INUVIALUIT SIVUNNIUQPAIT IMAKKUN
INUVIALUIT WATER BOARD

SCHEDULE C

(Waters Regulations *Subsection 5(1)*)

APPLICATION FOR LICENCE, AMENDMENT OF LICENCE, OR RENEWAL OF LICENCE

APPLICATION/LICENCE NO: _____
(*amendment or renewal only*)

1. NAME AND MAILING ADDRESS OF APPLICANT

Northwest Territories Power Corporation
4 Capital Drive, Hay River, NT, X0E 1G2
Attention: Joshua Clark, Environmental Analyst

TELEPHONE: 867-874-5248 FAX: 1-888-371-9433

2. ADDRESS OF HEAD OFFICE IN CANADA IF INCORPORATED

same as above

TELEPHONE: _____ FAX: _____

3. LOCATION OF UNDERTAKING

Former Aklavik power plant site, Lots 58, 58A, and 58B, L.T.O. 33, CLSR 40355
Akalvik NT

Latitude: 68.2184 Longitude: -135.0059

4. DESCRIPTION OF UNDERTAKING (*describe and attach plans*)

Construct and operate biotreatment cell to remediate soil; as necessary, collect, treat and release precipitation and seepage water from the remediation site. See Attachment A.

5. TYPE OF UNDERTAKING

1. Industrial _____
2. Mining and Milling _____
3. Municipal _____
4. Power _____
5. Agriculture _____
6. Conservation X
7. Recreation _____
8. Miscellaneous (describe) _____

Remediation and reclamation of former power plant site.

6. WATER USE

_____To Obtain Water

_____ Flood Control

_____ To cross a watercourse

_____ To divert water

_____ To modify the bed or bank of a watercourse

_____ To alter the flow of, or store, water

Other (describe)

Manage precipitation and ground water seepage that is expected to collect on the work site.

7. QUANTITY OF WATER INVOLVED (litres per second, litres per day or cubic metres per year, including both quantity to be used and quality to be returned to source)

130 to 240 m^3 per year

8. WASTE DEPOSITED (quantity, quality, treatment and disposal)

Water that collects on the work site (130 to 240 m^3 per year) will be tested to ensure it is of acceptable quality prior to allowing water to return to the existing regional surface water drainage system. Attachment A

9. OTHER PERSONS OR PROPERTIES AFFECTED BY THIS UNDERTAKING
(give name, mailing address and location; attach a list if necessary)

Hamlet of Aklavik (municipal ditch system)

10. PREDICTED ENVIRONMENTAL IMPACTS OF UNDERTAKING AND PROPOSED MITIGATION

_____No predicted environmental impacts.
_____In the absence of this project, the total amount of precipitation and ground water seepage leaving the site
_____would be the same. As an due diligence measure, precipitation and ground water seepage is being temporarily
_____collected, filtered and tested prior to allowing water to continue on within the regional drainage system.

11. CONTRACTOR AND SUBCONTRACTOR (names, addresses and functions)

Matrix Solutions Inc. (Prime Contractor)	K & D Contracting (Subcontractor)
Attention: Margaret Allan, P.Eng., P.Geo.	Attention: Dave McLeod
142, 6325 Gateway Blvd.	PO Box 149
Edmonton, AB T6E 5H6	Aklavik, NT X0E 0A0
780.989.8343	867- 978-2792
margaret@matrix-solutions.com	dave_mcleod@northwestel.net

12. STUDIES UNDERTAKEN TO DATE (attach list if necessary)

See References list in Attachment A

13. PROPOSED TIME SCHEDULE

Start Date: August 15, 2016

Completion Date: October 15, 2016 (first year); October 15, 2018 (3-year program)

NAME: Margaret Allan, M.Eng., P.Eng., P.Geo.
(print)

TITLE: Principal Engineer, Matrix Solutions Inc.
(print)

SIGNATURE: 

DATE: May 13, 2016

FOR OFFICE USE ONLY	
APPLICATION FEE Amount: $ _____	Receipt N°.: _____
WATER USE DEPOSIT Amount: $ _____	Receipt N°.: _____

ATTACHMENT A – DESCRIPTION OF UNDERTAKING

1 INTRODUCTION

Matrix Solutions Inc. has proposed to Northwest Territories Power Corporation (NTPC) to construct and operate a biotreatment facility at the site of a former NTPC power plant in Aklavik, Northwest Territories. Aklavik is located within the Inuvialuit Settlement Region, on the Peel Channel of the west side of the Mackenzie River Delta, approximately 100 km south of the Beaufort Sea and 55 km west of Inuvik (Figure 1). The site legal description is Lots 58, 58A, and 58B, L.T.O. 33, CLSR 40355.

The site was a former electricity generation station that initially burned heavy fuel oil (Bunker C) and was later fueled by diesel. Former infrastructure included an office, a deep concrete foundation (dock) with generator that was later replaced by a power house, and one aboveground storage tank. Remaining infrastructure includes the concrete dock and the chain-link fence (Figure 2).

Current land use is industrial. Surrounding land uses are residential to the north and commercial to the west. Public land use includes a cemetery to the south. Areas to the east are undeveloped.

The objective of this work is to implement the first year of a multi-year remediation plan using bioaugmentation to degrade petroleum hydrocarbon (PHC) constituents remaining from historic Bunker C and diesel storage and handling, as determined by previous studies (EBA 1998; Golder 2002; Biogenie 2004).

Part of the scope of work involves capturing, treating and releasing precipitation and ground water seepage that accumulates onsite. The purpose of the Schedule C application is to enable Inuvialuit Water Board staff to determine if a water licence is required.

2 PROCESS DESCRIPTION

A commercial Bio-Reclaim™ (F4 Environmental Inc., Stony Plain, Alberta) bioaugmentation technology will be employed. It involves inoculating contaminated soils with a blend of surfactants and purified, naturally occurring microbial strains of the genus *Pseudomonas* (essentially similar to dishwashing liquid and yogurt). The surfactant cuts the grease so that the bacteria can mineralize the PHCs into carbon dioxide and water.

