

**PROJECT DESCRIPTION
FOR THE PROPOSED SHELL CANADA LIMITED
WEST CHANNEL REMEDIATION PLAN**



**Prepared for:
Shell Canada Limited
Calgary, Alberta**

Prepared by:



Calgary, Alberta and Inuvik, Northwest Territories

**April 2001
Project # 5015-01**

**WATER REGISTRY COPY
DO NOT REMOVE**

PROJECT DESCRIPTION
FOR THE PROPOSED SHELL CANADA LIMITED
WEST CHANNEL REMEDIATION PLAN

Submitted by:

Shell Canada Limited
400-4th Avenue SW
Calgary, Alberta
T2P 2H5

DISTRIBUTION:

2 Copies	Randy Hetman, Shell Canada Limited Calgary, Alberta
16 Copies	Inuvialuit Land Administration Tuktoyaktuk, NT
11 Copies	Environmental Impact Screening Committee Inuvik, NT
20 Copies	Northwest Territories Water Board Yellowknife, NT
4 Copies	Inuvialuit Environmental & Geotechnical Inc. Calgary, Alberta & Inuvik, NT

EXECUTIVE SUMMARY

Previous environmental site assessment results have identified residual soil and groundwater contamination at the Shell West Channel Staging Point, Mackenzie Delta, NT. Shell Canada Limited (Shell) is applying for a Land Use Permit for a remediation program at the site. The proposed project entails an in-situ bioremediation process, which combines proven principles of bioremediation with novel advancements in fluid aeration with a site-specific engineered fluid distribution, infiltration, containment, and treatment process. A portable multiphase vacuum extraction pump will be added to further accelerate hydrocarbon recovery.

The proposed program is located on a vegetated peninsula adjacent to the West Channel of the Mackenzie River on Inuvialuit Private 7(1)(a) lands at 68°28'33" N latitude and 135°33'25" W longitude, approximately 37 kilometres northwest of Aklavik, NT. Pending regulatory approval, installation of remedial equipment will begin upon barge delivery (tentatively scheduled for the first week of July) for an approximate 15-day period, followed by the remediation operation scheduled to commence July 2001 for a period of 75 days following set-up.

Inuvialuit Environmental & Geotechnical Inc. (IEG) has been commissioned by Shell to prepare this Project Description for the West Channel Remediation Program. The Project Description has been prepared to meet the requirements of the Inuvialuit Land Administration (ILA) and fulfill the Operating Guidelines and Procedures of the Environmental Impact Screening Committee (EISC).

The proposed project is located in a lowland delta environment within the Mackenzie River Delta. The topography in the project area features typically subdued relief consisting of broad lowlands and plateaus incised by major rivers. On a regional basis, the predominant vegetation in the project area consists of stunted stands of spruce and tamarack, and a ground cover of dwarf-birch, willow, ericaceous shrubs, cottongrass, lichen and moss.

The Shell West Channel Remediation program has been developed with the consideration of minimizing impacts on the environment and land users. Anticipated potential effects being mitigated include: temporary alteration of wildlife habitat in the project area; temporary disruptions to traditional land use in the vicinity of the project; and disturbance to permafrost.

Protection measures designed to mitigate the potential impacts are presented in this Project Description and in Table 7. No significant residual impacts are identified. Shell and its contractors are committed to following these measures in order to minimize the risk of potential environmental impacts and disturbance of culturally and historically significant areas.

TABLE OF CONTENTS

	<u>Page</u>
EXECUTIVE SUMMARY	i
1.0 CONTACT NAMES AND ADDRESSES	1
2.0 REGULATORY APPROVALS	2
3.0 TITLE	3
4.0 DEVELOPMENT SUMMARY	6
4.1 Project Scope	6
4.2 Remedial Objective.....	6
4.3 Contaminants of Concern	6
4.4 Contaminant Distribution.....	8
4.5 Selected Remedial Alternative - In-situ Bio-Circulation Cell (IBCC).....	8
4.5.1 Process Description.....	8
4.5.2 General System Layout.....	9
4.5.3 Treatment Cell Infiltration Process.....	17
4.5.4 Groundwater Containment Process.....	17
4.5.5 Portable Multi-Phase Extraction System	18
4.5.6 Water Distribution and Recovery Piping Layout.....	18
4.5.7 Treatment Process Area Layout and Description	19
4.6 Effluent Sampling Process and Frequency	20
4.7 Progress/Confirmatory Soil Sampling	20
4.8 Groundwater Monitoring Wells and Program	21
4.9 Personnel Required	21
4.10 Equipment Required	21
4.11 Fuel Storage	22
4.12 Camps	22
5.0 ALTERNATIVES.....	22
5.1 Vapour/Multi-phase Extraction Options.....	23
5.2 Excavation Options.....	24
5.3 In-situ Bioremediation	25
5.4 Natural Attenuation.....	26
6.0 CUMULATIVE EFFECTS	26
7.0 LOCATION	29
8.0 TRADITIONAL AND OTHER LAND USES.....	29
9.0 DEVELOPMENT TIMETABLE	32
10.0 NEW TECHNOLOGY	32
11.0 ENVIRONMENTAL OVERVIEW.....	32
11.1 Methods.....	32
11.2 Physiography and Bedrock Geology	33
11.3 Soils.....	33

11.4	Climate.....	33
11.5	Permafrost.....	34
11.6	Vegetation.....	34
11.7	Wildlife.....	35
	11.7.1 Terrestrial Mammals.....	35
	11.7.2 Birds/Waterfowl.....	37
11.8	Hydrology and Fish.....	39
11.9	Cultural and Historic Resources.....	41
12.0	PROPOSED MITIGATION AND ANTICIPATED ENVIRONMENTAL IMPACTS..	42
13.0	EMERGENCY RESPONSE PLANS.....	49
14.0	CLEANUP, RECLAMATION, DISPOSAL, AND/OR DECOMMISSIONING PLAN	49
15.0	OTHER ENVIRONMENTAL ASSESSMENT.....	49
16.0	COMMUNITY CONSULTATION.....	51
17.0	PERSONAL COMMUNICATIONS.....	55
18.0	REFERENCES.....	56

LIST OF APPENDICES

Appendix A	Shell Canada Limited Emergency Response Plan.....	A
Appendix B	Licence Applications.....	B

LIST OF FIGURES

Figure 1	Regional Location.....	4
Figure 2	Project Area.....	5
Figure 3	Cumulative Effects of Development Activities in the Vicinity of the Project Area.....	28
Figure 4	Special Management Areas Within or Near the Vicinity of the Project Area.....	31

LIST OF TABLES

Table 1	Approvals Required.....	3
Table 2	Other Land Use Activities Within the Project Vicinity.....	26
Table 3	Special Management Areas Within or Near the Project Area*.....	30
Table 4	Vegetative Species of Significance Found in the Vicinity of the Proposed Project.....	35
Table 5	Vertebrate Species Found in the Vicinity of the Proposed Project.....	38

Table 6	Fish Species Found in the Vicinity of the Proposed Project.....	40
Table 7	Potential Environmental and Socio-Economic Impacts, Mitigation and Residual Impacts.....	45
Table 8	Government and Non-Government Notification.....	51
Table 9	Community Consultation Meetings	52
Table 10	Community Consultation Issues and Responses.....	52

