MW14 and 11MW15. Similarly, RBCA Tier I guidelines were also exceeded in consideration of **residential** land use adjacent to the site and potential future residential land use for the Assessed Property and **potable water. For the on-site food grade water supply**, 11MWS1 (location WS), **all BTEX parameters were exceeded** as well as the modified TPH value that was identified to be gasoline fraction. Refer to Tables C8 and C9 in Appendix C and Figures 3-9 and 3-10 for analytical results for commercial and residential considerations and potable water, respectively."

2. In A-2736, March 11, 2020, (page 3-41) Phase II & III ESA, Marine Extract Ltd., Pecheries FN Fisheries Ltee/Ltd. and Eastpre Feed Ltd Final Report by ACER Environmental Services (2015) Ltd. states:

"Sampling results for groundwater showed petroleum hydrocarbon concentrations for deep and shallow wells exceeded RBCA commercial and industrial and CCME potable water criteria in consideration of on-site water supply wells established in the saltwater/brackish aquifer used for food grade operations, on the MEL, FN, EFL and Town properties as well as the IOL bulk plant and underground gasoline transfer line and DFO property. See Tables 12 and 13, respectively, in Appendix 77 and Figure 3-6 (also contained in Appendix 76)."

3. In A-2942, April 24, 2022, (page 2-3) Update on contamination and significant environmental concerns, Shippagan property NB by ACER Environmental Services (2015) Ltd. states:

"As indicated in previous reports/discussions, based on IOL consultant Dillion Environmental Services Ltd. and ACER Environmental Services (2015) Ltd., concentrations of petroleum hydrocarbons in the soil and groundwater at the IOL Shippagan bulk storage site are similar now as in 1989, 31 years later. Similarly, current investigations by Dillon for what is referred to as the

Inactive Irving Oil Underground Fuel Pipelines (pipeline) and the ACER investigations indicate concentrations of petroleum hydrocarbons in the soil and ground, 24 years later. The same can be said for the adjacent properties."

Supporting references are provided in the extracted materials provided above. Based on the information available it is clear that a large and persistent source of hydrocarbon contamination is present in the groundwater and aquifer in the groundwater source area around the subject wells.

The contaminant pathway is documented by the following:

4. In A-662 July 13, 2011 (page 2) Shippagan Ground Water Model by Craig HydroGeoLogic Inc. states:

"As can be seen in Figures 2, 3, 5, and 6 the groundwater capture areas for the Marine Extract and FN Fisheries pumping wells include the adjacent Eastpre Feeds and Irving property. Any properties which are located within the groundwater capture areas of the pumping wells and which have sources of groundwater pollution/contamination pose a risk to the pumping wells."

The contaminant source identified above, i.e the hydrocarbon contamination existing in the groundwater and aquifer in the area, is located within the groundwater capture (source) areas of the wells and thus will impact the quality of groundwater produced by the wells.

The receptor that the contamination would impact is documented by the following:

5. In A-2719, September 28, 2019, (page 3) by Three D GeoConsultants Ltd. states:

"What all of this has shown is that the area has not been remediated to the appropriate level as required for the type of operation proposed. This is a property whereby food grade water sources are required that were never meet."

6. In A-2720, October 19, 2019, (page 2-3) Remediation of Petroleum Hydrocarbon Contamination, Former Irving Oil Limited Bulk Storage Operations, Shippagan, NB. Potential Application of NB Environment Potable Water Criteria by Craig HydroGeoLogic Ltd. states:

"To summarize the above, as a number of the impacted sites adjacent to the IOL contamination source site are processing sites for products destined to be consumed by humans (i.e. food and/or drugs) then the adjacent impacted sites where such activities occur or did occur at the time of the contamination should be remediated to the NB Environment and Local Government criteria for potable water sites. NBDELG's hydrocarbon remediation criteria for potable water sites are more stringent than the criteria for non-potable sites. The remediation order issued by NBDELG in this specific instance required remediation to the non-potable criteria."

"In my opinion there is no question that water used for the processing of food and drugs for human consumption should be as pure as possible. The application of potable water criteria to the remediation process in this specific instance seems to be a normal and necessary response. The potential for the introduction of contamination into the food and/or drug products is clear and obvious. NBDELG did not, however, order such criteria to be followed in this specific case, although they would normally do so in instances where private or public wells used for water supplies existed on adjacent impacted properties. As stated above, the remediation order issued by NBDELG in this specific instance required remediation to the non-potable criteria."

"It is my opinion that IOL should have to remediate the groundwater to potable water standards as common sense tells us that the impacted uses are equivalent or cannot be differentiated from potable water uses."

It is my opinion that the information relating to contaminant source, contaminant pathway and impacted receptor clearly demonstrates the hydrocarbon contamination existing in the groundwater and local aquifer has rendered the FN Fisheries and Marine Extract Wells unusable for their intended purposes. Based on the above environmental and hydrogeologic reports, in my professional opinion, the Marine Extract Ltd and Pecheries FN Fisheries Ltd. potable water process wells can not currently or in the previous 20-30 years be use for food processing activities at these facilities. Soils and groundwater in the affected drawdown (source) area of the wells indicated in A-662 would first have to be cleaned up to potable water standards.

Yours Truly

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