Bioaugmentation is protective of public health and the environment, will control the potential migration of contaminants, and is designed to be an effective remediation technology for the short term and long term. To our knowledge, this approach has not been used in the Northwest Territories, but F4 Environmental and its clients report good success in northern Alberta.

Matrix proposes to construct a biotreatment cell in 2016, and operate it in 2016, 2017 and 2018. The success of treatment will be tracked each year until the remediation program is complete.

Although bioaugmentation is expected to result in improved soil and water quality, part of the plan includes capturing, treating, and testing any water that collects in the biotreatment cell and releasing it to the municipal ditch system when it has demonstrated acceptable water quality parameters.

3 BIOTREATMENT PLAN

3.1 Cell Construction

A biotreatment cell will be constructed on the north half of the site, as shown on Figure 3. The biotreatment cell will feature an impermeable liner and a water collection/removal system (Figures 4 and 5). Referring to Figure 5, the biotreatment cell design includes 110 cm of clay backfill (700 m^3), followed by the 30 mil impermeable geomembrane, underlain and overlain with geotextile. A drainage layer of 20 to 30 cm gravel layer (150 to 180 m^3 gravel) will be placed over the geotextile.

Overtop of the gravel will be another layer of geotextile, over which the contaminated soils will be placed in windrows. The estimated soil volume to be placed in the first year of operation (2016) is 850 m^3 This soil volume) will result in a soil windrows of approximate height of 3.0 m above the top of the liner and above the ground surface.

Biotreatment cell instrumentation includes an array of six temperature and moisture sensors. The purpose of monitoring is to assess that the soils have sufficient warmth in the summer months to achieve biotreatment, to monitor how and when the pile freezes and unfreezes, to assess that soils at the base of the biotreatment cell stay cold, ideally near freezing, and to assess that the soils do not become overly saturated or too dry. The array of sensors will consist of five thermistors and one reflectometer, and will be placed vertically every 50 cm within the pile. The thermistors will measure temperature, and the reflectometer will measure temperature and moisture content. An additional reflectometer will be placed outside of the pile in a radiation shield to measure atmospheric moisture content and temperature. All seven of the sensors will be wired into a CR1000 data logger mounted inside a storage box connected to the onsite power supply.

3.2 Excavation, Placement and Testing of Contaminated Soil

An onsite area measuring approximately 32 m × 18 m (576 m^2) will be excavated in 2016 to provide PHC-contaminated material to be treated in the biotreament cell. Excavated material will be placed in lifts in the biocell to receive Bio-Reclaim™ treatment. Soil from the limits of excavation will be sampled at the base of the excavation (one sample every 25 to 35 m^2) and along the walls of the excavation (every 10 m at 0.5 m below grade and 1.0 m below grade) and will be analyzed for PHC parameters by ALS Environmental, an accredited environmental laboratory in Edmonton, Alberta. Results will be compared to the *Environmental Guideline for Contaminated Site Remediation* (Northwest Territories 2003).

Material within the biotreatment cell will be sampled at an approximate rate of 1 sample per 100 m^3 of soils before inoculation with Bio-Reclaim™. Interim sampling will occur before freeze-up in 2016, and again in 2017 and 2018.

3.3 Application of Bio-Reclaim™

Bio-Reclaim™ is shipped in a frozen state and will be mixed with water onsite by a technician from F4 Environmental. The inoculum will be sprayed with backpack sprayers onto 30 cm lifts of contaminated soils using a common garden sprayer. Local labourers will be used for this work, under the direction of the F4 Environmental technician. The soils will be piled loosely and not compacted during the application procedure.

3.4 Site Water Management

Water on this project could include accumulated precipitation in the excavation, in the treatment cell, surface water, and supra-permafrost groundwater. Because the water may contain dissolved-phase PHCs it will, as a precaution, be treated via filtration with activated carbon before being drained away from the site.

3.4.1 Treatment System

The water treatment system will consist of submersible pumps, a settling tank, a water treatment building, and a water holding tank.

The contaminated water will be pumped from a water collection sump located in the southeast corner of the excavation to a 20 m^3 settling tank. The water will be pumped into the first chamber, where any solids will fall out of suspension and, subsequently, overflow into the second chamber. When the tank is at capacity, the water will be pumped to the water treatment building.

Water will be treated in a three-stage process. First, the water will be passed through a bag filter to remove entrained particulates and sediment. Second, the water will be passed through two vessels containing a clay medium, and third, through two vessels containing an activated carbon medium, which removes liquid- and dissolved-phase hydrocarbons.

The treated water will be temporally stored onsite in a 40 m^3 Terra Tank™. Water samples will be collected by local labourers and shipped to ALS in Edmonton for confirmatory analysis. Once water quality is deemed acceptable, it will be discharged to the existing municipal drainage ditch north of the site. Capacity of this water discharge path to receive and accommodate the expected treated water volumes will be monitored during the active months of the project.

3.4.2 Training and Operation

Matrix will provide local workers with training on how to operate the water treatment system and sample water as required during the non-construction periods. The water treatment system will require winterization before freeze-up, which will be done under the supervision of Matrix staff.