LIST OF DRAWINGS

Drawing 1	Site Plan	10
Drawing 2	Proposed Layout of Recirculation and Recovery Network	11
Drawing 3	Cross Section of Recovery Trench	12
Drawing 4	Proposed Layout of Circulation and Recovery Network.....	13
Drawing 4a	Detail "A" Injection Well (Typical).....	14
Drawing 5	Schematic Process Diagram.....	15
Drawing 6	Site Map.....	16
1:50,000 Scale Map		Map Pocket

1.0 CONTACT NAMES AND ADDRESSES

Randy Hetman
DAR/Construction Manager
Shell Canada Limited
400 – 4th Avenue S.W.
Calgary, AB T2P 0J4
Phone: (403) 691-2521
Fax: (403) 269-7948
Email: randy.hetman@shell.ca

(Shell's primary contact for the remediation program)

Doug Lee
Environmental Toxicologist
Inuvialuit Environmental & Geotechnical Inc.
1338R, 36 Avenue N.E.
Calgary, AB T2E 6T6
Phone: (403) 291-0777
Fax: (403) 291-1150
Email: leed@sorel.ca

(Environmental Consultant - Project Manager for the remediation program)

Barry Nevokshonoff
Hydrogeologist
Sequoia Environmental Remediation Inc.
135 Sierra Nevada Close N.W.
Calgary, AB T3H 3H7
Phone (403) 240-0695
Fax (403) 286-6974
Email: office@sequoiaenvironmental.com

(Remediation Specialist for the project design and implementation)

Kevin Keenan
Hydrogeologist
Sequoia Environmental Remediation Inc.
135 Sierra Nevada Close N.W.
Calgary, AB T3H 3H7
Phone (403) 620-9488
Fax (403) 286-6974
Email: kkeenan@telusplanet.net

(Remediation Specialist for the project design and implementation)

2.0 REGULATORY APPROVALS

Shell Canada Limited (Shell) is applying for a Land Use Permit to allow for the in-situ remediation of contaminated soil at the West Channel site. The proposed remediation work will occur on Inuvialuit 7(1)(a) lands in the Inuvialuit Settlement Region, and occupies a total area of approximately 4.5 hectares (Figure 1). The primary agency with jurisdiction over the area is the Inuvialuit Land Administration (ILA).

The ILA amended Land Use Licence #ILA00AN43 to allow Inuvialuit Environmental & Geotechnical Inc. (IEG) to collect 60 litres of surface soil for pre-testing before remediation. The sampling took place April 2, 2001.

Other agencies with regulatory interest in the approval process include: Fisheries and Oceans Canada (DFO) with reference to potential effects on fish and fish habitat; the Government of the Northwest Territories (GNWT) Resources, Wildlife and Economic Development (RWED), regarding wildlife and associated habitat; the Prince of Wales Northern Heritage Centre (PWNHC) for an archaeological and historical records review; and Environment Canada (EC) in regard to pollution prevention. The Environmental Impact Screening Committee (EISC) will be responsible for screening all proposed projects on private land, should an Inuvialuit organization refer a project to the EISC. When a screening occurs, the EISC's responsibilities are set out in clause 11(13) of the Inuvialuit Final Agreement (IFA), which reads:

11(13). On receipt of a project description, the Screening Committee shall expeditiously determine if the proposed development could have a significant negative environmental impact and shall indicate in writing to the government authority competent to authorize the development that, in its view:

- (a) the development will have no such significant negative impact and may proceed without environmental impact assessment and review under this Agreement;
- (b) the development could have significant negative impact and is subject to assessment and review under this Agreement; or
- (c) the development proposal has deficiencies of a nature that warrant a termination of its consideration and the submission of another project description.

Should the EISC determine that the project may have a significant negative impact, the Project Description will be referred to the Environmental Impact Review Board (EIRB) or other equivalent environmental review process for a public assessment and review pursuant to clause 11(24).

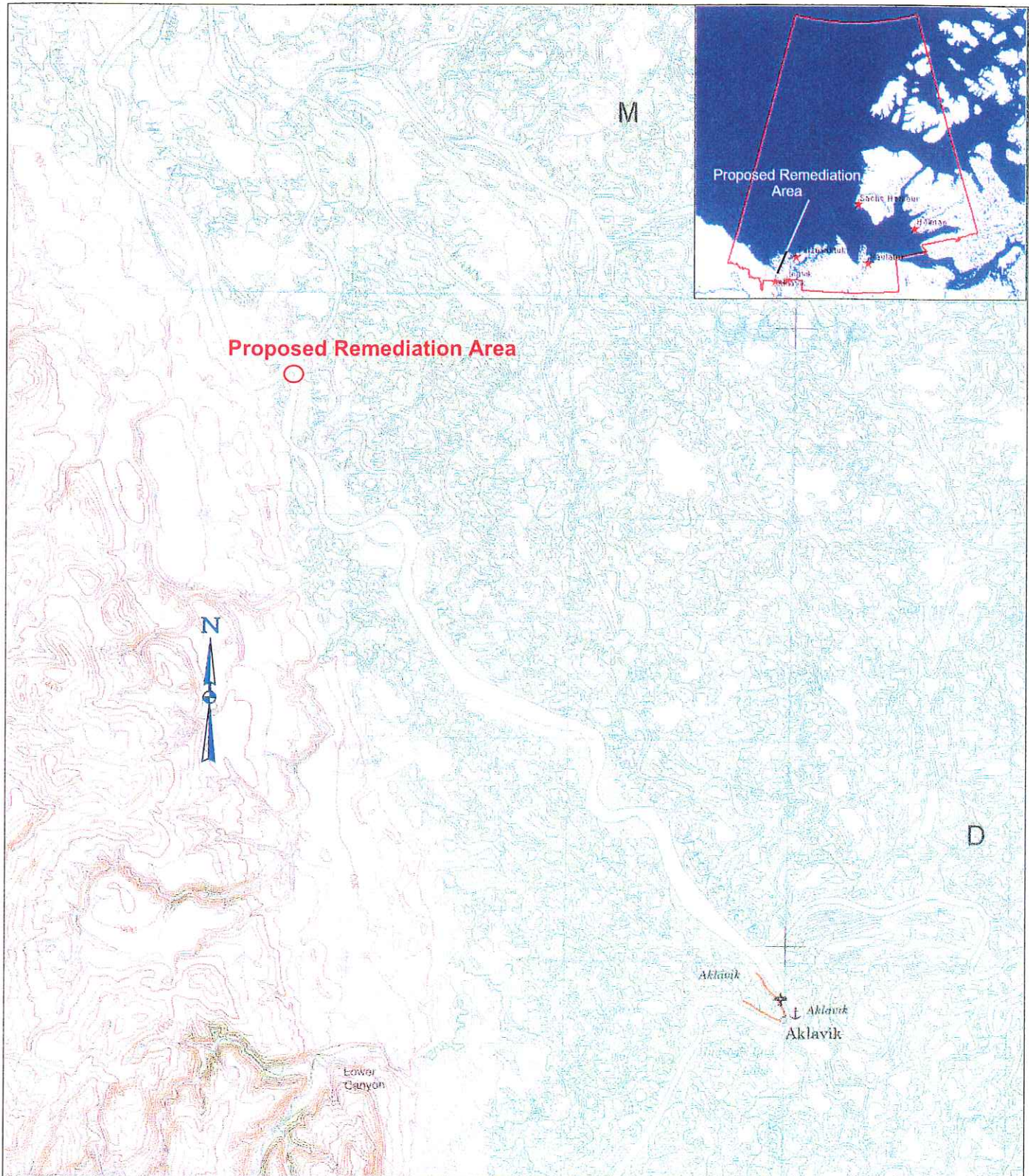
Approvals required for this project are summarized in Table 1. Shell will contact the agencies listed as appropriate, and will satisfy any requirements they may have in their respective areas of jurisdiction.