4 WATER IMPLICATIONS

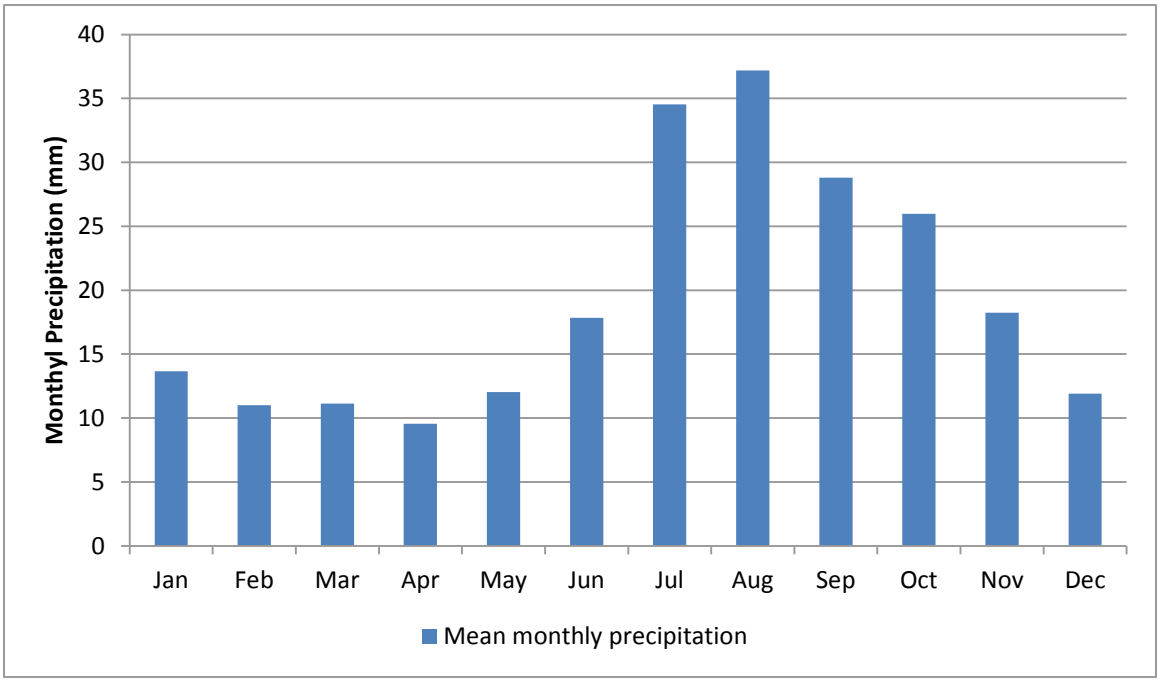
4.1 Water Volumes

Site hydrology was assessed to estimate the approximate quantity of water expected to accumulate in the biotreatment cell. The excavation will be backfilled as soon as sufficient material has been removed to load the biotreatment cells. Therefore, it is the area of the biotreatment cell that chiefly determines how much water will be captured for treatment.

Aklavik is in the Marine Tundra climatic zone, which is characterized by long, cold winters and short, cool summers. In this area, snow is accumulated over approximately 8 months and subsequently melts over several weeks. Snowpack accounts for about 55% of annual precipitation in the Aklavik area and usually attains its maximum water equivalent in early May.

There is a weather station at the Aklavik Airport (Aklavik A). Annual precipitation at the Aklavik A weather station averaged 206 mm over the past 30 years. Monthly precipitation is summarized on Figure A. Precipitation that falls before May or after September is generally in the form of snow. Monthly precipitation is generally greatest in August (as rainfall), with a mean value of 37 mm.

FIGURE A Aklavik Monthly Precipitation (1926 to 1962, 1981 to 2010)



Assuming no evaporation, mean annual precipitation of 206 mm falling on a biotreament cell measuring 32 m × 20 m would amount to 132 m³ of water. The design basis for the water treatment system is storage of treated water within a 40 m³ bladder tank (Terra Tank™), and water pumping and treatment at a rate up to 50 L/min. Conservatively, Matrix is accounting for testing and releasing the Terra Tank™ water up to six times in 2016, meaning up to 240 m³. This larger volume would be met with only 80 hours of water pumping and treatment at 50 L/min.

Precipitation will be allowed to accumulate as snow between October and April each year. Assuming that the water pumping and treatment system restarts in May and faces 250 mm of accumulated snow-water-equivalent plus 30 mm of rain, there would be up to 170 m³ of water. Assuming the area of soil in the cell approximates 16 m × 26 m, the soil has a porosity of 0.4, and the cell has a sump capacity of 8 m^3, the cell design accommodates a height of 0.5 m of water above the base of the liner, leaving 0.4 m of freeboard. Therefore, we do not anticipate that the biotreatment cell would be at risk of overtopping.

It should be noted that the anticipated release volumes of 130 to 240 m³/year are not an additional load to the Aklavik watershed, as these precipitation volumes would land on the site regardless whether there was a biotreatment facility. The difference is that the volume would be captured, treated, tested and batch-released rather than released at a rate dictated by the rate of precipitation.

4.2 Water Chemistry

Because collected water will pass through a settling tank to remove suspended solids, then into filters that use activated carbon to remove any hydrocarbons, we expect hydrocarbon concentrations to be low to non-detectable because of the biotreatment, and non-detectable following carbon filtration.

For inorganic constituents, we have examined analytical results for groundwater and surface water samples collected onsite, and surface water sampled offsite at locations upgradient and downgradient of the site (Golder 2002). Results are summarized in Table A.

Table A Summary of Water Quality Analyses

Parameter/Constituent	Onsite water collection*	Offsite ditches downgradient**	Offsite ditches upgradient**
pH	6.7 to 7.2	6.9 t 7.8	7.3 to 7.5
Total dissolved solids (mg/L)	840 to 1,800	2000 to 4200	1,400 to 2,100
Sodium (mg/L)	20 to 110	40 to 60	50 to 160
Calcium (mg/L)	160 to 310	410 to 730	260 to 390
Magnesium (mg/L)	50 to 120	110 to 160	90 to 150
Potassium (mg/L)	6 to 25	9 to 15	10 to 20
Chloride (mg/L)	5 to 40	380 to 920	200 to 560
Sulphate (mg/L)	190 to 570	630 to 850	380 to 410
Nitrate (mg/L)	<0.1	<0.1	<0.1

* - estimated from 10^{th} and 90^{th} percentiles for groundwater and surface water samples collected onsite
** - range observed in samples from offsite locations

It is expected that water collected in the biotreatment cell will have organic chemistry similar to onsite groundwater and surface water, and that the filtration system will not be capable of lowering concentrations of these dissolved constituents. When compared to results for offsite ditches both upgradient and downgradient of the site, it is seen that the onsite water quality is superior. Thus, releasing it to the municipal ditch system is not expected to have any adverse environmental effects.