TABLE 1
APPROVALS REQUIRED

Agency	Approval Required/ <i>Governing Legislation</i>	Status
Hans Arends Land Administrator Inuvialuit Land Administration P.O. Box 290 Tuktoyaktuk, NT X0E 0T0	Land Use Permit <i>Territorial Lands Act</i> <i>Territorial Land Use Regulations</i>	Submitted April 19, 2001
Linda Graf Secretary Environmental Impact Screening Committee P.O. Box 2120 Inuvik, NT X0E 0T0	Approval on Project Description (if referred to Screening by the ILA) <i>Inuvialuit Final Agreement</i>	Submitted by April 30, 2001
Gordon Wray Chairman Northwest Territories Water Board 4920 – 52 nd Street P.O. Box 1500 Yellowknife, NT X1A 2R3	Class B Water Licence <i>NWT Waters Act</i> <i>NWT Waters Regulations</i>	Submitted by April 30, 2001

3.0 TITLE

Shell Canada Limited West Channel Remediation Plan.



Inuvialuit Environmental & Geotechnical Inc.

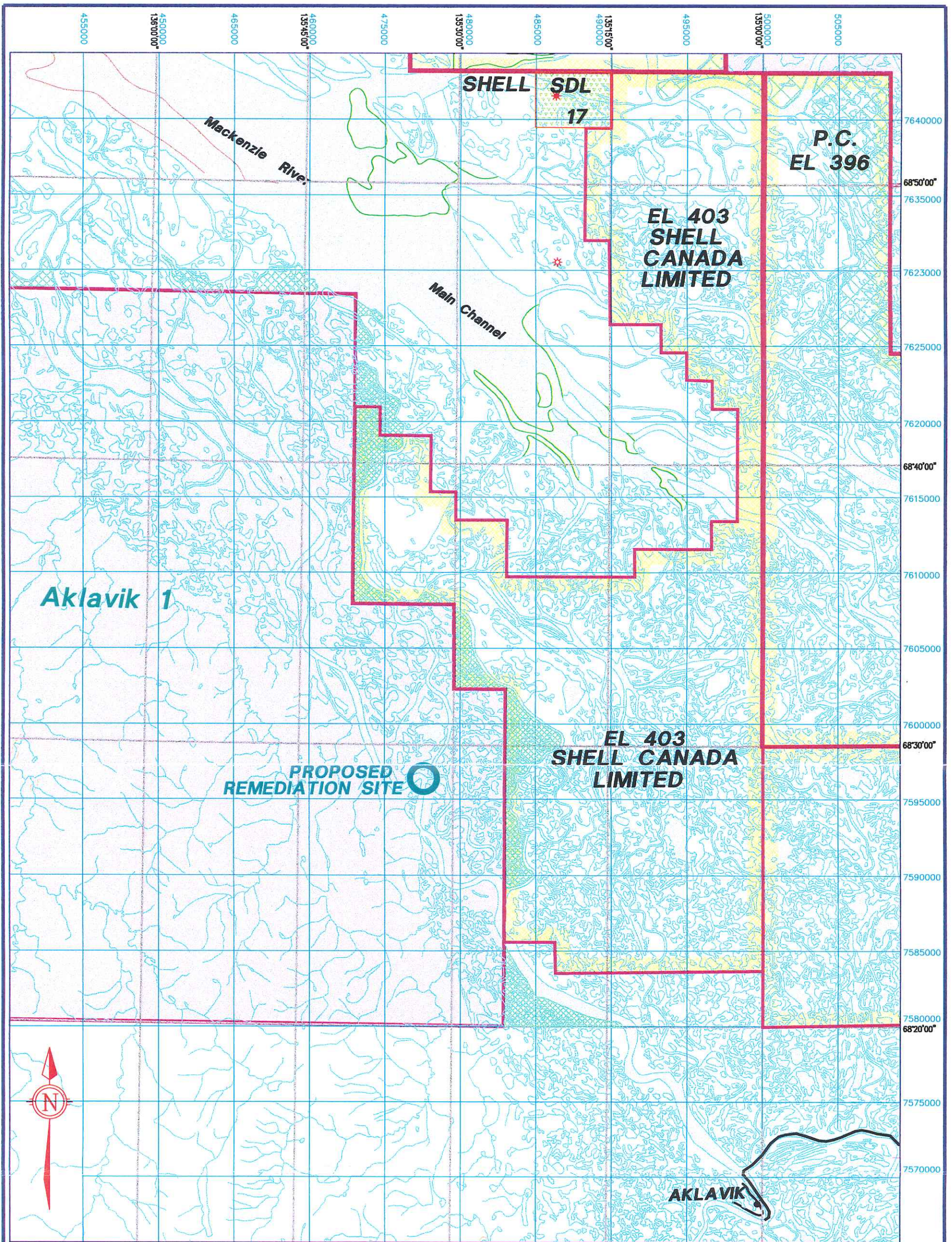
Proposed Remediation Site

April 2001


5015-01


Scale:
1: 250,000

Figure 1



LEGEND

PROPOSED REMEDIATION SITE 

EXPLORATION LEASE (EL) BOUNDARY SHOWN THUS 

SHELL CANADA LIMITED

FIGURE 2

**PROPOSED SHELL CANADA LIMITED
WEST CHANNEL REMEDIATION PLAN
PROJECT AREA**

MACKENZIE DELTA, N.W.T.

SCALE : 1 : 250 000



INUKSHUK
Geomatics Inc.

DRAWN : B.T.	JOB NO. : 00-12929 12215MAP1-FIG3-R
DATE : APRIL 16, 2001	REV NO: 0

4.0 DEVELOPMENT SUMMARY

4.1 Project Scope

Previous environmental site assessments have identified residual soil and groundwater contamination at the Shell West Channel Staging Point, Mackenzie Delta, NT. The scope of this project is to provide and implement a feasible and cost-effective remedial option to reduce residual contamination at the site. Included in this document are a description of the contaminants of concern, the distribution of the contaminants, a summary of various remedial options evaluated for their feasibility in achieving the remedial objective, and a detailed description of the selected remedial option.

4.2 Remedial Objective

The general objective of implementing any remedial action is to reduce the toxicity, mobility, or mass of the contaminant in a manner that will protect public health, public safety, and the environment. The goals for remediation of this site are to reduce contaminant concentrations in soil and groundwater to levels acceptable to the regulatory agencies.

4.3 Contaminants of Concern

Historical site use records coupled with two previous phases of site investigation which entailed soil sampling and laboratory analysis, have been utilized to identify the contaminants of concern on this property.

The site was utilized by Shell in the 1970s for staging northern operations which included storage of petroleum fuels in an aboveground tank farm.

A Phase I investigation conducted by Shell in July 2000, consisted of a soil sampling program utilizing a Dutch auger. Results from the investigation indicated elevated concentrations of benzene, toluene, ethylbenzene, xylenes (BTEX) and some metals. In four of these samples, the BTEX and metal concentrations exceeded the applicable Canadian Council of Ministers of the Environment (CCME) criteria.