5 CONTINGENCY PLANS

5.1 Affected Parties

The biotreatment cell construction and operation activities will be contained within the fenced NTPC property. Workers from Matrix (Prime Contractor) and K&D Contracting (subcontractor) will have the greatest exposure to the planned activities.

Offsite areas are within municipal jurisdiction. Mr. Joshua Clark of NTPC and Ms. Daniela Felske of Matrix met with the Senior Administrative Officer (SAO) of the Hamlet of Aklavik on August 26, 2015. The SAO had no immediate objections to the project. The community will have occasion to get additional information about the project in 2016 (such as through an open house or public presentation), as well as participate directly in the project through employment opportunities.

5.2 Environment

The potential for spills will be managed as follows.

- Equipment operators will be required to inspect their equipment before usage and to repair any worn components that could lead to a release of a fluid such as fuel, lubrication oil or hydraulic fluid.
- Spill kits will be maintained onsite in the event that a fluid does inadvertently get released.
- Water will be collected in the excavation and/or treatment cell sump and will be pumped to the water treatment system for treatment, testing and release.

5.3 Health and Safety

Matrix will be the prime contractor for the remediation program, and all onsite personnel, regardless of their employer, will be required to comply with legislated, Matrix, and NTPC health and safety standards. A project kickoff meeting will be completed with the contractor and Matrix personnel. All personnel onsite will participate in a combined daily tailboard meeting and will conduct and document safety assessments before starting work each day.

A site-specific health and safety plan will be developed and will be referenced and available onsite. The plan will include specifics for the project such as the following:

- roles and responsibilities
- applicable occupational health and safety regulations
- health and safety targets
- training requirements
- emergency response plan
- personal protective equipment requirements
- incident reporting and investigation
- safe work guidelines and procedures
- health and safety policies

6 SUMMARY

Remediation of the former Aklavik power plant will include the construction of a biotreatment cell in 2016 to initiate three season of soil treatment. A commercial blend of surfactants and purified, naturally occurring microbes (Bio-Reclaim™) will be sprayed on soils in the biotreatment cell so that the bacteria can mineralize the PHCs into carbon dioxide and water.

As an due diligence measure, precipitation and ground water seepage will be temporarily collected, filtered and tested prior to allowing this water to continue on within the regional drainage system.

This project is not expected to have any significant adverse effect on water resources or the environment because:

- Bioaugmentation is protective of public health and the environment, will control the potential migration of contaminants, and is designed to be an effective remediation technology for the short term and long term.

- Water released to the municipal ditch system is expected to have chemistry that is superior to water in ditches upgradient and downgradient of the site.

- The anticipated release volumes of 130 to 240 m^3/year are not an additional load to the Aklavik watershed, as these precipitation volumes would land on the site regardless whether there was a biotreatment facility. The difference is that the volume would be captured, treated, tested and batch-released rather than release at a rate dictated by the rate of precipitation.

The foregoing information was prepared to support a Schedule C application and enable Inuvialuit Water Board staff to determine if a water licence is required for this activity. Further information including names and contact information for personnel familiar with the project is provided on the Schedule C application form.