A subsequent Phase II investigation was conducted by Inuvialuit Environmental Inc. (IEI) in September 2000. This investigation included drilling 25 borehole locations in a grid pattern centered around the former tank farm. The grid spacing was set at approximately 25 meters between boreholes. Soil samples were collected and selected samples were submitted for

laboratory analyses. Details of the site investigation were reported by IEI in a report (*Phase II Environmental Site Assessment West Channel Staging Point – Mackenzie Delta, NT*) dated November 2000.

Results from the September 2000 investigation indicated that thirteen soil sample locations contained measurable petroleum hydrocarbon constituent concentrations, which exceeded either the Government of Northwest Territories (GNWT) or CCME Commercial/Industrial Remediation Criteria. Eight samples exceeded the GNWT criteria of 2,500 mg/kg for total petroleum hydrocarbons (TPH), two samples exceeded the CCME criteria for benzene, four samples exceeded the CCME criteria for toluene, and five samples exceeded the CCME criteria for xylenes. In addition, a single soil sample slightly exceeded the CCME criteria for barium. The sample result of 2,040 mg/kg was marginally above the CCME criteria of 2,000 mg/kg. No other soil samples of the 49 samples analyzed contained metals concentrations in excess of the guidelines.

Based on the laboratory analyses of selected soil samples collected from the two investigations, coupled with the known historical site use, the main environmental concern is soil contaminated with total petroleum hydrocarbons (TPH) and BTEX. A review of laboratory chromatograms for the soil samples analyzed identifies the TPH contaminant carbon range to be broad (C6 to C60).

In addition, it was noted that total extractable hydrocarbon (TEH) analysis (C10 to C60) performed on selected soil samples commonly indicated concentration spikes centered near C14-16 and C34-36. These hydrocarbon ranges are of lower mobility and volatility when compared to hydrocarbons in lower ranges (<C10). Sorption properties of high range carbon molecules (>C20) enable them to remain adsorbed to soil particles and therefore reduces their ability to move in vapour and water (dissolved) phases. The profiles of these hydrocarbons are consistent with heavier fuels such as Jet-A fuel or kerosene.

Total volatile hydrocarbons (TVH) analysis (C6 to C10) of selected soil samples indicated the presence of some limited volatile hydrocarbon concentrations. These contaminant carbon ranges (<C10) are typically more mobile and more volatile than longer chain hydrocarbons and will generally partition more easily to both the vapour and water (dissolved) phases.

The single exceedance for barium is not considered, for the purposes of this remedial action, to be a contaminant of concern.

4.4 Contaminant Distribution

The approximate lateral distribution of residual fuel hydrocarbons is depicted in Drawing 1. Based on available information, the residual fuel hydrocarbons appear to exceed applicable criteria in two distinct areas (west area and east area) of the overall impacted soil zone. As shown in Drawing 1, the two areas of concern appear to have two distinctive smaller plumes: a heavier-ended hydrocarbon plume (>C10) and a lighter-ended (<C10) plume. The remediation program has been designed to address these plume characteristics. However, in general, the two plumes will be treated as one.

Vertical distribution of contamination within the outlined lateral extent is generally limited to the 0 to 1 m depth range. Samples obtained from depths greater than 1m below grade exceed applicable criteria at one location on the site (BH20) where some select BTEX components in excess of CCME criteria extend to 4 m below grade.

4.5 Selected Remedial Alternative - In-situ Bio-Circulation Cell (IBCC)

Other options/technologies have been considered and are summarized in Section 5.0. An in-situ bioremediation approach has been selected for this site. Through a combination of site-specific data evaluation and general in-situ bioremediation principles, a hybrid system has been designed. The proposed process has been referred to as an In-situ Bio-Circulation Cell (IBCC). The selected option combines proven principles of bioremediation with novel advancements in fluid aeration with a site-specific engineered fluid distribution, infiltration, containment, and treatment process.

As an enhancement to the IBCC, a portable multiphase vacuum extraction pump will be added to further accelerate hydrocarbon recovery for the volatile hydrocarbons. This system will be utilized to extract soil vapour and enhance groundwater recovery under high vacuum conditions at locations determined to be "hotspots" of volatile hydrocarbon components.

4.5.1 Process Description

The general IBCC process will consist of three components:

- 1) Construction of a series of groundwater extraction/containment trenches to allow removal of water from the subsurface in a pattern surrounding the contaminated soil.
- 2) Construction of an onsite water treatment system to allow development of a water based solution rich in oxygen and micro-nutrients for application to the contaminated soil mass.

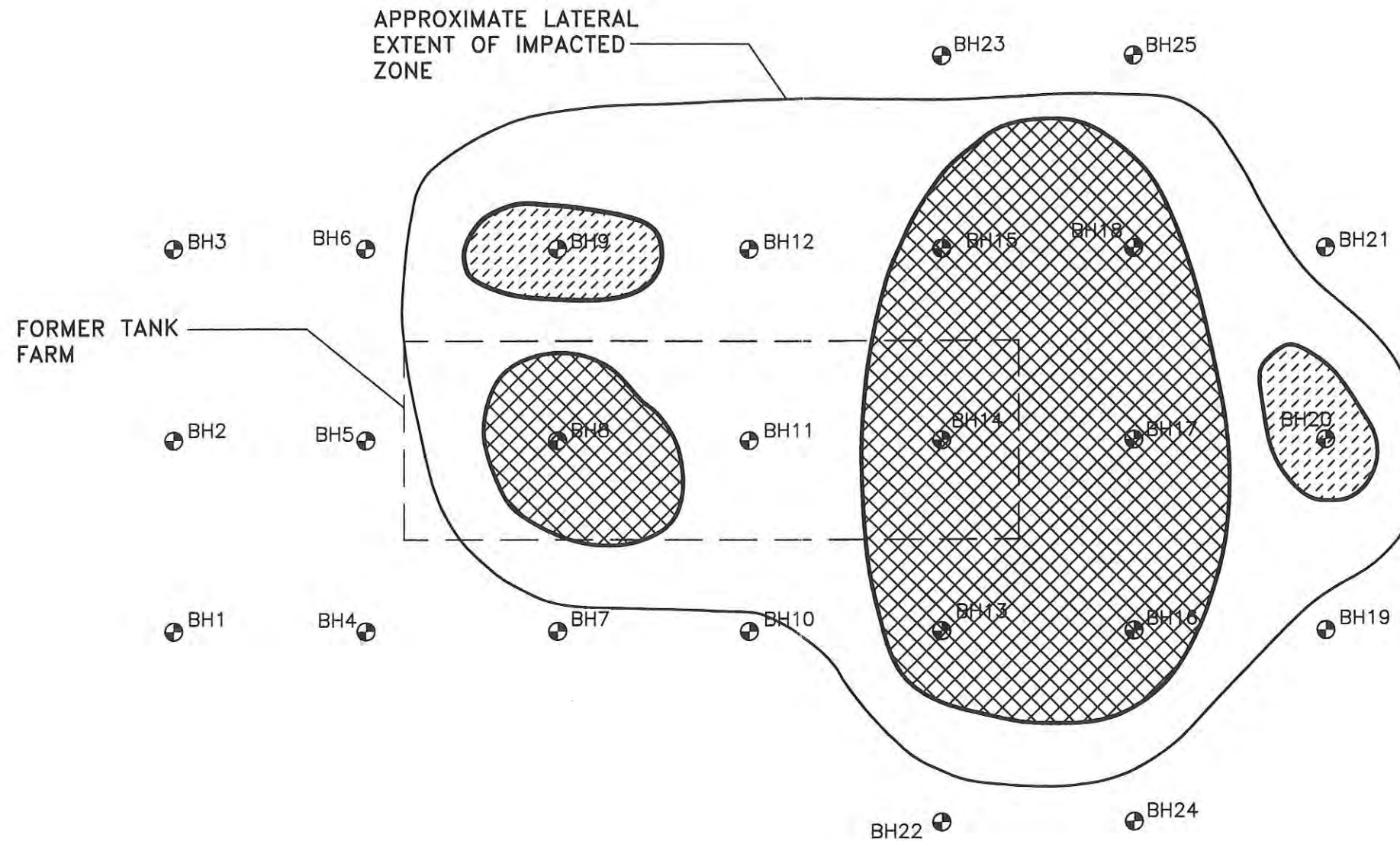
- 3) Construction of a solution distribution network consisting of re-circulation wells, and shallow infiltration piping.

By applying, recovering, and re-circulating nutrient and oxygen rich water through the contaminated soil mass, naturally occurring hydrocarbon degrading microorganisms will thrive throughout the operational season to effectively reduce residual fuel hydrocarbon concentrations present in the soil. Once fully operational, the system will effectively operate as a closed-loop system to limit both removal from, and discharge back to, the Mackenzie River. The following sections provide details on the operation and function of each component of the system.

4.5.2 General System Layout

Drawing 6 is a site diagram indicating the remediation area, while Drawings 2, 3, and 4 depict the overall system layout. A central water treatment system will be located within the process system compound near the center of the site near BH11 and BH12. As indicated on the drawings, the treatment compound will feed approximately 35 re-circulation wells and several shallow surface infiltration lines (not shown) with amended water. Water will infiltrate the zone of contamination by percolating through the soil column and moving within the vadose and saturated soil zones.

On the perimeter of the contaminant zone, a series of groundwater containment trenches surround the infiltration network (Drawing 2). The groundwater levels in each trench will be maintained by recovery pumps to ensure complete recovery of introduced water. The extracted water will be recycled through a series of bioreactors to remove any residual hydrocarbons derived from the soil, re-oxygenate the water solution to maintain aerobic conditions through the treatment cycle, increase bacterial hydrocarbon degrader populations and re-circulate the water back into the IBCC. Drawing 5 is a schematic of the water treatment system.



LEGEND:

-  BH4 BORE HOLES
-  EXCEEDENCES < C10
-  EXCEEDENCES > C10

NOTES:

All information on this drawing is strictly confidential and is the property of Sequoia Environmental Remediation Inc. This drawing can be reproduced only with written consent.



SEQUOIA
ENVIRONMENTAL REMEDIATION INC.

135 Sierra Nevada Close SW
Calgary, Alberta T3H 3H7
Phone: (403) 240-0695

TITLE:

SITE PLAN - LATERAL EXTENT OF OF IMPACTED ZONE

SITE:

**WEST CHANNEL, SHELL CANADA LIMITED
MACKENZIE DELTA, NT**

DWG. NO.:

1

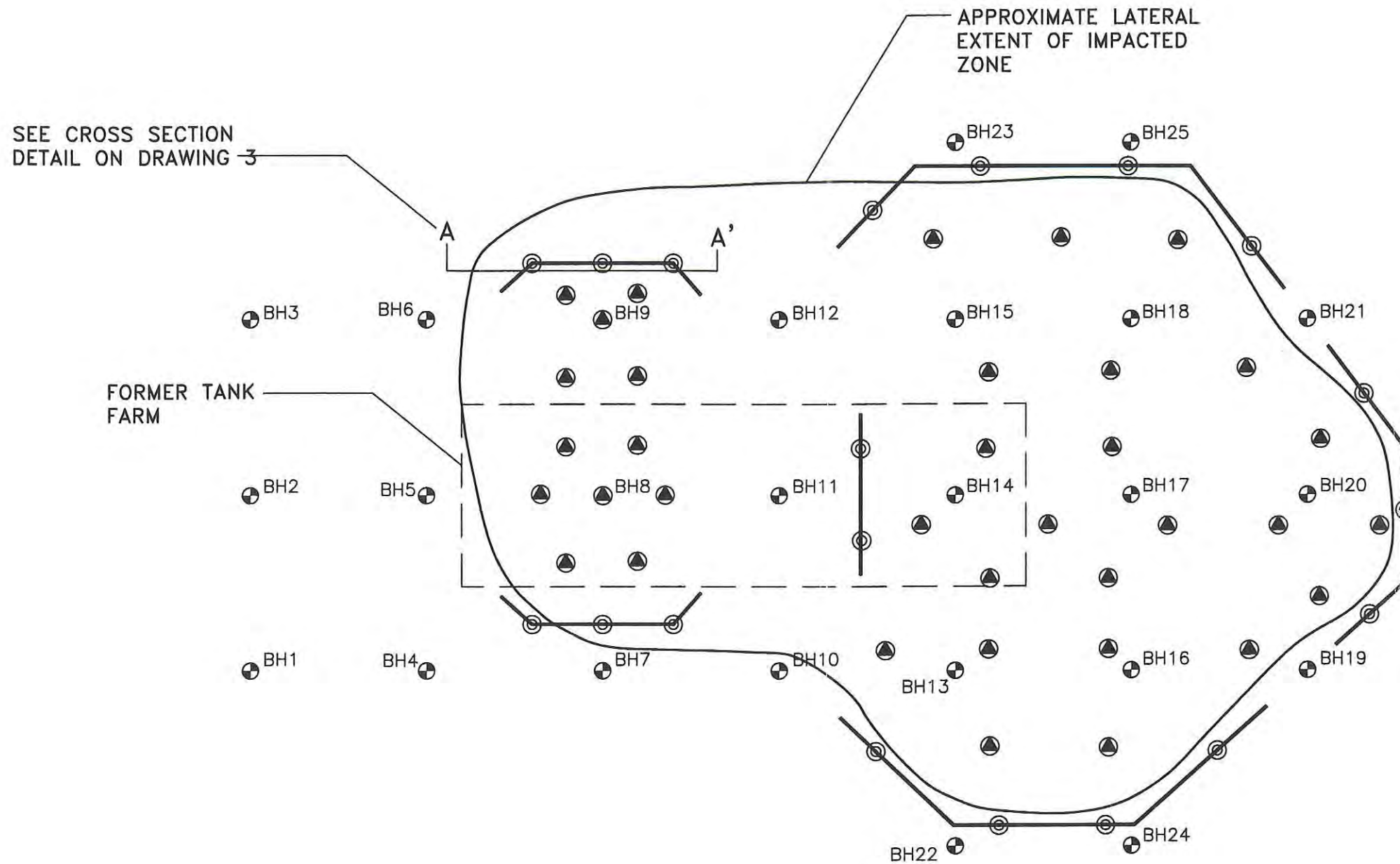
DATE:

APRIL 11, 2001

JOB NO.:

SCALE:

1:750

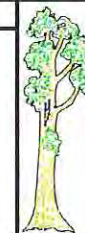


LEGEND:

- BORE HOLES
- CIRCULATION/RECOVERY WELLS
- RECOVERY WELLS IN TRENCH

NOTES:

All information on this drawing is strictly confidential and is the property of Sequoia Environmental Remediation Inc. This drawing can be reproduced only with written consent.