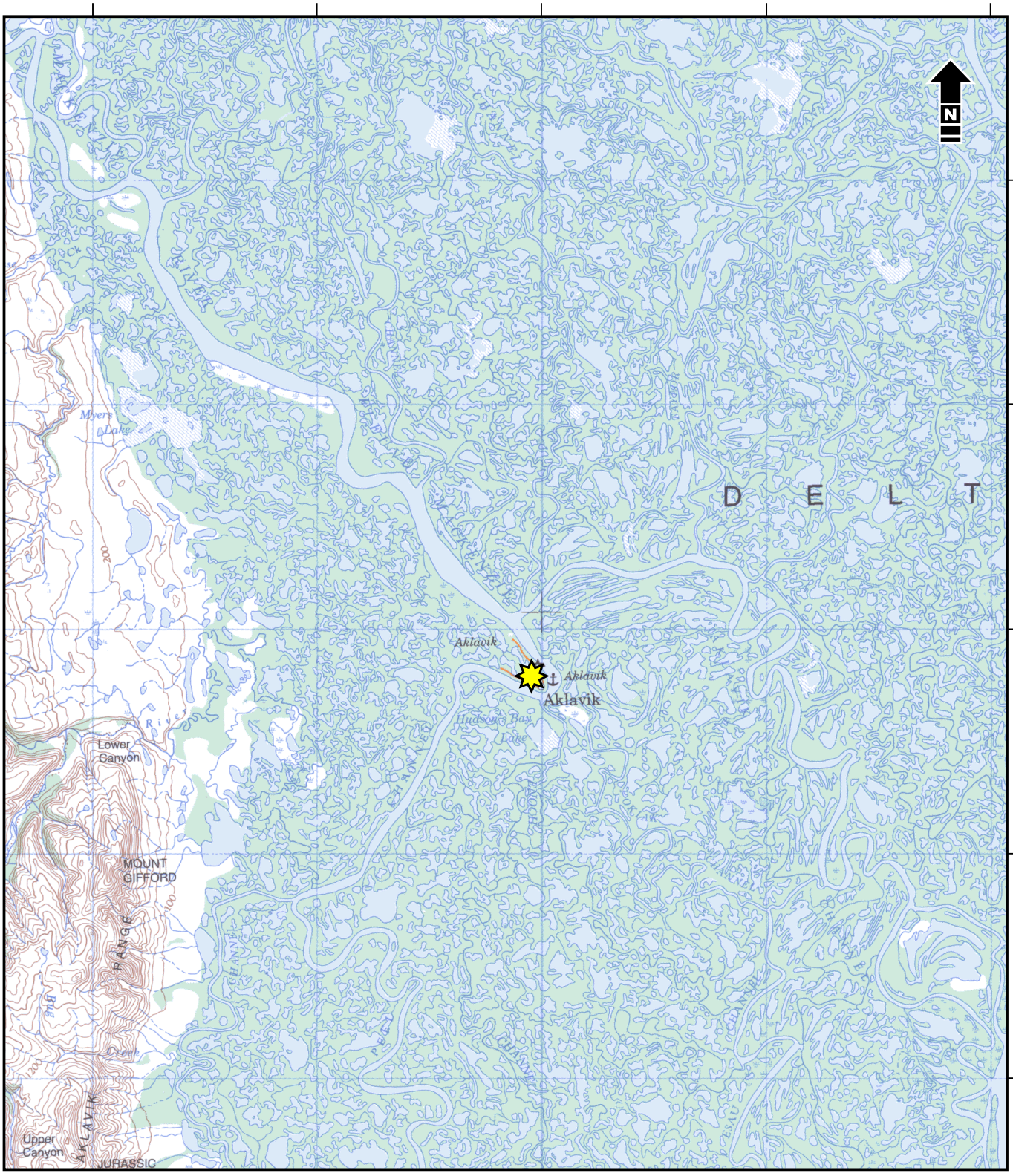
REFERENCES

Biogenie S.R.D.C. Inc. (Biogenie). 2004. *Phase III Environmental Site Assessment, NTPC Powerplant, Aklavik, Northwest Territories.* Report prepared for Northwest Territories Power Corporation. Sainte Foy, Québec. February 2004.

EBA Engineering Consultants Ltd. (EBA). 1998. *Phase 2 Environmental Site Assessment, Aklavik, N.W.T.* Report prepared for Northwest Territories Power Corporation. Yellowknife, Northwest Territories. April 1998.

Golder Associates Ltd. (Golder). 2002. *2002 Groundwater Monitoring Program - Aklavik*. Letter report prepared for Northwest Territories Power Corporation. Calgary, Alberta. October 23, 2002.

Northwest Territories Environment and Natural Resources (Northwest Territories). 2003. *Environmental Guideline for Contaminated Site Remediation*. November 2003. http://mvlwb.com/sites/default/files/documents/Environmental-Guideline-for-Contaminated-Site-Remediation.pdf



Site Location

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

Northwest Territories Power Corporation
Lot 58, 58A and 58B, LTO 33, Plan CLSR 40355, Aklavik, NT

Site Location Map

Date:	Project:	Technical:	Reviewer:	Drawn:
April 2016	21784-LP-16	D. Felske	M. Allan	J. Kern

Figure 1

Reference: 107 B (Aklavik), Edition 1.1, UTM Zone 08, NAD83

1:250,000 metres
2,500 0 2,500 5,000

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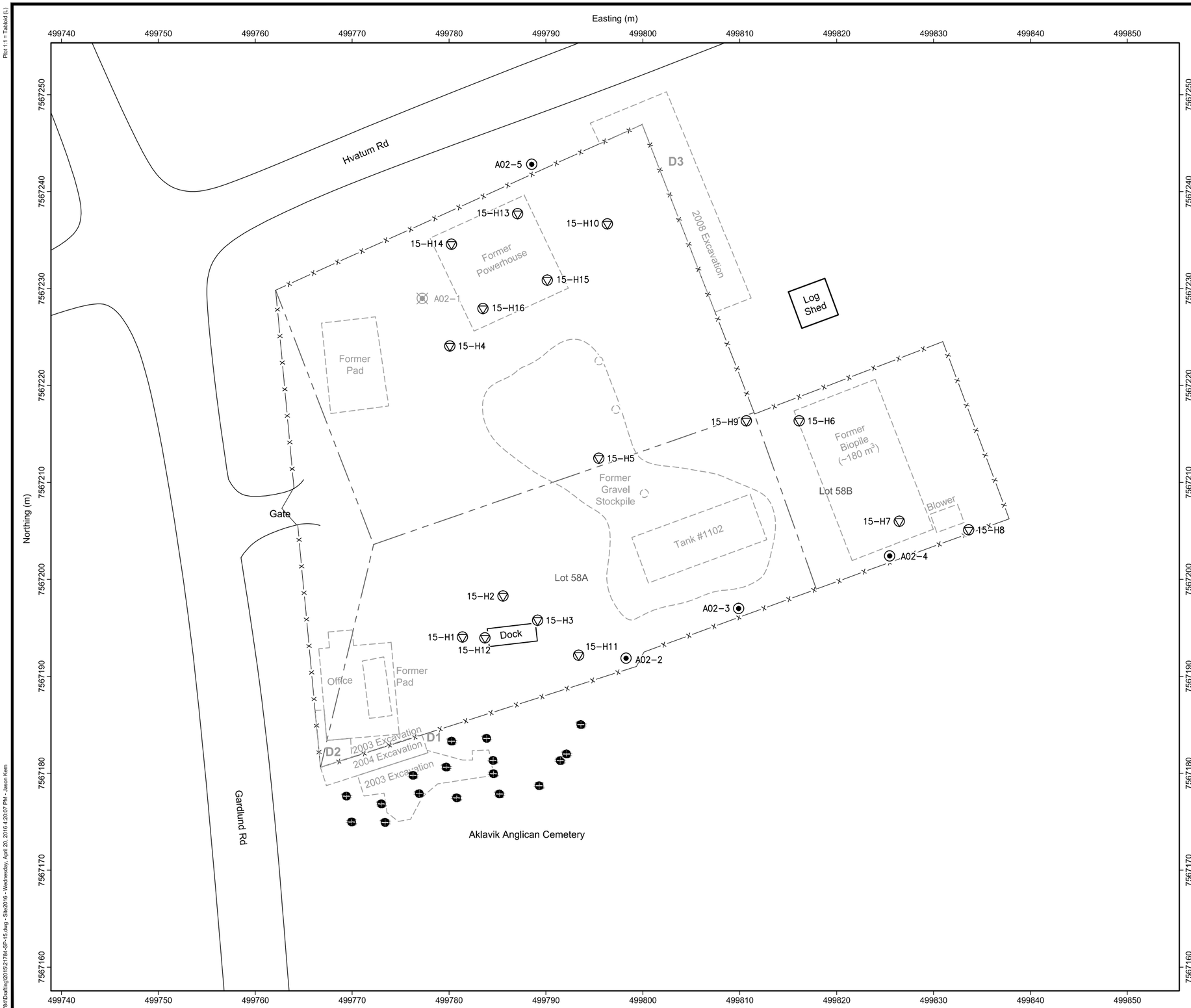
Plot 1:1 = Tabloid (L)



Reference:
Historical site information referenced from Request for Proposals (RFP No. 21511) Soil Remediation Project report provided by Northwest Territories Power Corporation.