SEQUOIA
ENVIRONMENTAL REMEDIATION INC.

135 Sierra Nevada Close SW
Calgary, Alberta T3H 3H7
Phone: (403) 240-0695

TITLE:

PROPOSED LAYOUT OF RE-CIRCULATION AND RECOVERY NETWORK

SITE:

**WEST CHANNEL, SHELL CANADA LIMITED
MACKENZIE DELTA, NT**

DWG. NO.:

2

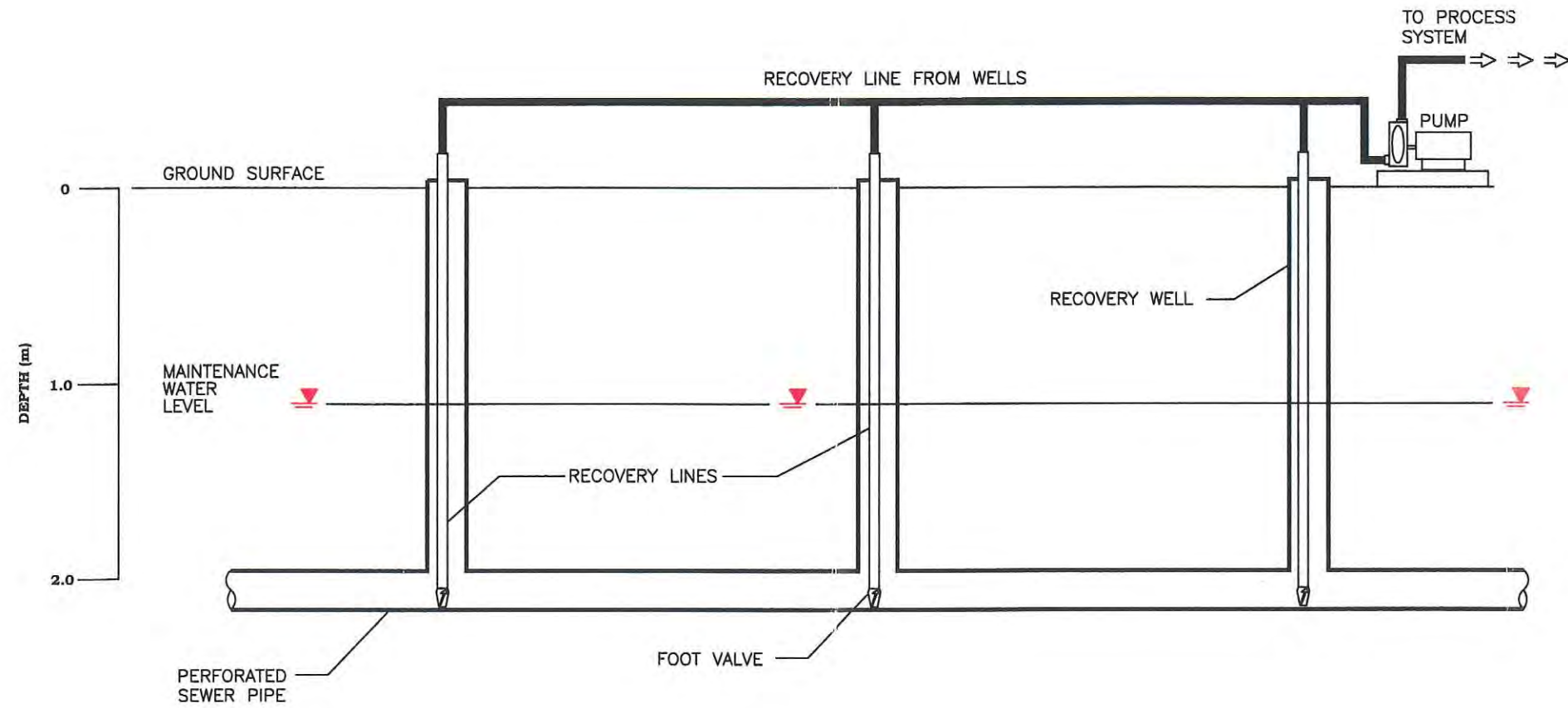
DATE:

APRIL 11, 2001

JOB NO.:

SCALE:

1:750



CROSS SECTION A--A' - RECOVERY TRENCH AND WELLS

SCALE: NTS

LEGEND:

NOTES:



SEQUOIA
ENVIRONMENTAL REMEDIATION INC.

135 Sierra Nevada Close SW
Calgary, Alberta T3H 3H7
Phone: (403) 240-0695

TITLE:

CROSS SECTION OF RECOVERY TRENCH

SITE:

**WEST CHANNEL, SHELL CANADA LIMITED
MACKENZIE DELTA, NT**

DWG. NO.:

3

DATE:

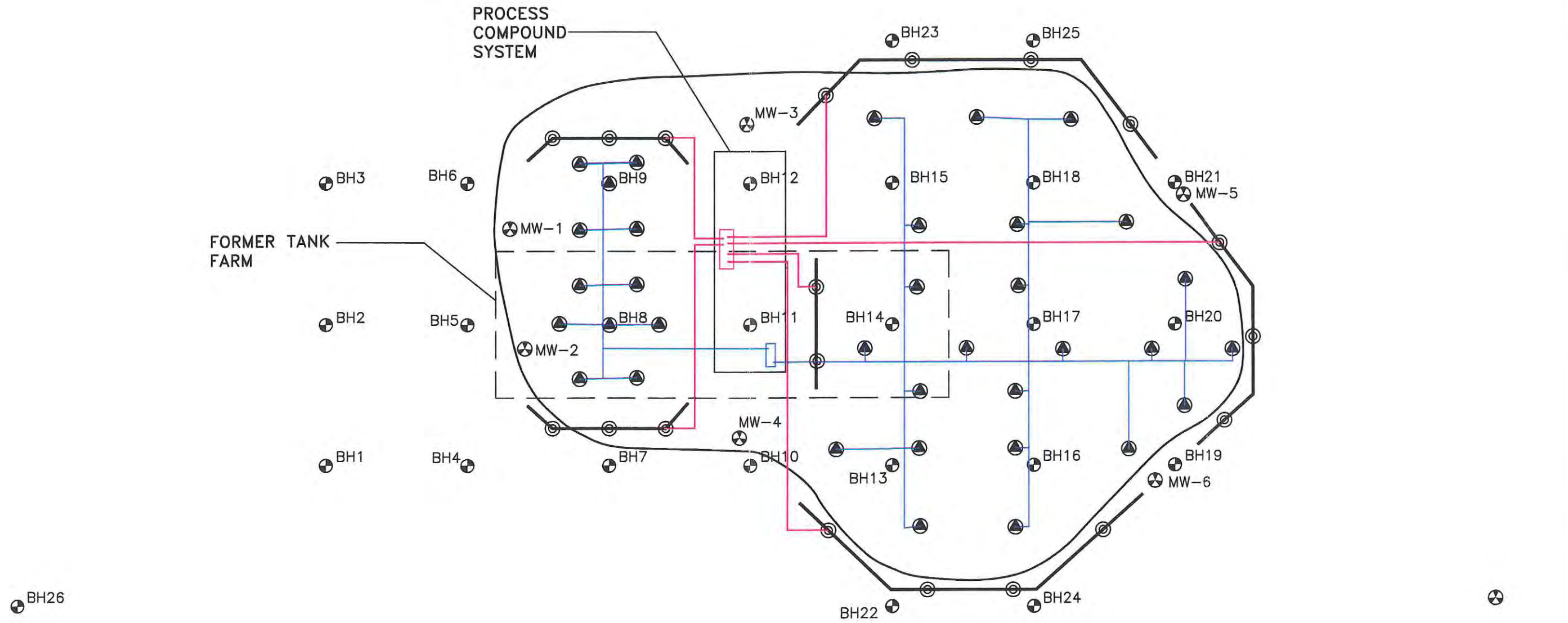
APRIL 11, 2001

JOB NO.:

SCALE:

NTS

All information on this drawing is strictly confidential and is the property of Sequoia Environmental Remediation Inc. This drawing can be reproduced only with written consent.