1:400 metres
4 0 4 8
UTM83-08

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

Northwest Territories Power Corporation
Lot 58, 58A, and 58B, LTO 33, Plan CLSR 40355, Aklavik, NT

Site Plan and 2016 Sampling Points

Date:	Project:	Technical:	Reviewer:	Drawn:
April 2016	21784-SP-15	D. Felske	M. Allen	J. Kern

Figure 2

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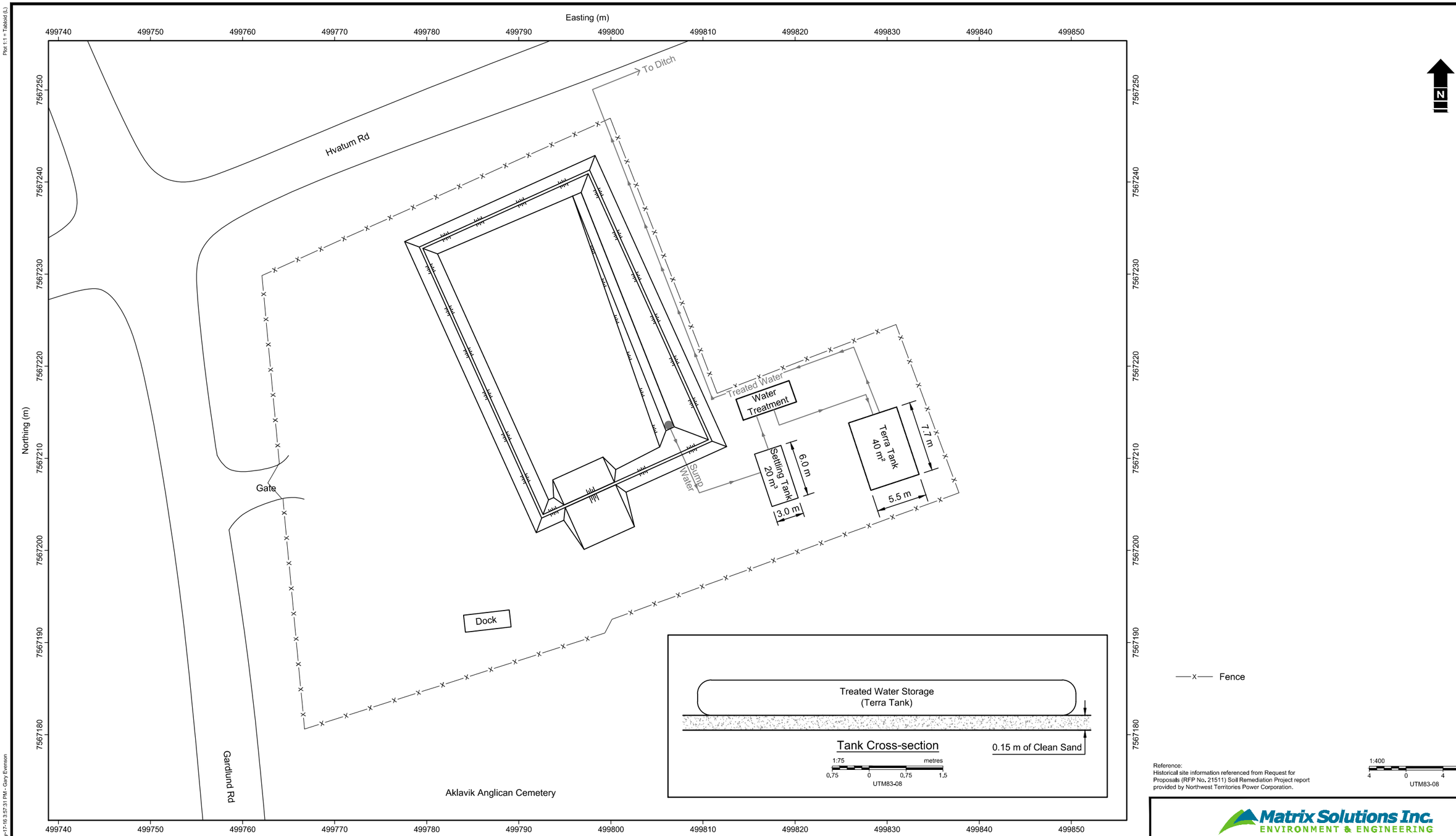


Reference:
Historical site information referenced from Request for Proposals (RFP No. 21511) Soil Remediation Project report provided by Northwest Territories Power Corporation.

Notes:
Drawing(s) must be used in conjunction with the attached report, Remedial Action Plan dated April 18, 2016 and is subject to the limitations and conditions stated in the report.

STAMP

Permit to Practice No.: L3176

No.	DATE	DESCRIPTION	BY	CHK.	DRN.
1		Issued for Review			

REVISION

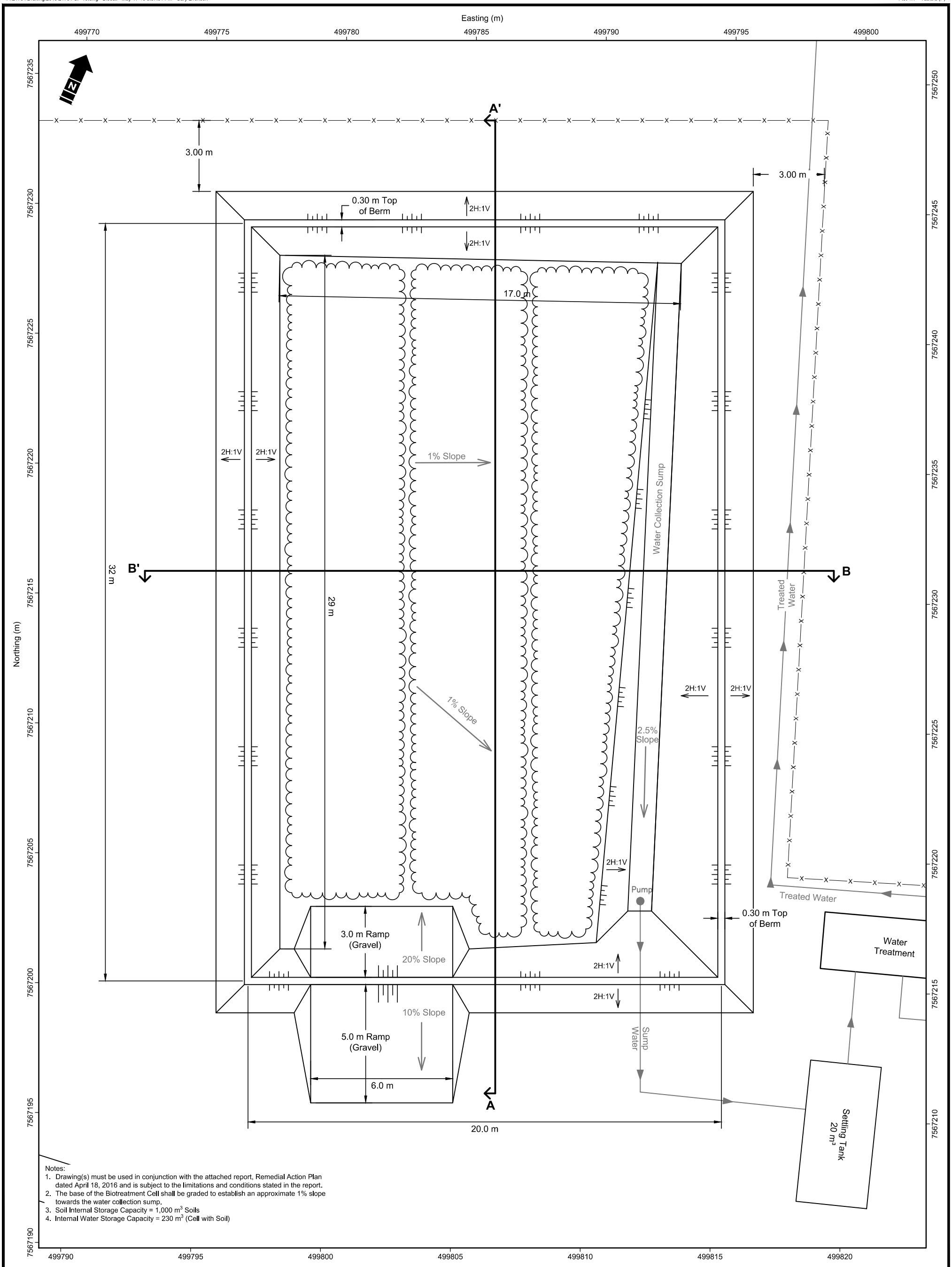
Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

Northwest Territories Power Corporation
Lot 58, 58A, and 58B, LTO 33, Plan CLSR 40355, Aklavik, NT

Plan View of Biotreatment Cell and Water Treatment

Date:	Project:	Technical:	Reviewer:	Drawn:
April 2016	21784-SP-15	D. Felske	M. Allen	J. Kern

Figure 3



Notes:
1. Drawing(s) must be used in conjunction with the attached report, Remedial Action Plan dated April 18, 2016 and is subject to the limitations and conditions stated in the report.
2. The base of the Biotreatment Cell shall be graded to establish an approximate 1% slope towards the water collection sump.
3. Soil Internal Storage Capacity = 1,000 m^3 Soils
4. Internal Water Storage Capacity = 230 m^3 (Cell with Soil)

—x— Fence

Footprint of Biotreatment Soils

1:150 metres

1.5 0 1.5 3

UTM83-08

STAMP

Permit to Practice No.: L3176

REVISION					
No.	DATE	DESCRIPTION	BY	CHK.	DRN.
2		Issued for Review			

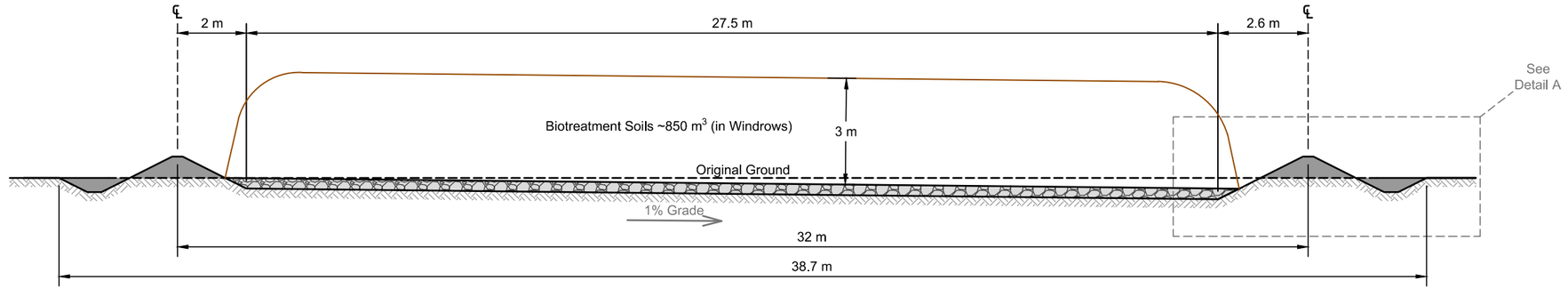
Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