LEGEND:

- BH4 BORE HOLES
- CIRCULATION/RECOVERY WELLS
- RECOVERY WELLS IN TRENCH
- RECOVERY LINES
- INJECTION/CIRCULATION LINES
- MONITORING WELLS

NOTES:

All information on this drawing is strictly confidential and is the property of Sequoia Environmental Remediation Inc. This drawing can be reproduced only with written consent.



SEQUOIA
ENVIRONMENTAL REMEDIATION INC.

135 Sierra Nevada Close SW
Calgary, Alberta T3H 3H7
Phone: (403) 240-0695

TITLE:

PROPOSED LAYOUT OF CIRCULATION AND RECOVERY NETWORK

SITE:

**WEST CHANNEL, SHELL CANADA LIMITED
MACKENZIE DELTA, NT**

DWG. NO.:

4

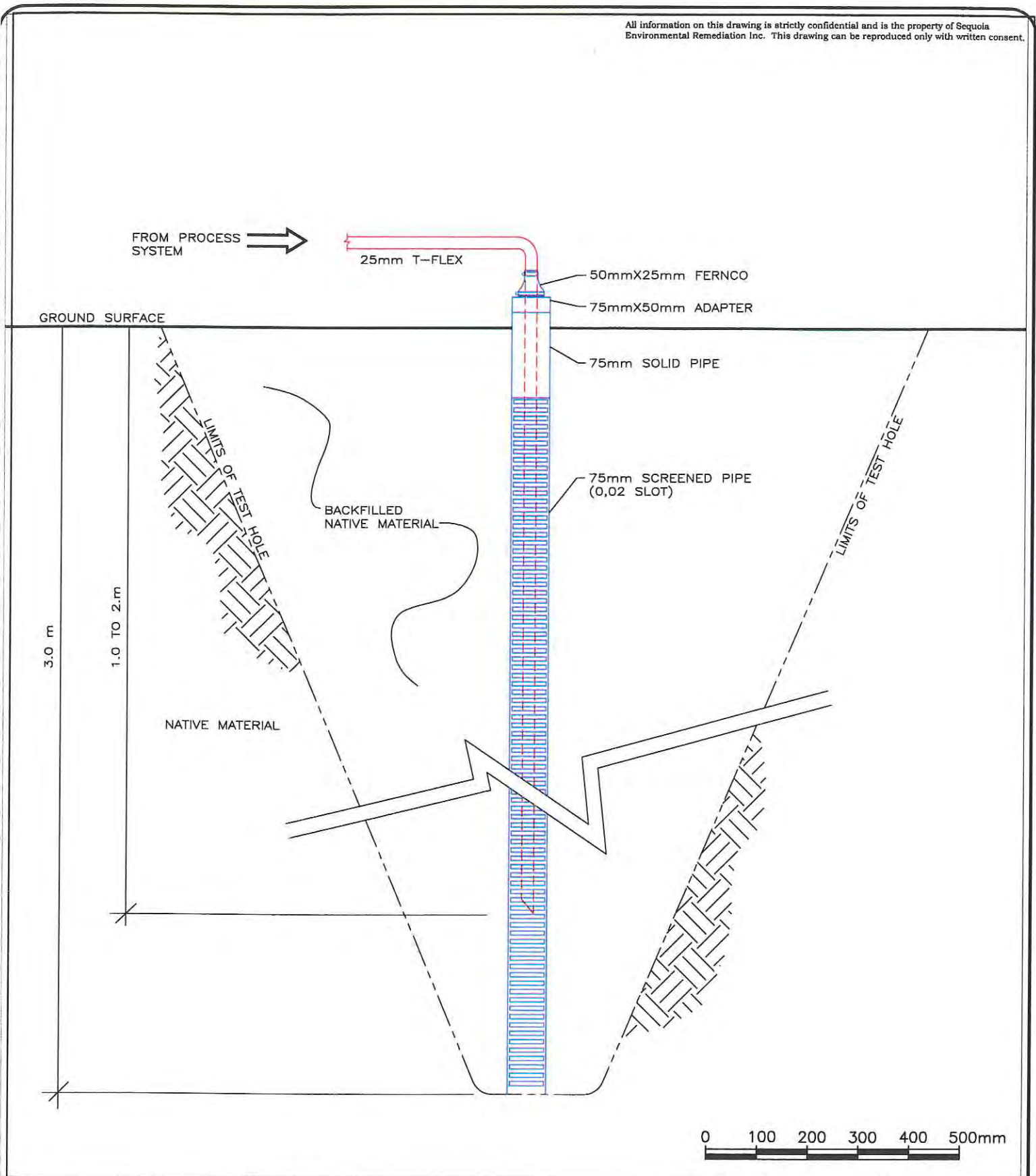
DATE:

APRIL 11, 2001

JOB NO.:

SCALE:

1:750



NOTES:



SEQUOIA
ENVIRONMENTAL REMEDIATION INC.