Northwest Territories Power Corporation
Lot 58, 58A, and 58B, LTO 33, Plan CLSR 40355, Aklavik, NT

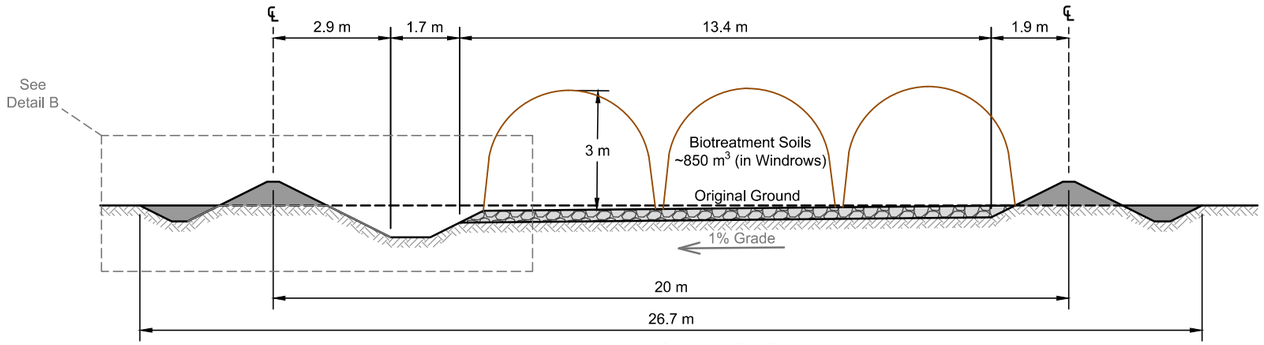
Plan View of Biotreatment Cell

Date:	Project:	Technical:	Reviewer:	Drawn:
April 2016	21784-SP-15	D. Felske	M. Allen	J. Kern

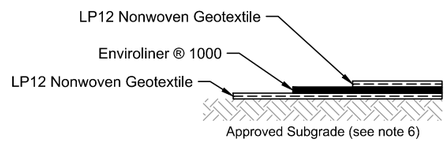
Figure 4



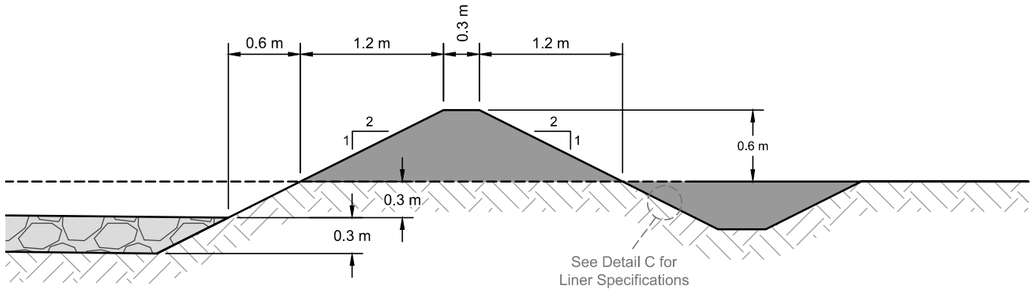
Section A - A'



Section B - B'



Detail C



Detail A

1:50 metres
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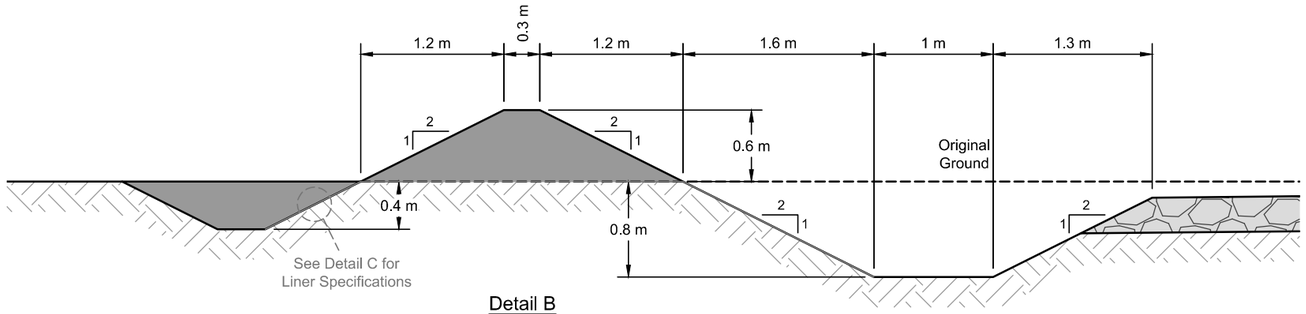
Approximate Scale



Detail B

1:50 metres
0.5 0 0.5 1
Approximate Scale

Fill

Gravel

Notes:
1. Drawing(s) must be used in conjunction with the attached report dated May 13, 2016 and is subject to the limitations and conditions stated in the report.
2. Scales and Dimensions are approximate.
3. Crest of perimeter Berm will be a minimum 0.6 m in height but may be increased to accommodate field conditions.
4. Geomembrane will be installed according to manufactures recommendations.
5. Existing grades assumed to flat and level.
6. The subgrade shall be smooth and free of sharp objects and rocks greater than 30 mm.
7. Liner and membrane to be anchored in place as shown or equivelent method.

1:150 metres
1.5 0 1.5 3
Approximate Scale

STAMP

Permit to Practice No.: L3176

REVISION					
No.	DATE	DESCRIPTION	BY	CHK.	DRN.
3		Issued for Review			

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

Northwest Territories Power Corporation
Lot 58, 58A, and 58B, LTO 33, Plan CLSR 40355, Aklavik, NT

Cross-section Details

Date:	Project:	Technical:	Reviewer:	Drawn:
April 2016	21784-SP-15	D. Felske	M. Allan	J. Kern

Figure 5