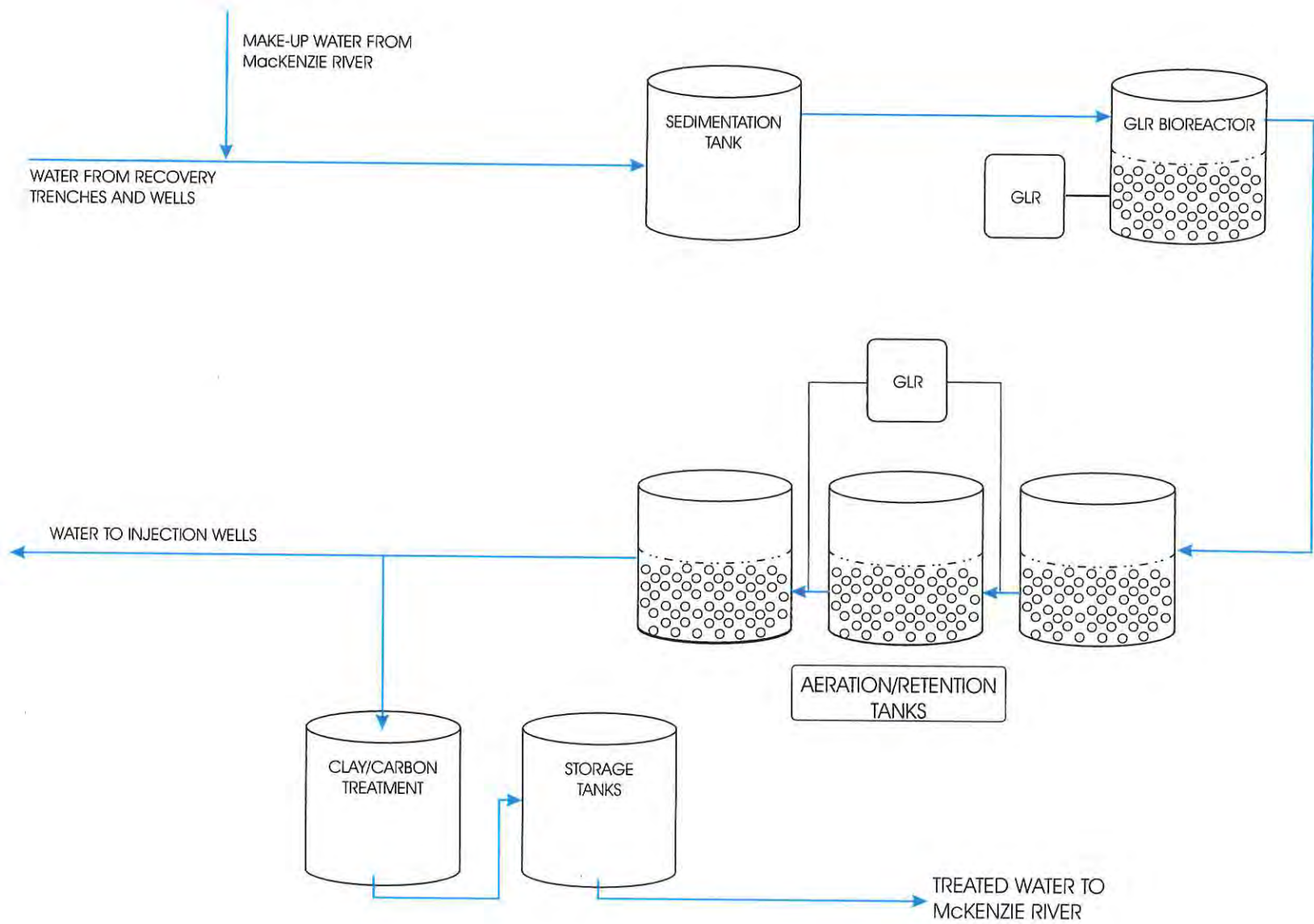
135 Sierra Nevada Close SW
Calgary, Alberta T3H 3H7
Phone: (403) 240-0695

TITLE: **DETAIL "A"
INJECTION WELL - (TYPICAL)**

SITE: **WEST CHANNEL, SHELL CANADA LIMITED
MacKENZIE RIVER, NT**

DATE: **APRIL 17, 2001** JOB NO.: SCALE: **1:10**

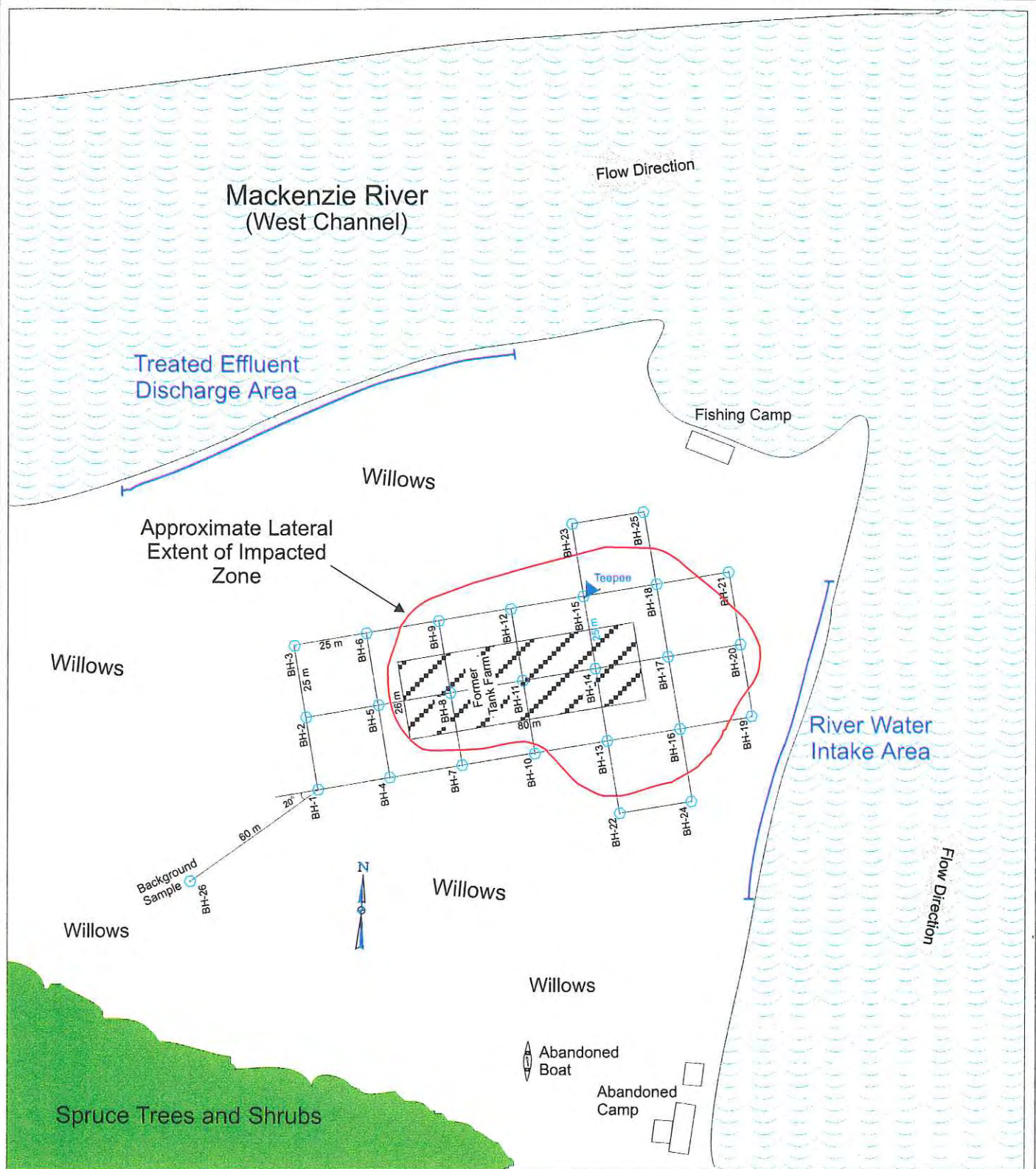
DWG. NO.: **4a**



SCHEMATIC PROCESS DIAGRAM
 WEST CHANNEL - SHELL CANADA LIMITED
 MACKENZIE DELTA, NT

 SEQUOIA ENVIRONMENTAL REMEDIATION INC.
 135 SIERRA NEVADA CLOSE SW
 CALGARY, ALBERTA T3H 3H7
 PHONE (403) 240-0695

PROJECT NUMBER:	DRAWING NO.:
DATE: April 11, 2001	5
SCALE: NTS	



SITE MAP

Sample Locations and Lateral Extent of Impacted Zone

West Channel, Mackenzie Delta NT.
 UTM 68°28.33N 135°33.25W

DWG. NO.:

6

Not To Scale

April 2001

Project No.



Inuvialuit Environmental &
 Geotechnical Inc.